Soft Landings based Design Management as a tool to enhance Sustainability: A case study of non-residential buildings in the UK

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Abstract

Curiosity, especially intellectual inquisitiveness, is what separate the truly alive from merely going through the motions.

Tom Robbins

This thesis charts the rise of sustainable buildings and traces the evolution of design management from a process used in design to its current position in the construction industry in the UK. The established fact that design plays a vital role in achieving sustainability in building presents itself from different perspectives. For projects to achieve their sustainability targets, the industry must understand the issues surrounding sustainability. The industry can look to Soft Landings to be the next step in the evolution of design management. With the industry having to deal with ever stringent targets from policy makers, and the uncertainty surrounding the decision of the United Kingdom to leave the European Union, how can Soft Landings be positioned to be effective in closing the performance gap in non-residential buildings? 'Intellectual inquisitiveness' should lead us to ask how we can get the best out of the current processes.

The thesis looks at the working processes of Soft Landings projects at the design stage to discover how the interactions between the design team and other team members can foster collaborative working. It also aims to develop a framework for quality communication and information flow. Using case studies and interviews with the professionals involved in the projects, the research uncovers important elements for achieving sustainability. Analysing the data using cross comparison analysis, the thesis is able to unveil the layers surrounding the design process to get the elemental issues. By recognising where the weaknesses lie in information flow, this thesis strengthens the areas where adjustments will be effective. Discovering that the key to sustainable buildings do not lie in complex technological attachments but in the basic interactions between teams.

The research concludes that although the framework for Soft Landings is comprehensive and can enhance the sustainability of buildings when used in projects, it does not adequately address communication between teams especially during the design process. The teams must not only be prepared to share information, they must also be prepared for the flow of quality information. From the case studies, it is apparent that the construction companies are not fully prepared to embrace Soft Landings as proposed by the government. Instead they pick aspects that suit them as a company. This can be as a result of inadequate information and unpins the reason for this research.

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Dedication

The early part of my childhood was filled with scenes of indescribable beauty; diverse trees, breath-taking hills and formations, plants which I took for granted. Growing up in an area which had not yet felt the impact of excessive human development, I was happiest when I was exploring tree tops and crevices in the hills opposite my house. When development finally come to our area, all these wonders were bulldozed without a moment's thought to the ecosystem and environment. I remember the feeling of loss when I discovered the tree I curved my name on had been uprooted to make way for a new house. Even as a child, I wondered if there could be a way that the trees and plants can flourish side by side with my new neighbours.

Years later while speaking to my late father about how much our area had changed, he listed different solutions to the loss of natural resources around us. He concluded by saying this was the reason for an education; to find solutions to seemly complex problems. That conversation coupled with my mother's love of all things natural, propelled me in my quest to pursue solutions to environmental problems using my training as an architect. For this reason, I dedicate this research to both my parents who instilled in me a love of nature and natured my inquisitive mind to search for answers in faraway places.

Statement of original Authorship

I Victoria Fatima Gana declare that this thesis and work presented in it are my own original research. The work was done while in candidature for a research degree at the University of Kent. Where I have consulted the published work of others, this is clearly attributed. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work.

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List of Abbreviations

BEPAC	Building and Environmental Performance Assessment Criteria
BER	Building Emission Rate
BIM	Building Information Modelling
BMS	Building Management Systems
BRE	Formerly Building Research Establishment
BREEAM	Building Research Establishment Environmental Assessment Method
CASBEE	Comprehensive Assessment System for Building Energy Efficiency
CIBSE	Chartered Institute of Building Services Engineers
CIC	Construction Industry Council
CIOB	Chartered Institute of Building
DBERR	Department for Business, Enterprise and Regulatory Reform
DBFO	Design, Build, Finance, and Operate contract
DCLG	Department for communities and Local Government (from 2006)
DEC	Display Energy Certificate
DECC	Department for Energy and Climate Change
EPC	Energy Performance Certificate
IPCC	Intergovernmental Panel on Climate Change
LCA	Life Cycle Analysis
LEED	Leader in Energy and Environmental Design

PFI	Private Finance Initiative
RIBA	Royal Institute of British Architects
SL-CHAM	Soft Landings Champion
UKGBC	UK Green Building Council
WCED	World Commission on Environment and Development.

Chapter 1

Introduction: Context of research

1.1 Introduction

This research project charts the course of the complexities involved with interpreting sustainability in the built environment and the use of design management elements with Soft Landings principles to achieve sustainability in a broader context. The thesis ponders how using Soft Landings' principles in design management may produce more sustainable buildings using collaborative working. This chapter gives an overview of the thesis through a description of background information, the debate on sustainability and sustainable development (section 1.2); and the problem area, highlighting the issues that the UK construction industry are currently dealing with (section 1.3). Finally, the research questions are outlined and discussed (section 1.6).

1.1.1 Background Information

The debate about climate change and factors responsible for increased temperature continues to rage. While researchers from both sides of the debate try to use the earth's rising temperature to justify their arguments, some writers have expressed concern at the way researchers are presenting their conclusions (Shellenberger & Nordhaus, 2004; Sabin, 2013); They argue that the message of scarcity and managing resources is uninspiring which can lead to apathy and increase resistance to change. The Intergovernmental Panel on Climate Change (IPCC), which was formed in 1988 by the United Nations Environmental Program and the World Meteorological Organization, states categorically that it is an agreed scientific opinion that the earth's climate is being affected by human activities. According to J.J McCarthy et al (2001),

> *'Human activities ... are modifying the concentration of atmospheric constituents ... that absorb or scatter radiant energy. ... Most of the observed*

warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations' (Pp 21).

The IPCC in its special report 'Managing the risks of extreme events and disasters to advance climate change adaptation' (2012), emphasised the need for all sectors of the economy to adapt to climate change and plan strategies to reduce greenhouse gases. Most researchers agree that in order to reduce the harmful effects of climate change, an interdisciplinary approach must be a key priority. The International Energy Agency (IEA) in its World Energy Output Report, (IEA/OECD, 2010) stated that we should prepare for increased annual average temperature increases of 3–6◦C by 2100. This will obviously have a profound impact on all aspects of world economies and building design (Rostvik, 2013).

The Stern Review on the economics of climate change carried out by the economist Nicholas Stern in 2006 on behalf of the UK treasury, outlined the need to act to mitigate the harmful effects of climate change. The review argued that without direct action, the cost of climate change would be equivalent to losing at least 5 per cent of Global Gross Domestic Product (GDP) every year. It declared that Greenhouse gas emissions could be reduced in the following four ways (Stern Review, 2006).

a. Reducing demand for emission-intensive goods and services
b. Increased efficiency which will reduce both cost and emissions
c. Action on non-energy emissions, such as avoiding deforestation
d. Switching to low carbon technologies for power, heat, and transport.

The review focused heavily on technological solutions for policies and encouraged development from the government. Although this route of technological solution was seen by some as shifting focus from the broader objectives of sustainable development, it was well received. This was emphasised by the National Audit Office in a briefing to the House of Commons Environmental Audit committee in 2010. They stressed that:

'*Climate change is a particularly significant consequence from unsustainable development. However, whilst the links between climate change and sustainable development are strong, interventions that act on climate change do not* *simultaneously offer a solution to all aspects of sustainable development, as they do not, for example, tackle social injustice, depletion of natural resources or endangered ecosystems. So, a commitment to sustainable development implies that climate change policy should be pursued as just one issue within the wider framework of pursuit of sustainable development.'*

(National Audit Office, July 2010)

Despite this position, the review had only a perceptible effect on emerging policies about climate change both in the UK and the EU (Moncaster, 2012). The Construction Industry output has slowed since the last economic recession but it still accounted for 6% of Gross Domestic Product of the economy in 2016 (ONS, 2017). Due to the high value of construction in GDP and its stand-alone status as a key economic indicator, the construction estimate is widely used by economists and industry specialists as an aid to economic interpretation and forecasting. Even with the uncertainty surrounding the decision of the UK to leave the European Union, construction output rose by 1.8% in December 2016 and 0.2% in the final quarter of the year. This growth showed that the construction industry is still one of the main contributors to the economy of the country; and a major consumer of energy and natural resources.

The Construction Industry is responsible for nearly 50% of all CO_2 emissions in the UK (UKGBC, 2014). The Energy Information Administration (EIA, 2008) estimated that buildings accounted for 30.8% of global energy consumption, and the Greenhouse Gas emissions of the building industry will account for 25% of all emissions across the world in 2030. Table 1.1 shows the total greenhouse gas emission by countries in the EU from 1990 to 2015, with the UK having the second largest emissions (12.1%, despite its size). The non-domestic building stock in the UK accounts for 20% of total carbon emissions (Isaacs Steadman, 2014), while domestic stock generates 27% of emissions (UKGB, 2014). This means that the construction industry is in a unique position to have the most influence on sustainable developments and buildings as majority of all human activity takes place in the built environment (Asif et al, 2007; Mills and Glass, 2009). The growing reliance on mechanical means of heating and cooling buildings with air conditioning has positioned large buildings on a collision course with meeting energy efficiency standards and the responsibility of CO_2 reduction (Chappells and Shove, 2005).

Table 1. 1: Total greenhouse gas emissions by countries, 1990-2015 (Million tonnes of $C0_2$ equivalent).

Country	**Year**						
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**Total**
Total EU	**5,716.4**	**5,381.4**	**5,270.8**	**5,345.2**	**4,909.5**	**4,451.8**	**100.0%**
Belgium	148.8	157.3	154.2	148.7	136.6	121.6	2.7
Bulgaria	104.4	75.3	59.6	64.3	60.8	62.0	1.4
Czech Republic	198.5	157.6	150.0	148.6	140.6	128.8	2.9
Denmark	72.1	80.1	73.1	68.9	65.6	51.0	1.1
Germany	1,2630	1,135.7	1,062.2	1,014.9	966.0	926.5	20.8
Estonia	40.5	20.3	17.4	19.3	21.3	18.1	0.4
Ireland	57.2	60.9	70.9	72.5	64.0	62.4	1.4
Greece	105.6	118.8	128.9	138.9	120.9	98.6	2.2
Spain	293.4	335.2	395.8	451.6	369.6	350.4	7.9
France	555.8	554.6	566.4	569.1	527.7	474.6	10.7
Croatia	31.7	22.6	25.5	29.6	27.6	23.9	0.5
Italy	524.1	536.8	560.9	588.3	514.1	442.8	9.9

Country	Year						
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**Total**
Cyprus	6.4	7.9	9.2	10.2	10.4	9.2	0.2
Latvia	26.4	12.8	10.4	11.5	12.6	11.6	0.3
Lithuania	48.4	22.4	19.7	23.2	20.9	20.3	0.5
Luxemburg	13.1	10.6	10.6	14.3	13.5	11.7	0.3
Hungary	94.4	76.0	74.2	76.6	66.1	61.6	1.4
Malta	2.6	2.9	3.0	3.3	3.3	2.6	0.1
Netherlands	226.1	239.2	229.7	225.4	224.5	206.7	4.6
Austria	79.7	81.2	82.2	94.6	87.1	81.0	1.8
Poland	486.5	439.7	391.4	399.8	408.4	387.7	8.7
Portugal	61.1	71.1	84.5	88.6	72.1	72.1	1.6
Romania	247.1	181.7	140.6	146.8	121.4	117.8	2.6
Slovenia	18.6	18.8	19.2	20.6	19.7	16.9	0.4
Slovakia	74.5	54.5	49.9	51.5	46.7	41.4	0.9
Finland	72.3	72.7	71.1	70.9	77.3	57.5	1.3
Sweden	73.0	75.2	70.7	68.8	66.7	55.9	1.3
United Kingdom	809.1	765.8	739.8	724.5	643.9	536.9	12.1

The government directive or Climate Change act of 2008 (CCA) aimed for a reduction in carbon dioxide emission of 25% by 2010, 44% by 2013, 68% by 2016 from 1990 levels and by 2019 all new homes built must be zero carbon emission (DECC, 2007). This led construction industry experts to look for ways to achieve and meet this target.

Although the committee on the Climate Change Act (the independent statutory body which was set up to advise the government) has repeatedly called for more measures to be adopted (CCC, 2014), the government in 2015 announced a slowdown in the climate change act and is in consultation to revise the timetable (DECC, 2015). The carbon trust recommends that two thirds of new buildings need to be narrow and naturally ventilated by 2020 to achieve the 80% target cut in carbon emissions by 2050. The EU Directive 2010/31/EU introduced in 2002 summarised that by 31 December 2020, all new buildings be nearly zero energy (EPBD, 2010). This policy is to align with European Energy Policy, specifically the Energy Performance of Buildings Directive that requires all new buildings to be nearly Zero Energy Buildings from 2020. (Directive 2002/91/EC, EPBD), and requires all EU member states to enhance their building regulations and introduce energy certification schemes for all building types. This also included the yearly inspection of boilers and air conditioners. The need to be in continuous contact with buildings and appliances to check they are functioning as predicted and that energy targets set are being met can play a key part in enhancing sustainability.

This directive can only be achieved by the design of buildings, which will be powered with very little energy through efficiency and passive design strategies. What these incremental reductions aim to achieve is for the building industry to progressively increase the techniques and acquire the skills, expertise and experience necessary to design and construct low-carbon buildings (Zapata-Lancaster, 2014). This means that emphasis will be on the design stage which according to Elmaulim and Gilder (2014), is one of the most important parts of a project; in the sense that if the design aspect is correct, the other elements directly linked to the design can be achieved more efficiently in the project.

This directive is being implemented in England, Wales, Northern Ireland and Scotland as the Energy Performance of Buildings Regulation and the Building Regulation

Amendment. The Standard Assessment Procedure (SAP), which was developed in 1992 by the Building Research Establishment (BRE), and has been in use ever since, is the method which the government uses to assess and compare energy and environmental performance of domestic buildings. It has undergone a series of upgrades since its inception; the latest version is the SAP2016, which although it had been upgraded, has not been implemented as policy(CLG,2014). The government advices that SAP2012 be continued for all official purposes. It works by assessing how much energy a building will consume; it is based on standardized assumptions for occupancy and behaviour. SAP quantifies a building performance with respect to: energy use per floor area, a fuel- cost based energy efficiency rating, and emissions of CO_2.

1.2 The debate on Sustainability and Sustainable Development

There have been different notions and definitions of 'sustainability' and its relationship with design, construction, and management of buildings (Burnett, 2007; Vakili-Ardebili and Boussabaine, 2007; Lombardi and Trossero, 2013). Burnett asserted that sustainability is usually discussed in three areas; environmental, social, and economic with the International Council for Local Environmental Initiatives, (ICLEI) defining sustainability in these terms (Table 1.2) Burnett claimed that the term 'sustainable' is ill defined and used interchangeably with words like 'green' buildings or construction (Burnet, 2007; Taheriattar and Farzanehrafat, 2014). Burnett stated that 'green' implied environmentally friendly and reducing the negative impact of such buildings while 'sustainable' suggests something more i.e. something capable of being sustained, as defined by the World Commission on Environment and Development (WCED) see table 1.2. Cole (2012a) agreed with Burnet when outlining the explanation of the relationships between 'green' 'sustainable' and 'regenerative' approaches to design. Arguing that terms like 'sustainable design' and 'sustainable building' have been generally used interchangeably with 'green building', that all the terms have been distorted and that now there is no clear distinction between the terms. Researchers who are in favour of regenerative design (Reed, 2007; Pedersen& Jenkin, 2009) have presented the idea of sustainable design as a mid-way point between green and regenerative tools. They have argued that sustainable design is a method to bridge the

green design, which means ‘doing no or less harm’ to regenerative design, which means designs that will help to sustain the ‘doing no harm’ notion.
The idea of sustainability is relatively new and the concept was first used 35 years ago at the United Nations conference on human environment (Adams, 2006). The term eco-development was coined at the meeting to integrate environmental protection with development. In 1987, the term sustainability and sustainable development was used in the context of construction in the Brundtland report by the United Nations’ World Commission on Environment and Development (WCED,1987. P.43). The report described sustainable development as ‘development that meets the needs of the present without compromising the ability of future generations to meet their own needs’. It highlighted six main challenges facing humanity. These were ‘Population and human resources’, ‘Food security: Sustaining the Potential’, ‘Species and ecosystems: Resources for Development’, ‘Energy: Choices for Environment and Development’, ‘Industry: Producing More with Less’ and ‘The Urban Challenge’ (WCED, 1987). These challenges represented a broad definition of the important issues facing world economies although some researchers have argued that the definition was too simplistic to cover the complex issues that sustainability will have to address (Norton 2003, Mason 2008).

The WCED report was further expanded and refined by the United Nations Conference on Environment and Development (UNCED) in 1992 (The Rio Earth summit). A plan including multiple environmental and developmental objectives for the 21st century was also developed in Agenda 21 (UN, 1992). Both WCED and UNCED tried in their resolutions to show that economic development and growth were possible even with the added responsibility of ‘protecting the environment’ (Carter, 2007, p.208). However, critics highlighted the broad definition of the ‘sustainable development’ permitted such a different array of views that this presented a problem during its actual implementation (Viñuales, Depledge, Reiner & Lees, 2017). This meant that although governments agreed to the process, the implementation presented difficult questions that could not be easily resolved. The term sustainability is now used in almost all sectors of the economy to describe the responsible use of resources by good management practise and implementation. For the construction industry, the first international conference on sustainable construction in the United States in 1994 defined sustainable construction as 'a creation of a healthy built environment based on resource-efficient and ecologically based principles' (Kibert, 1994). Research on sustainability has grown since the late 1990's (Davies et al, 1997; Hill and Bowen, 1997; Kibert, 2007; Davies and Oreszczyn, 2012).

Table 1. 2: Definition of Sustainable Development from different national and international bodies in chronological order. Taheriattar and Farzanchrafat (2014).

Reference	Definition
World Commission on Environment and Development (WCED), Bruntland, 1987	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
Caring for the Earth, IUCN/UNEP 1991	Improving the quality of human life while living within the carrying capacity of supporting ecosystems.
International Council for Local Environmental Initiatives, ICLEI 1996	Development that delivers basic environmental, social and economic services to all residences of a community without threatening the viability of natural, built and social systems upon which the delivery of those systems depends.
Amsterdam Treaty, 1997	Determined to promote economic and social progress for their peoples, taking into account the principle of sustainable development and within the context of the accomplishment of the internal market and of reinforced cohesion and environmental protection, and to implement policies ensuring that advances in economic integration are accompanied by parallel progress in other fields.

Reference	**Definition**
(Sage, 1998)	Refers to the fulfilment of human needs through simultaneous socio-economic and technological progress and conservation of the Earth's natural systems.
Forum for the Future, UK's Sustainable Development Association (Parkin, 2000)	A dynamic process which enables human all people to realize their potentials and improve the quality of their life in ways that simultaneously protect and enhance the Earth's life-support systems.

Reed (2007) explained sustainable design as the ability for humans to take steps that will sustain the health of their social and ecological systems over a period of time. Mang and Reed (2012) looked in the direction that says 'sustainability' encompasses both green and regenerative approaches to design and that they have a symbiotic relationship, which contributes to the on-going process of sustainability. Pearce (2006) even goes further in saying 'sustainable development is a process of ensuring a rising per capita quality of life over time'. Pearce explained that these needs rising per capita endowments of the four types of capital which are man-made capital (buildings, roads, etc.), human capital (this comprises of knowledge and skills), nature capital (goods and services from nature), and social capital (relationships of trust and equality). This means that 'sustainable' buildings and development go deeper than earlier defined and affect every area of the community where such developments are taking place. This definition reflects the area that this research is focused on, i.e. the view that a building should not only benefit the occupants but also be a learning tool for the constructors to take forward into new buildings.

According to Burnet (2007), environmental sustainability means that the target for sustainable buildings must go beyond the consideration of exhausting natural resources and environmental loadings especially in CO_2 emissions. Cooper (1999) earlier pointed out that otherwise there is the danger of treating the sustainability of buildings and the wider built environment as simply a matter of energy and mass flows without due regard to the socioeconomic and political dimensions of sustainability'. Research on the impact of sustainability of buildings on the economy, society and the environment allows better assessment of how building design, construction, operation and use can be improved to achieve a more sustainable building stock (Pearce, 2003, 2006). Some researchers look at sustainability in construction from a managerial point of view. This includes issues like the supply chain, methods of procurement (Rwelamila et al, 2000; Rekola, Ma˙kela¨inen and Ha˙kkinen, 2012), government collaboration with the private sector like PFI and PPI (Bossink, 2002), the adoption of 'green' policies during the construction phase (Lam et al, 2009). Other researchers support the view that for a successful sustainable construction, processes such as stakeholder management, and organisational structures should be the main focus of the project team (Wu and Low 2010; Bal, 2014). More detail views on sustainable development can be found in chapter four.

From the different points of view above, it is obvious that sustainability has become a high priority for most governments. Although the complex nature of how it can be achieved in various sectors of the economy still presents a challenge. Hopwood et al (2005, p47) explains further saying

> *'confusion about sustainable development...is further complicated because, as in many political issues, some people may say one thing and mean another'.*

This is reflected in the different assessment tools for measuring sustainability in different countries. The Building Research Establishment Environmental Assessment Method (BREEAM) which was introduced in the UK in 1990 allows stakeholders from a local authority to developers to integrate sustainable design features into the master planning stage (Siew, 2014). BREEAM is discussed in detail in chapter four. The challenges that sustainability presents in construction include the energy efficiency of the building, waste management, how occupants and users perceive the building and the performance of several elements of the buildings. Questions asked of such buildings from the building data exchange UK include:

- What is the overall energy consumption of the building and how do they compare to industry benchmarks and other buildings in the UK?
- How is the energy use broken down and how does this compare to known benchmarks?
- How does the building fabric perform compared to design estimates?
- How does the air tightness performance vary from design specifications?
- How do building services perform compared to design estimates and industry benchmarks? This will include lighting, heating, ventilation etc.
- What are the levels of building occupant satisfaction?
- How can occupant satisfaction be improved? How can building occupants influence further reductions in energy consumption?
- What lessons can be learned from the design, procurement and construction of this building? How has this affected the energy performance and occupant satisfaction of the building?

These challenges in achieving sustainability targets impact the design process with different requirements from regulatory bodies; which can sometimes be confusing and contradictory (Rekola, Mäkeläinen, & Häkkinen, 2012). The variation of different sustainability tools which are dependent on stakeholders and the current market conditions (Emmitt, 2009). Complex design analysis needs to be carried out including energy modelling and life cycle costing (Horman et al, 2006) and these requirements are often time consuming and add to the overall cost of the project. The time and cost implication means that the project will be put under pressure from the early stages which can lead to conflict.

1.3 Problem Area

Researchers have noted that despite the consensus on the need for more sustainable construction, the progress to more sustainable buildings is slow (H¨akkinen, and Belloni, 2011; Bordass and Leaman, 2013; Zapata-Lancaster, 2014). Questions asked by such researchers include whether the current policies are sufficient to tackle the problem and if institutions and delivery systems are fit for purpose. Others have argued for the re-organisation and management of the construction process for the industry to progress (Adamson and Pollington, 2006; Elmualim and Gilder, 2014). The need to look for more sustainable design and construction methods and has led to different schools of thought. The different recommendations on how government directives and policies can be achieved (Blockley & Godfrey, 2000; Bows et al, 2006) has not been fully utilized. Several areas of design management which can help to significantly lower CO_2 emissions and help to lower the cost of energy use in buildings have not been fully explored (Kurul, Tah and Cheung, 2012). It seems highly unlikely that the present management styles, even with advances in technology and streamlining of the supply chain will be able to meet government targets. (Egan, 1998; Hellmund, Van Den Wymelenberg and Baker, 2008; EU, 2011; Agyekum-Mensah et al, 2012). There is therefore a need to look for more effective, and restructured methods of achieving the goals desired.

The Egan report (1998) entitled 'rethinking construction', highlighted some of the issues with the construction industry that included under funding for capital, research, and development. The report also encouraged the industry to create an integrated project process around the four key elements of project development, project implementation, partnering the supply chain and production of components. This report was presented in 1998 when the construction industry output was £58 billion, which was roughly equivalent to 10% of GDP. In 2016, the industry output was £116.8 billion which equalled 6.5% of GDP. The importance of the industry cannot be overstated as it provided 2.1 million jobs in 2016 (ONS, 2017). Many of the problems in the construction industry identified by Egan can also be seen as barriers to achieving sustainability in buildings. They have been divided into nine categories (Table 1.3) according to H¨akkinen & Belloni, (2011).

Table 1.3: Barriers to Sustainable buildings (Hakkienen & Belloni, 2011).

Policies and instruments of steering	Lack of effective economic incentives Ineffective creation of demand with help of policies. Inadequate support for the innovation of Sustainable Buildings (SB) technologies and services.
Demand and the role of clients	Lack of information about the costs and benefits of SB. Distant role of users in the building processes. Ineffective mobilization of the sustainability assessment methods. Inadequately active role for the owners of state and municipal buildings in order to encourage SB.
Costs, risks and market value	Lack of sustainability considerations in financing processes and lending procedures Lack of property databases including SB indices. Defective linkage of SB with the corporate policies and market related issues.
Tendering and procurement processes	Lack of measurable indicators for target setting. Lack of information, methods and tools for tendering processes.

Process phases and scheduling of tasks	Problems in the right timing, scheduling and commitment of all needed actors early enough may cause a barrier for SB. Late involvement of the design team.
Cooperation and networking	Ineffective communication and cooperation. Problems in real team working and inadequate participation of different actors in various process tasks and phases. Lack of collaborative working methods.
Knowledge and common terminology	Defective common understanding and common language.
Availability of integrated methods	Lack of effective methods for the information management. Lack of appropriate methods suitable for different phases of design and building and for comparison. Defective implementation of these methods to different process phases is a serious barrier.
Innovation process	Lack of technology policy that supports innovations. Inability of the building sector to quickly adopt innovative ways of working.

1.3.1 Overview on the Construction Industry

- **The fragmented nature of the Industry**

One of the first problems identified by the Egan report, was the fragmented nature of the construction industry, (Egan, 1998, pp 11). According to the office of National statistics (ONS), there are about 163,000 construction companies registered in the UK with most of them employing fewer than 8 people. This fragmentation was formally identified by the Latham report (1994). This report was very well received by the industry and the government adopted a lot of its recommendations. Some of the recommendations to tackle the fragmented nature of the industry included partnering and framework agreements, benchmarking and total quality management have been implemented by the industry with varying degrees of success. Other researchers have noted that recommendations and initiatives such as those of Egan and Latham are having little effect on working practices of contractors and many of the recommended changes remain objectives yet to be achieved (Wild, 2002; Moore and Abadi, 2011). Although it has been argued by Alderman & Ivory (2007) that significant benefits have been achieved in projects where collaborative partnering agreements have been utilized, especially when all the key professionals are involved early on in the project.

Problems such as lack of partnering and long-term relationships within the supply chain are still very much present in the industry (Moore and Abadi, 2011). Table 1.3 identifies inadequate participation by different actors as a barrier to sustainable buildings. Highlighting the problem of fragmentation right from the supply chain. As far back as 1998, a survey of Architectural, Engineering, and Construction (AEC) companies in America found that 'collaboration among parties' was ranked first among the factors that affected the quality of the project in the design phase (Arditi and Gunaydin, 1998). Pryke and Smyth (2006) also emphasized the need for the construction industry to adopt good teamwork practices in the different stages of a project especially at the design stage. The issue of partnering was recognized by Egan as an option that will be difficult to adopt because it will require all parties (contractors, suppliers, clients) to deviate from well-established and traditional relationships (Egan, 1998).

The impact of the fragmentation of the industry is most acutely felt in the design management area (Mills and Glass, 2009), as this aspect of the project is not given adequate consideration and all the responsibility is pushed solely on the design team. This results in poor design considerations which is reflected in the poor ratings given by end users during post occupancy evaluations (Bordass and Bunn, 1999). There is a need for other professionals to be added to the design process to increase the chances of achieving the project goals. It is in this context that this research is positioned.

The effect of poor design considerations is reflected in the poor ratings given by end users during post occupancy evaluations (Bordass and Bunn, 1999). The call for more collaborative partnerships over the years by researchers is one of the reasons for this research. The need to reduce fragmentation in the industry and encourage working partnerships from the design to post occupancy stages of a project. The research focuses mainly on the design stage because of the poor attention which has been given in terms of collaboration.

- **The fragmented nature of the design process.**

According to Elmualim and Gilder (2014), one of the major shortfalls of the construction industry is the separation of design from the whole project process, which they say, often results in poor building performance in terms of flexibility in use, operating, and maintenance costs and sustainability (Table 1.3). The decisions taken early during the early design stage are going to have a profound effect on the whole project. Therefore, emphasis should be for stakeholder involvement at this stage. When reviewing global challenges to sustainable construction, Prasad and Hall (2004) discovered that sustainability can be considerably influenced by its initial design and that consideration for the life cycle of the building should begin during the design stage. Halliday (2007) reinforced this by arguing that the majority of the environmental impact of a building is usually determined in the early stages of design; this places the designers in a very important position for sustainable outcomes.

Sim Van der Ryn and Stuart Cowan (1996) stressed that ‘the environmental crisis is a ‘design crisis’. It is a consequence of how things are made, buildings are constructed and landscapes are used’ (Van der Ryn & Cowan, 1996). This means that the fundamental key to solving the issue of sustainability in the construction industry is to look more closely at the design principles. In fact, the Strategy of Sustainable Construction (SSC) views good design as synonymous with sustainability (HM Government, 2008). According to Elimualim et al (2009) good design is vital for delivering sustainable buildings. Sustainable construction can only be achieved by sustainable design, which will have to satisfy the triple bottom line of its environmental, social and economic responsibilities. All these researches emphasize the design process still suffers from lack of collaboration between the design teams and other teams in a project (Zanni, Soetanto and Ruikar, 2016). This situation thereby creates scenarios where problems arise from the design due to lack of information between teams. To overcome this problem, adequate and systematic information flow must be key in ensuring the success of the project.

Issues dealing with buildability are often restricted to the design stage, which hinders the speed of the construction, effective learning, and cost control. Architects are being challenged in their traditional roles to embrace a more inclusive role in the life cycle of the buildings they design as stated by Zapata-Lancaster (2014) … 'fragmented tasks and less control over the process is detrimental to low carbon design intentions.' As an architect, the appeal of a solution based on design is very strong, that is, using design in general and design management in particular to increasing energy efficiency in buildings and sustainability as a result. The idea is that many of the problems that arise later in buildings could have been avoided using design management processes should be embraced by all stakeholders. This is reflected in problems developed after initial hand-over, which is mostly linked to the design. If the problems are identified early, they can be solved at lower cost and time over runs can be avoided.

Design management itself has the problem of being poorly defined in the traditional design process (Mills and Glass, 2009). There is an uncertainty about the role that design management should play and how far through the project process it should go. The processes involved in design management at the moment are still largely disconnected from the construction and operational phases leading to buildings not achieving performance targets (Elmaulim and Gilder, 2014). Design management decisions should be subject to other stakeholders because getting the design right is one of the most important elements in a project is delivery (Hellmund, Van Den Wymelenberg and Baker, 2008).

A more refined design (embracing insulation, better building services) can lead to between 40 to 70% reduction in energy consumption for a household (Clarke, 2001). According to Farmer (2013),

> *'design is commonly viewed often within sustainability research and policy-making as an autonomous and intentional activity carried out by individual and proximate designers who use their particular expert knowledge and skill to shape artifacts in predictable and desirable ways'.*
>
> (Farmer. G, 2013).

This statement underpins one of the problems of design management where other team members expect the designers to work independent of them. What needs to change is the use of design, not only as a template for the construction of a building, but that it continues to evolve and change during the construction process. The design should create a sense of cohesion between all the stakeholders in the industry and build trust and lead to closer working relationships, which will help to spot problem areas and find solutions more quickly. These are some of the core principles of Soft Landings, where design is not treated as a separate part of a project but is an integral part of the whole project right from the start (see chapter four). Thaheem and Anwar (2016) underlined this when reinforcing the work of Korkmaz et al (2010), pointing out that green (sustainable) buildings need a cross disciplinary effort with increased levels of design collaboration and coordination between all parties of the project during the design stage. Butera (2013), observed that the result of an architect designing without input from other members of the construction team usually has a negative impact on the building's energy performance. Using design to achieve project goals with respect to sustainability places this research in the present context where the construction industry finds itself. Present debates and discussions all touch on the issue of design and its management as one of the approaches to achieving sustainability.

1.3.2 Management Styles in Construction.

Twenty-five years ago, it was widely believed that the barriers to a sustainable built environment were clients and the 'market place' (Bordass and Leaman; 2013). The environment in which the business of construction was done was seen as detrimental to sustainability because of its working practices (Table 1.3). The working methods and the cultures in the industry have also been highlighted as a barrier against low carbon buildings by Zapata-Lancaster (2014) who consequently advocated for a change of the current practices in Management styles. The issue of poor management in project delivery continues to be a source of concern to all stakeholders (Bryde, 2007).

Sorrel (2003) showed a clear link between management in construction and climate policy, which was concluded as barriers to better sustainability in the UK construction industry. According to Sorrel (2003), the source of the barriers to energy efficiency in the UK, 'lie in the organization of the construction Industry, including the linear design process, the reliance on cost-based competitive tendering and the incentives placed upon different actors'. This means that the basic and fundamental structure and hierarchy of the construction industry is a major barrier for sustainable and energy efficient buildings. Sorrell (2003) maintains that while the problems and barriers are well known to the construction players, they are neglected in the academic literature of energy policy. The recommendation for all parties in the construction industry to move from confrontational to more collaborative approaches to working has been written about and discussed (Latham, 1994; Egan, 1998; Dainty et al, 2007). The present methods of project management in construction are usually fractured with many groups of professionals which have to deal with a wide range of subjects. Designing and building a commercial building will typically involve six different major disciplines, along with the client and other sub-contractors (Bouchlaghem. D et al, 2005).
This research is placed with the current efforts of the industry to change years of traditional practice to one of cooperation and partnerships. Using processes which advocates collaborative working at every stage of the project.

1.3.3 Procurement Methods.

Present procurement methods are noted not to support the necessary attention to detail to increase the sustainability of a building (Bordass and Leaman, 2013). They stressed that most processes used for procurement of projects were used to cut costs in the short-term and ignore the long-time implications. Hellmund, Van Den Wymelenberg and Baker (2008) highlighted the contractual delivery mechanism as a key component to achieving success in projects. In 2001, Winch and Courtney recognised that one of the most important drivers to change must be new forms of procurement and contract arrangement as the presents methods are inadequate to complement the rapid changes in sustainable developments.

The Chartered Institute of Building (CIOB, 2010) discovered from research that 87% of industry professionals stated that good procurement is crucial and synonymous with a successful project. They also found that 77% of professionals believed that clients are not sufficiently knowledgeable about different procurement options; this often leads to projects overrunning costs, deadlines and poor standards. This agrees with H ̈akkinen & Belloni (2011), who highlighted the lack of information about the procurement options (see Table 1.3) as one of the barriers to achieving sustainability. Bresnen and Marshall (1999) discovered that the construction industry uses procurement methods that encourage clients and contractors to see themselves as adversaries. This was highlighted in the Latham report five years earlier (1994), with recommendations of partnerships to overcome the challenges.

The effectiveness of the Private Finance Initiative/ Public-Private Partnership Projects (PFI/PPP) has long been a subject of debate. This type of procurement method was introduced in the UK in the 1990s. It was designed for large-scale, high value projects such as roads and rail infrastructure. The government agrees to pay a private firm an annual fee over a specified number of years to take on the entire construction, finance, design, management, and operation of the project. The firms gain by making a profit on the fee while the government avoids administrative work. This method has had a lot of

criticism because many of the projects have come in late and over budget, raising questions about its relevance in cost saving measures (CIOB, 2010).
Framework Agreements (FA) are template contracts that are agreed for a series of projects. This method is simple and uncomplicated because just one contract is negotiated for a series of projects. This is a big advantage for projects with multiple sites and covers a long period of time. This also builds trust between the client and contractor because they have worked on several projects together. The disadvantage to this method is smaller construction firms cannot compete because they may be unable to handle multiple projects due to limited resources (CIOB, 2010).

According to Elmualim and Gilder (2014) 'the problems of poor industry performance can be associated with the common model for UK construction'. They stressed that the present way in which projects are procured causes a lot of uncertainty, which has led to a shift towards construction managers taking the control of the whole, design and build process. Of course, now, Elmualim and Gilder have pointed out that this has added a new dimension of conflict between design and construction project management especially in terms of Building Information Modelling (BIM).

The construction management method of procurement is not widely used because it deals mostly with large and complex construction works such as Heathrow Terminal 5, where there were multiple layers of construction and works to be done simultaneously. Here, project manager is the point of contact, who will head the design team and co-ordinate the whole project. This is seen as the best form of procurement for large projects when they need design to run in tandem with construction. Soft Landings can be used with any of the procurement methods for setting and maintaining client and design aspirations (Bunn, 2013). The industry will need processes like Soft Landings which encourages tenderers to focus on delivering a building design which is uncomplicated to use, easy to run and maintain. The process is flexible enough to provide support for any form of procurement and can shore up areas where responsibilities to the project are unclear (see chapter two).

1.3.4 Risk Management and Design Risk Management.

According to Mills (2001), 'the construction industry is one of the most dynamic, risky and challenging businesses'. The issue of risk is foremost in the mind of all the project team, as plans should be made in case of any foreseen and unforeseen circumstances. The party responsible for the risk also must be identified and be prepared for incidents. Nevertheless, the industry has a poor reputation of safely managing risks (Mills, 2001) with the majority of the projects having cost overruns and unmet deadlines (Koskela, 2000; H¨akkinen & Belloni, 2011). Many times, the risk is not adequately identified and resolved with team members passing the risk to other parties in the project team, as in the case of contractors passing their risks onto the sub-contractors. This typically leads to delays in building works, litigations and abandoned projects. Researchers have argued that the fragmentation of the industry makes it difficult to share the risk appropriately (Mills and Glass, 2009). This also applies to risk transfer; many contractors usually hire sub-contractors to undertake jobs that require specialist handling or simply the contractors pass on their risk to the subcontractors. This results in low trust and adversarial relationships (Winch 2000, pp 144). Egan also states this in his report as

> '*…The efficiency of project delivery is presently constrained by the largely separated processes through which they are generally planned, designed and constructed. These processes reflect the fragmented structure of the industry and sustain a contractual and confrontational culture……This process may well minimise the risk to constructors by defining precisely, through specifications and contracts, what the next company in the process will do. Unfortunately, it is less clear that this strategy protects the client…'*
>
> *(Egan, 1998, p. 22)*

Soft Landings advocates for risk and responsibility to be shared between team members (SLCP, 2014). It encourages a no-blame culture with information and problems readily shared with other team members. H¨akkinen & Belloni (2011), points to lack of sustainability considerations in financing processes and lending procedures as causing increasing the risk in the industry (Table 1.3). This situation therefore, positions this research at the crossroads where these problems can be explored to find the best solutions.

1.3.5 Incompatible Vocabulary

The problem of incompatible vocabulary between the participators in the construction industry also presents challenges as to how building drawings are interpreted and implemented (Chinowsky and Meredith, 2000). The fact that a single project can involve companies from different parts of the world is one of the reasons for this problem. The huge leaps in technology has truly made the world a global village which has many advantages to the construction sector but it has also exposed a lack of cohesion in the global construction industry (Chinowsky and Meredith, 2000). It is hard enough dealing with a group of companies on a national scale; a project on an international scale presents new challenges with respect to vocabulary. Dainty et al (2007) stated that each project is different in terms of both the type of project and the professionals involved in the project. Different groups of people are expected to immediately establish working relationships, while dealing with issues like relocation of offices, contracts and deadlines. H¨akkinen & Belloni (2011), regards this as one of the barriers to achieving sustainable buildings (Table 1.3).

1.3.6 Lines of Communication.

This also applies to the way information is transmitted within the construction industry; researchers have noted that the construction industry is one of the most information-dependent in a country’s economy (Xue, et al 2007; Senaratne and Ruwanpura, 2016). The quality of communication has been identified as playing a major role in the success of a construction project (Nielsen and Erdogan, 2007). Because there are many sub-contractors and other groups of professionals working on a single project, the line of communication often gets muddled or confusing (Chinowsky and Meredith, 2000), information may arrive too late for a particular variation in the project or sent to the wrong group involved with that stage. Dainty et al (2006) argued that communication in construction is multifaceted and inherently complex, existing on different levels on individuals, groups or organizations. They stress that communication does not only mean the disseminating of information but that it bridges distances and is the basis of interaction between people. Therefore, the use of communication as a tool to increase the sustainability should not be underestimated. Barret (2008) stressed the need for thorough communication between building design, construction and maintenance team.

Hansen and Olsson (2011) have recognized that the way to better projects is to give greater consideration to information flow and values generation. This has been supported by Tribelsky and Sacks (2011) that concluded in their study of teams using lean measures, that there was a positive correlation between the quality of information flow and the quality of the design documentation. The fact that one of the core principles of Soft Landings is communication and information means that this project once again finds its position at the forefront of discussions within the industry. With the importance of not only transmission of information, but also the quality of information transmitted between stakeholders.

1.3.7 Adoption of new Technology.

The UK construction Industry has been slow to adopt Information Technology, not only in respect of software and management styles but also in human resources (O’Brien & Al-Soufi, 2006; Lindebaum & Jordan, 2012). The industry has therefore been playing catch up to take advantage of the information and communication technology available to them. Rydin (2008) underlined the challenges to sustainable building by stating that they required innovation and learning within organizations (Table 1.3). The whole industry must be ready to embrace new innovation to make sustainable buildings more widely acceptable. The reason may be because daily communication still largely depends on face-to-face meetings, or emails and phone conversations (Zanni, Soetanto and Ruikar, 2016). This situation weakens the importance of the inclusion of certain professionals in the early stages of the design. Adopting new technologies such as BIM (Building Information Modelling) can simplify the integration of sustainability in the design and construction process. It will allow multidisciplinary professionals to receive and divulge the right information at the right time (Pala and Bouchlaghem, 2012). Although Soft Landings advocates simple designs and systems, the adoption of new sustainable technologies is also encouraged. The introduction of Building Information Modelling (BIM) and other applications are currently debated.

1.3.8 Focus on Clients and End users

Another key problem identified by the Egan report was a focus on the client/ end user. The report identified that construction companies do not engage actively with the end user to discover their aspirations for the building and do not educate them to be more discerning. A series of post occupancy surveys by Bordass and Bunn (1999), on ‘green buildings’ discovered that the occupants complained of poor functionality and user interfaces for controls and they also noted that the building management systems were complicated and difficult to use, which led to energy inefficiency. It has been noted by researchers that Designers and Architects commonly fail to learn lessons from past projects and end up repeating mistakes that could have been easily avoided. (Bordass and Leaman, 2005). The needs and requirements of the end-user should always be at the forefront of any design team therefore the decisions to be made should not be limited one professional but involve as many teams that are working on the project (Elmualim and Gilder, 2014). In this way, a much broader picture of the function of the building will be available and the design team can consider all the information available.

1.4 Sustainability in non-residential buildings

According to Brown et al (2010), non-residential building stock accounts for about one third of energy use in the UK. Many of the buildings have significant performance gaps (see chapter 4) which lead to energy inefficiency in buildings. The link between energy efficiency and sustainable buildings has been proven (Galvin, 2014; Johnstone et al, 2016). The research on energy use in non-residential buildings goes as far back as the 1970’s (Nicholls, 2014). The Commercial Buildings Energy Consumption Survey (CBECS) started in the 1970’s and is still done every 4 years. In the UK, the data from energy surveys started in the 1980’s. With the debate on sustainable commercial buildings growing due to the understanding that these inefficiencies contribute to the increased carbon emissions (Dixon et al, 2009), the focus of sustainability on the non-residential sector is also growing. In addition to government policy, other reasons include the change of corporate attitudes towards sustainability and the public demand for corporate accountability. It has been stressed that progress towards achieving sustainability in these buildings has been slow due to the ‘circle of blame’ between investors, occupiers and construction companies (Dixon et al, 2009; Keeping, 2000).

Non-residential buildings cover a wide variety of buildings. They range from industrial to commercial to educational buildings. With researchers highlighting the advantages of living and working in sustainable buildings (Ellison et al, 2007; Luzkendorf and Lorenz, 2007), there is now more demand for them. There is therefore a need to focus research on non-residential buildings to help meet national and international carbon reduction targets.

1.5 Research Aim and Objectives

1.5.1 Research Question

The overarching question asked in this research is ‘Can design management with Soft Landings principles lead to sustainable non-residential buildings in the UK?’ To address this main question, the research poses other important questions within the scope of the research.

- ‘How does policy influence the sustainability of buildings in the UK?’
- ‘How can design management continue to evolve to keep up with policies dealing with sustainability?’
- ‘Can Soft Landings be an approach by which design management can reinvent itself to keep up with sustainability targets?’
- ‘What type of communication framework needs to be considered to engage the design team in quality communication and information flow?’

The earlier sections of this chapter set the backdrop to which this research belongs. Many of the problems affecting the construction industry can be traced to lack of adequate communication and information between stakeholders. Considering all the issues plaguing the industry, the focus of this research is on the way that project objectives with respect to sustainability can be achieved from the design stage with processes such as Soft Landings principles. With many in the industry calling for a paradigm shift in current attitudes and processes (Blutstein and Rodger, 2001; Mills and Glass, 2009; Rekola et al, 2012), there is a need to explore how processes could be integrated to work together to achieve goals (sustainability, economic, social). This research therefore fulfils this criterion of advocating for a paradigm shift on relying on design solution to sustainability challenges. By focusing on the underlying symptom of information flow and quality of information, this research is in a position to resolve questions on achieving sustainability from the design stage of a project.

To support the research, aim and address the research questions, the researcher developed the following objectives.

- Identify current definitions and interpretations of Sustainability within the Industry and policy makers.
- Review the role that design management plays in enhancing the sustainability in non-residential buildings.
- Analyse the impact of collaboration between the design team and other members of the project.
- Assess the impact of communication and information flow in a Soft Landings design stage.
- To propose a conceptual communication and information flow framework for adopting Soft Landings at the design stage.

1.6 Significance of Research

This research is directed by an extensive literature review (see Chapter four) within the relevant theoretical concept (see Chapter three). Previous studies on Soft Landings were conducted mostly by the Building Services Research and Information Association (BSRIA). Working with members of the association and construction companies, they developed the framework and the core principles of the process. Their research mostly concentrated on the handover and Post Occupancy Evaluations of buildings. The design stage of Soft Landings has not been fully explored either by academics or industry researchers. This research therefore, has the potential to bridge the knowledge gap in existing research and contribute design management knowledge on the theoretical development of Soft Landings processes.

With new revisions in carbon reduction policy and the uncertainties with the UK voting to leave the EU (Ward, 2016), Design Management must be positioned to take advantage of new processes introduced in other sectors. The evolution of design management (discussed in Chapter four) shows that the discipline has survived by incorporating new ideas and process. The fluidity of the discipline is demonstrated in the debate on the roles and duties of a Design Manager (Mills and Glaser, 2009). By providing a conceptual framework which will amalgamate Design Management elements at the Soft Landings design stage, this research can be used as a strategic document to encourage construction companies to embrace the principles of Soft Landings. The framework will contribute to knowledge by providing options for information flow and quality of information to designers when designing for sustainability. It will give team members the flexibility to adopt the Soft Landings process within the confines of their procurement methods.

1.7 Thesis Layout

Chapter One- Introduction: Context of the research: Discusses the position of the research in the terms of defining of problems, research gap and justification. Poses the research question with its aim and objectives (Table 1.4).

Chapter Two- Design Management and Soft Landings as tools for Sustainability: Provides arguments for Design Management and Soft Landings in aiding sustainability I buildings (Table 1.4).

Chapter Three- Research Design and Method: Discusses the methodology based on the theoretical framework. The methods are discussed and determined the best methods for achieving the objectives (Table 1.4).

Chapter Four- Literature Review: Provides the context of the research with respect to past, current and forecast information available for achieving sustainable buildings and the effects of sustainability in design (Table 1.4).

Chapter Five- Data Collection: Discusses the processes involved in collecting the data using interviews and case studies, criteria for choosing buildings and the respondents for the interviews and also provides the framework of coding highlighting the recurring themes amongst respondents and the differences between them (See Figure 1.1).

Chapter Six- Data reporting: This chapter introduces the four case studies giving an overview of the buildings while discussing their objectives in terms of sustainability, energy and environmental performance, and design and functionality of space (Figure 1.1).

Chapter Seven- Data analysis: Using cross comparison analysis, this chapter uses descriptive codes generated to discuss the case studies (Table 1.4).

Chapter Eight- Data analysis: Cross comparison analysis using themes generated from the codes and Soft Landings Core Principles to discuss the findings from the case studies (Table 1.4).

Chapter Nine- Conceptual Framework: After discussions on the information flow and communication, this chapter offers a conceptual framework for quality communication and information flow (Table 1.4).

Chapter Ten- Conclusion and contribution to research: Discusses the conclusions of the research with a summary and limitation of the research. It ends by discussing areas for future research (Table 1.4).

Table 1.4: Descriptive Objectives of the research

Descriptive Objective	**Chapter**
• To identify current definitions and interpretations of sustainability within the industry and policy makers. • Review the role that design management plays in enhancing sustainability in non-residential buildings	**Chapter One:** Introduction: Context of Research. **Chapter Two:** Tools of sustainability **Chapter Four:** Literature Review

Descriptive Objective	Chapter
• To interview professionals using Soft Landings to discover the processes involved during the design, • To study non-residential buildings which used Soft Landings during design to discover the interactions between teams.	**Chapter Three:** Research Design and Method. **Chapter Five:** Data collection with interviews and case studies. **Chapter Six:** Presentation of case studies.
• Analyse the impact of collaboration between the design team and other members of the project. • Assess the impact of communication and information flow in a Soft Landings design stage.	**Chapter Seven:** Cross comparison analysis using descriptive codes. **Chapter Eight:** Cross comparison analysis using themes and Soft Landings Core Principles.
• To propose a conceptual communication and information flow framework for adopting Soft Landings at the design stage. • Conclusion, discussions on the contribution of the research.	**Chapter Nine:** Analysing the flow of information and communication. **Chapter Ten:** Conclusion.

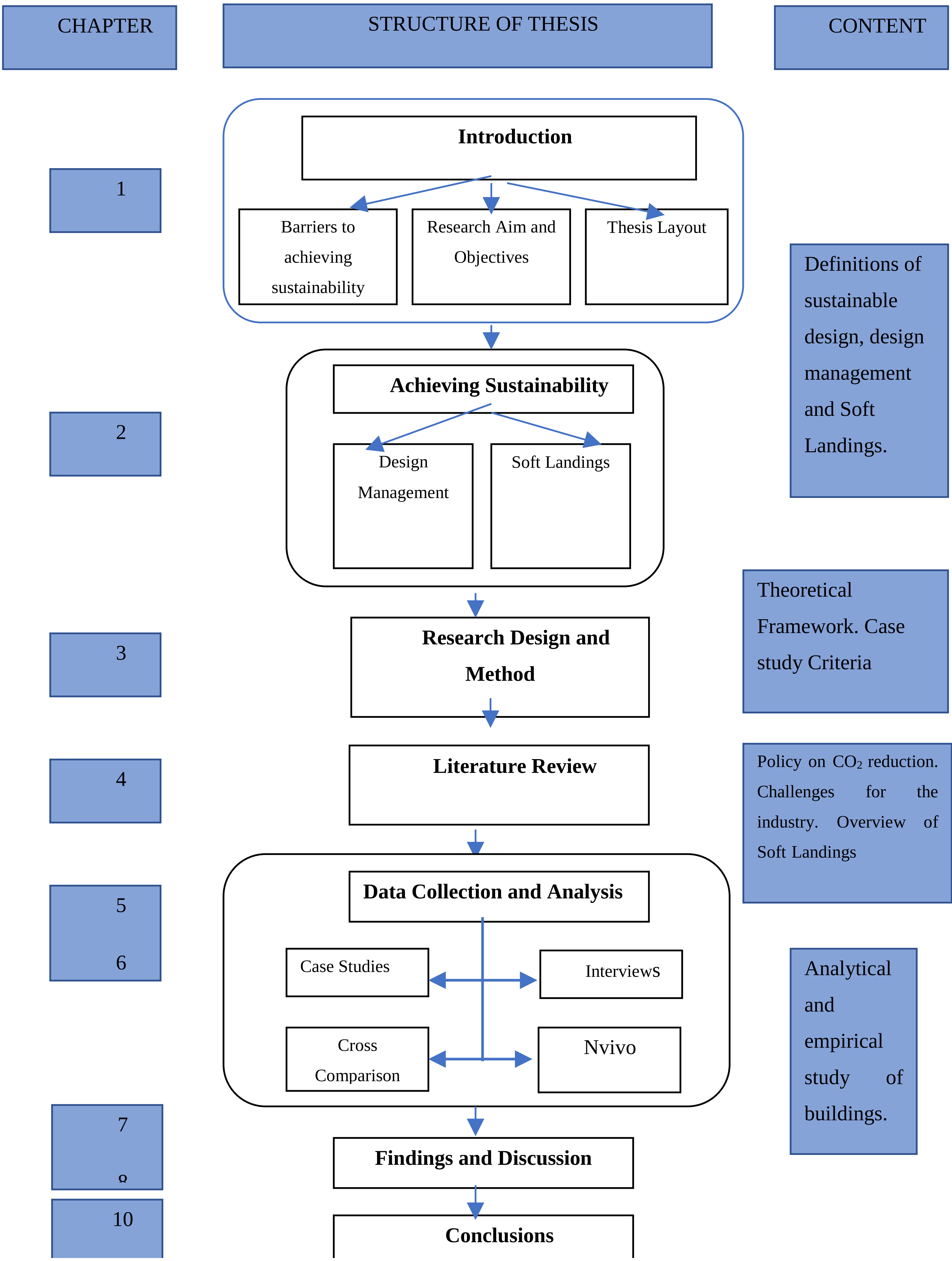


Figure1.1: Structure of Thesis

1.8 Summary

This chapter introduced the aspects of this research; looking at the different concepts of sustainability. It also explored the context in which this research finds itself within the UK construction industry. By discussing the present practices and processes of the industry, the chapter was able to position this research in the middle of current events. This chapter discovered that:

- The definition of sustainability can often cause confusion during implementation.
- The issue of sustainability in non-residential buildings seeks energy efficiency.
- The debate of the nature of the industry calls for a shift from conventional management practices.
- The UK construction industry is plagued with problems that are often barriers to sustainability.

The chapter went on to discuss the research aim and objectives, setting out the layout of the thesis.

Chapter 2

Design Management and Soft Landings as tools for Sustainability

2.1 Introduction

From chapter one, it was discovered that the solution to more sustainable buildings is understandably complex because of issues such as fragmentation and procurement methods. What was clear in the discussion was that the design of buildings can play an important role in enhancing sustainability. The design team will need to partner with other project team members and end users to produce sustainable buildings. The use of design management must be combined with a process which can be flexible enough to accommodate the different issues in construction but rigid enough to provide structure for all the teams. One of such processes is Soft Landings which tries to reconcile estimated design targets with actual building targets; encouraging cooperation from inception to handover (see Section 2.4).

For this reason, this chapter will discuss Design Management and the changes it has undergone over the years to keep up with demands from clients and government policy on sustainability targets. The introduction of the Soft Landings process will highlight why the construction industry needs to evolve to embrace cooperation and partnership. The questions that will be answered at the end of this chapter are:

- 'How can design management continue to evolve to keep up with policies dealing with sustainability?'
- Can Soft Landings be an approach by which design management can reinvent itself to keep up with sustainability targets?'

2.2 Premise of Design Management

The Chartered Institute of Building (CIOB) DM working group defined Design Management activities as

> '*Design Management includes the management of all project-related design activities, people, processes and resources* (Eynon, 2013)*:*

- *Enabling the effective flow and production of design information*
- *Contributing to achieving the successful delivery of the completed project, on time, on budget and in fulfilment of the customer's requirements on quality and function in a sustainable manner*
- *Delivering value through integration, planning, co-ordination, reduction of risk and innovation*
- *Achieved through collaborative and integrated working and value-management processes.'*

The issue of design is often complex and multi-dimensional, the balance of satisfying a brief with aesthetic, ergonomic, technical and financial implications from the different perspectives of the parties involved in a project is often difficult to achieve (Oney-Yazici and Dulaimi, 2014). Design Management exists in many industries, this therefore makes it difficult for any definition to fit the different aspects (Eynon, 2013). The effective management of design is considered as important as the construction process itself. (Elmualim et al 2009). McDonough and Braungart (2002) stated that 'design management is considered to be the holy grail of sustainability.' They stressed that buildings where sustainability is a main objective need to apply correct design management principles in order to be successful.

The manipulation of the built environment to solve problems in comfort and economic terms is not a new phenomenon. The attachment of sheets of material to blow wind into low-lying houses in Hybarabad Sind in West Pakistan or 'wind catchers' is an early example of Passive Design and Management of design to achieve maximum comfort. Of course, the problems have become more complex as the buildings and the requirements of people become more diverse and individual. Modern Design Management however, started in the 1980's when there was a shift favouring Design and Build contracts from the Architect led contracts. The contractors needed a professional who would take an existing design and procure it for the best possible price either with a new team of designers or with the original architect (Elmualim et al, 2009). This led to a professional who has the technical ‘know how’ of an architect and an insight into the working practices of the construction companies. Early Design Management was plagued by poor quality projects because the cost and speed of the projects were their success factors (Monaghan and Eynon, 2007). In the UK, there have been positive changes in the discipline in the last 15 years with the rise of clients demanding better quality and cost control on their projects (Gray and Hughes, 2001 p1; den Otter and Emmitt, 2009). This is especially true of government Private Finance Initiative (PFI) projects where the demand for accountability is high.

Different writers have different points of view when discussing Design Management with Koskela et al (2002) looking at Design Management as a process to convert participation to production (input to output), a flow of information through time and space and a process for increased value of the end product for the client. Gray and Hughes (2001) explained that Design Management harmonizes the design process with high quality information to allow the objectives of design, manufacturing and construction to be achieved. Emmitt (2007) simplified the Design Management role as information management and/or a coordination function from an architect’s point of view. Design Management however, cannot function in isolation (Eynon, 2013), the process must be linked closely with other processes to be successful (Figure 2.1). The closest being Construction Management and Commercial Management. During construction, it is difficult to distinguish between all three because the lines of responsibility become blurred in practice. Attention to detail in Design Management will mean encroaching into other disciplines like finance (during cost plans and cost reviews) and safety procedures (during market testing).

According to Gray and Hughes (2001), there were some significant changes that happened while Design Management was evolving.

- There was a shift where greater emphasis was placed on the management and the organisation of specialist designers and contractors.

- Construction firms were able to increase their profit and reduce risk by specialising in different areas. This increased their knowledge and competence in those areas.
- There was a change in the role of the architect from project leader and manager to design team leader. This led to confusion about the leadership of the whole project.

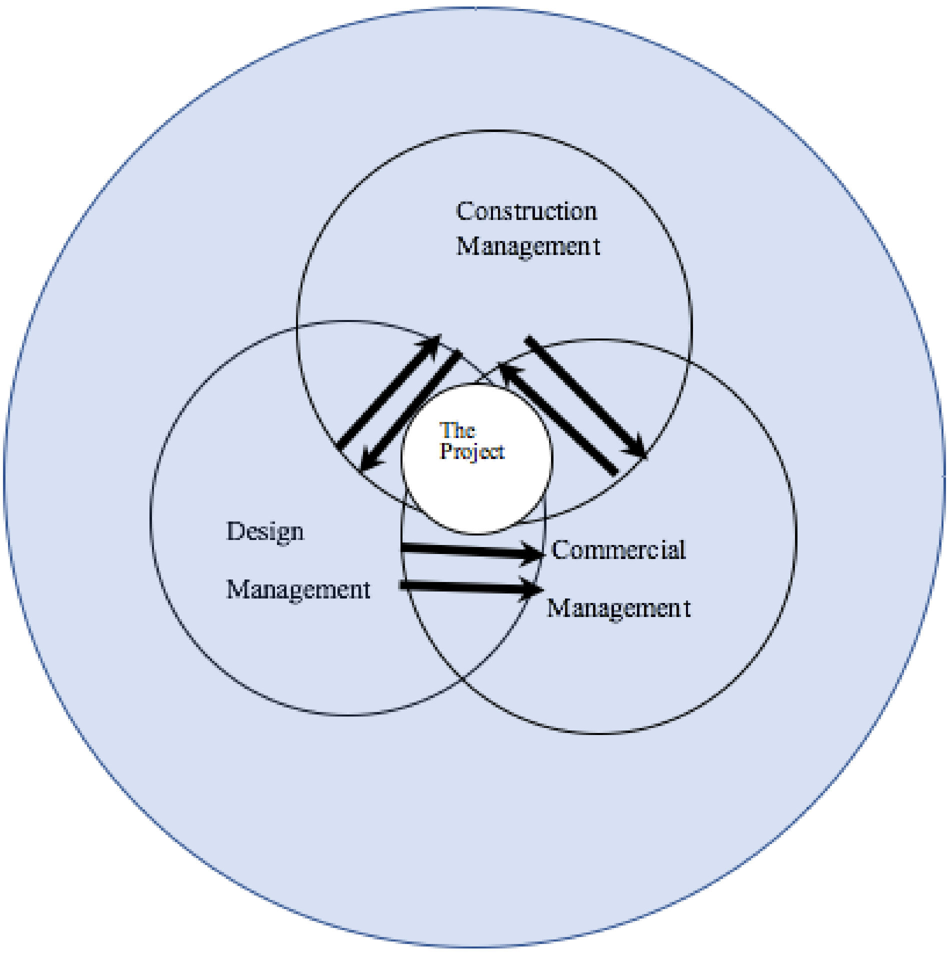


Figure 2.1: A successful project must balance Design Management, Construction management and Commercial Management, (Eynon, 2012).

All these developments meant that the way design was delivered started to change. The complexities of design were made even more complex by the introduction of new specialist knowledge including the production of pre-fabricated building components to be assembled on site (Gray and Hughes, 2001). Including new professions and practices into the design team forced design to be adopted as a process where information exchange and dissemination played a major role. This meant that although design was a very important part of construction projects, it was not an isolated process but now part of an integrated complex system of successful project delivery. The introduction of sustainable objectives in construction projects has also propelled design management into the forefront of delivering sustainable projects (Rekola, Ma˙kela¨inen and Ha˙kkinen, 2012). Stressing that the role of design is important in delivering sustainable projects not only in solving problems but also identifying problems that can arise from the design. Design management has been commonly used in the manufacturing sector for decades (Cooper and Press, 1995) and once again the construction industry must try and catch up to other sectors as it is only just being recognized as a profession (Tzortzopoulos and Cooper 2007). Eynon (2013), explained the importance of design management with 'The Three Humps' (Figure 2.2). The humps represent 'the design, delivery and operation' of the building. The best time to maximize the benefit of the building with minimum effort is at the design stage. Design Management therefore, needs a process that can take advantage of the opportunities presented early in the project. The opportunity reduces as the design progresses into construction and delivery (Figure 2.2) and only increases again during occupation/operation of the building. A good design manager should aim to maximize the opportunity to create value for the customer during all stages of the project (see Chapter four).

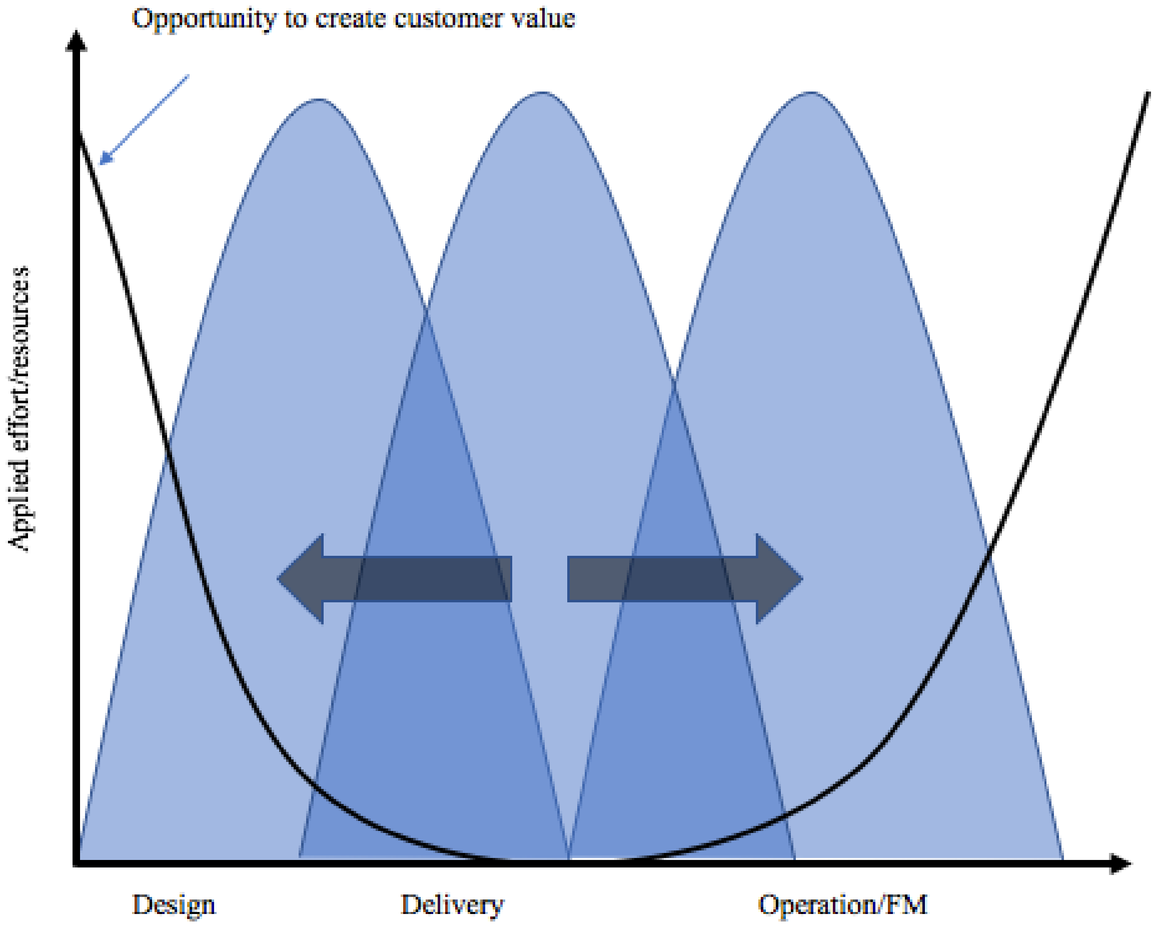


Figure 2. 2: The Three Humps, showing opportunity to create customer value,

(Eynon, 2012)

2.3 The evolution and impact of Design Management in Construction

Design Management has been evolving since the 1940s and 1950s where it primarily dealt with function. From the 1960s to 1970s, it dealt primarily with style, from the 1980s to 1990s it evolved into a whole process. From the 1990s to the 2000s the evolution path took design into a leadership role. While from the 2000s, Design Management evolved into a thinking process (De Mozota and Kim, 2009). The writers charted the course that Design Management took starting off as a necessity to a more refined process of thinking and leadership. The role that the government plays in the evolution of Design Management and other industry practices has been acknowledged by various writers (Adetunji et al, 2003; Williams and Dair, 2006; Braithwaite, 2007).

In construction, the role of Design Management attempts to the add structure to a discipline where creativity and innovation are not usually measured, by adding planning, monitoring and controlling principles (Sebastian, 2004). While Emmitt (2007) has described Design Management as information management or coordination function, others like Tzortzopoulos-Fazenda and Cooper (2007) have stressed that Design Management focuses on improving design processes which allows the production of high quality buildings through effective processes.

Design Management has also been seen as a route to a more collaborative environment where all the parties involved are actively seek innovative and inventive ways to achieving cost, time, quality or sustainability targets. Rekola et al (2012) and Sebastian (2005) argued that sustainable design should not be seen as a separate task and the design should not be solely the responsibility of the design team. Design has been identified as a social process where the individual will be stimulated by collaborative work of the collective (Den Otter and Emmitt, 2008). Sebastian (2004) summarised that Design Management is being presented in 5 categories. Engineering-instrumental which deals with problem solving mechanisms. Design-methodological sees empirical and logical knowledge as products of certain design processes. Value-performance-quality measure, concentrates on the quality of the end product and the processes and measures for meeting requirements. Systematic decision tries to get value from the decision-making process. The organisation-protocol deals with management and relationship between stakeholders.

Although there has been a great deal of information about Design Management, researchers have found that the definition of a Design Manager is vague which can lead to poor working practices (Tzortzopoulos-Fazenda and Cooper, 2007; Den Otter and Emmitt, 2009). Researchers have been trying to define the role of a design manager since the discipline was introduced. They highlighted the lack of understanding and skills that are needed for the role among current Design Managers. In the past, researchers attributed the problems with clarity in Design Management to the lowly position the Design Managers held in the project team, they were not able to effectively channel the goals of Design Management without a leadership position (Bibby et al, 2003). According to Mills and Glass (2009), the role of a Design Manager has not been properly defined in a traditional design process and this ambiguity has caused misunderstanding among professionals. Some researchers have attempted to define the role in the context of the fluctuating balance of power between designers, developers and construction companies when dealing with issues such as the challenges in sustainable design (Rekola et al 2012). Other researchers have noted that the inclusion of other disciplines such as engineers in the integrated design process has created a need for a common design vocabulary (Magent et al 2009; Tribelsky and Sacks 2011).

The current evolution of Design Management has seen the discipline positioned at the fore front of sustainable buildings (Mills and Glass, 2009). This can be attributed as discussed in chapter one to the increased popularity of procurement routes like Design and Build and PFI (Tzortzopoulos-Fazenda and Cooper,2007; Eynon, 2013). The fact that many researchers have highlighted information management and coordination of functions as important areas in Design Management (Gary and Hughes, 2001; Emmitt, 2007), has revealed to the industry stakeholder areas where the most improvements are needed. This of course has led the industry in adapting systems of information management, cost planning, change control and value management (Figure 2.3). Many of the processes in Design Management have had a positive effect on the design stage because it allows designers to identify waste during the design stage and the causes of such waste (Magent et al, 2009). According to Reed and Eisenberg (2003), these wastes can be in the form of missing design competencies. Key design competencies are important because it identifies the right professional needed for a particular part of design; such as building energy performance expert for a sustainable building. Excluding such competencies can result in achieving sustainability targets (Lapinsky et al, 2006). Other areas of waste include poor timing of decision making (Magnet, 2005). The timing of reaching relevant decisions is also crucial as too soon may mean that several elements are left out and too late may lead to delay of the project. Missing information can also lead to waste as time and resources must be spent to obtain all the necessary information for decisions to be made (Magnet, 2005). All these can be solved by using tools of Design Management (Figure 2.3) such as systematic analysis of the design team, matrix of elements or package responsibilities and an integrated design/procure/construct programme (Eynon, 2012).

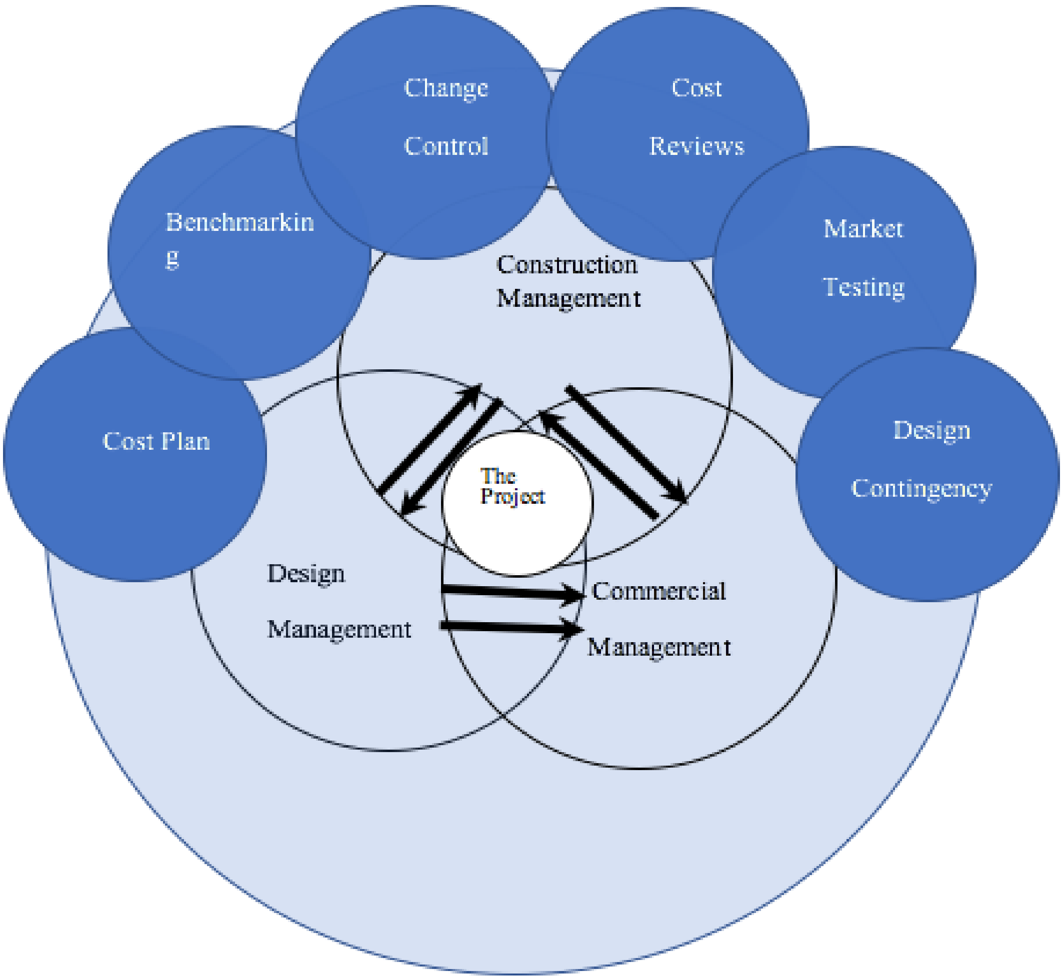


Figure 2. 3: Evolution of Design Management elements, (Eynon, 2012).

2.4 Introduction to Soft Landings

The emphasis for the need for a paradigm shift in the industry is the main reason for looking at Soft Landings as a process that can deliver sustainable buildings. Soft Landings encourages partnering and collaborative working; which according to Wood and Ellis (2005) provides a major opportunity for improving project performance which also offers direct benefits to the contractors, sub-contractors and the supply chain. The construction industry is often slow to learn from completed projects (Bordass, 1997; 2003; Way and Bordass, 2005), especially their performance during occupation of the end user. Lessons can be learnt from problems that persist, and success can be carried over to new projects. According to Way and Bordass (2005), the post occupancy evaluation of a building is one of the most important aspects of the construction.

a. Soft Landings can be adopted at any stage of the construction process but the advantages are greater if incorporated from the beginning. It adds several services to the construction including (BSRIA, 2014):
b. Greater transparency of all stakeholders at the key stages
c. Increased cooperation and involvement between the designers and contractors at all stages of construction
d. The initial 'settling in' period will include a dedicated member of the Soft Landings team
e. Continuous monitoring and review of the building for a period of three years.

(BSRIA, 2014)

Soft Landings aims to add value to the three distinct stages of the construction process (the early briefing stage, the handover and aftercare). The complete attention to detail at these stages is what sets Soft Landings apart from other processes. The advantages can be seen in the post occupancy evaluations that will be carried out. These include:

- Greater clarity in communication between all the parties involved in the project
- Better fine tuning
- Greater speed of problem solving and resolving
- Better feed-back to improve future projects.

All these elements come together to produce better buildings where the estimated energy consumptions and the actual energy usage will be more in line with targets, end users will have a better understanding of the building and how to optimize the assets of the building.

2.4.1 Core Principles of Soft Landings

The core principles of Soft Landing are set out in the Building Services Research and Information Association (BSRIA, 2014) manual and there are guidelines on how to set up a team that will include the key members of the project and construction team. These core principles are discussed below.

- **Adopting the entire process of Soft Landings**

The Soft Landings process is designed to be part of a conventional project, not an add-on. Most of the briefing, design and construction work steps can be carried out within conventional design processes and forms of contract with very little additional work. The aftercare work steps are additional, but also designed to complement existing post-completion activities such as seasonal and continuous commissioning, energy monitoring and reporting, and post-occupancy evaluation. Project documents should ensure that all stakeholders are commitment to use the Soft Landings process throughout the project. Soft Landings will succeed within organisations and teams that are willing to collaborate and share risks and rewards. The process needs to be clear to the project team with the purpose of Soft Landings agreed by all. This will require all stakeholders to understand that the process will be carried out during the distinct stages of the project, not just during commissioning or facilities support after handover. Support will be provided by the Soft Landings Champion (see Chapter four) outlining a clear plan for carrying out the five Soft Landings stages, as defined by the Soft Landings Framework (see Chapter four).

- **Providing leadership**

The Core Principles need to be client- driven, and coordinated by the project's Soft Landings champions. Ideally there should be a Soft Landings Champion on the client side who will be involved all the way through, and another on the project team side (who may share the role or pass on responsibilities through the contractual chain). The

Soft Landings Champions should be people with good experience of contract management (see Chapter four). They should seek fair play on both sides, and ensure that both the client and contractors fulfil their Soft Landings obligations, as specified in tender documents.

- **Setting out roles and responsibilities**

As a client-driven process, the client has the responsibility to identify and make key people available for consultation and reporting (which should extend to the supply chain). The team should include all technical people, and professionals with a stake in the management and operation of the building, such as facilities managers. Where possible, the team should maintain professionals to ensure continuity of personnel. It is not unusual for bid teams to win a project, only then for a different set of people to work on the job. With the current procurement styles, this cannot be prevented but the client can ask contractors for greater continuity as part of their Soft Landings commitment. Sub-contractors appointed later need to be briefed on the Soft Landings process and sign on to the team. Specialists advisors should be introduced early to advise on design development, like the commissioning engineer, and the facilities manager (where appointed). Effort should be made to introduce suppliers and sub-contractors whose input is central to building performance early in the project. These should include the controls designer or engineer, lighting controls supplier, and catering and IT suppliers. Where these people are not available or yet to be appointed, proxies in the form of industry specialists should be invited to comment in a (non-contractual) advisory capacity. All aftercare activities should be agreed early in the project even if the client opts to issue a separate contract for aftercare services rather than extend the main contract to cover the three years of aftercare. The aftercare roles and responsibilities – along with any specific performance targets – also need to be set early so that the objectives and desired operational outcomes are clear from the outset.

- **Ensuring Continuity**

Soft Landings should be maintained throughout the entire project; The roles and responsibilities specified at the project’s inception need to bridge any gaps in professional responsibility that usually occur, particularly in design and build procurement projects. These gaps can be deepened by overly- prescriptive contract clauses. Maintaining continuity will not be easy, but with a little effort the client and Soft Landings Champions can prevent the good intentions of Soft Landings from falling through any contractual gaps. Clients should require a clear gateway process throughout their projects to enable sign-off of Soft Landings activities (see Chapter seven for comparison of teams).

- **Committing to the building aftercare**

Soft Landings advocates for a three-year aftercare period. By the end of year one the building should have settled down. By year two, the building systems should be functioning at its best capacity, energy data should be reviewed and adjustments recommended in a quest to improve performance. The second year will also involve fine-tuning, at the end of which a structured post-occupancy evaluation (POE) should be carried out. The third year will be a period where the aftercare team respond to findings from the POE, make any necessary interventions, and maintain their monitoring of the building's performance and energy consumption. Visits by professionals to the site should reduce as the building settles down and monitoring becomes routine.

The aftercare process should end with a final POE to measure and report the building's performance (primarily energy performance and occupant satisfaction) against the agreed performance objectives, and any specific targets required by the client. In design and build procurement, dialogue will be needed between the main contractor (see Chapter seven for interactions between teams) and the Soft Landings aftercare professionals. Those doing troubleshooting and fine-tuning during the aftercare should ideally be from the original design team, but may also be specialists appointed by the client. Independent analysts are recommended for POE so that unbiased assessments can be done. Clients need to ensure that the feedback loop between building operation and design which is central to Soft Landings learning, is not broken. Effort should be made to ensure all relevant feedback is recorded and communicated to the original project team, and the client. For aftercare and fine-tuning activities to add value, it is important that commissioning is done well (see Chapter seven for analysis of the case studies). Clients must ensure commissioning (including seasonal and continuous commissioning where relevant) has a high status at project inception. Commissioning must be well defined and planned, adhered to, and protected from time and cost pressures. All commissioning activities must be fully recorded.

- **Sharing risk and responsibility**

It is important to any Soft Landings project that it operates within a no-blame culture. It will ensure that information is shared, and that problems are discussed openly and not hidden or buried. While defects and problems must be resolved, all outcomes – good and bad – should be treated as a learning experience. This means that there must be a clear policy of proactive problem resolution, where emerging issues are addressed and resolved collaboratively. Incentives can be helpful, but should be free of heavy legal definition.

- **Using feedback to inform design**

Feedback from other projects is a valuable source of information for both the client and teams, for understanding the needs and expectations of the building's end-users, and for obtaining insight into the technical performance of systems. Feedback can also be used as design progresses, particularly for reality-checking decisions at key stages in the process, and at points when outline ideas turn into systems, and from systems into specified products. Feedback should be used to inform the employer's requirements, the brief that emerges from those requirements, and the subsequent design response. An example of useful feedback is the energy profile of a similar building, which would help to identify the likely energy use of specific systems in the new building, such as lighting (see Chapter seven for more discussion). It would also enable the designers to get a better grasp of energy loads, such as IT, that are not covered by the Building Regulations but which are directly related to ventilation and cooling loads. The feedback process also requires occupant expectations to be obtained and understood. They also need to be well managed from project inception through to occupation. The use of occupant surveys can be valuable for understanding expectations, which will be a blend of what people need to perform their tasks, what they would like in terms of comfort levels, and their desired amount of control over environmental systems.

- **Focusing on operational outcomes**

Reality checking should identify the cause of changes that will affect the client's requirements and the design brief. Subsequent changes should be agreed and appended to the documentation. Performance targets should be revisited, checked, and altered where necessary. Designers need to check and refine their energy use targets. This should be done on a regular basis during the project, preferably in line with the client's gateway process. A reality-checking process could make use of existing provisions, for example being linked to team meetings, design reviews, and contract prelims. Outputs from reality checking could inform a project's operational risk register. This could be a standing item for all progress meetings. BSRIA's Pit stopping approach too provides a reality-checking methodology.

- **Involving the building managers**

It is important to anticipate the operational requirements of running a new or refurbished building. The emphasis of this input should be on designing for ease of use, management and maintenance. Designers familiar with building technologies often struggle to accept that building managers may not understand the purpose of building services systems and how to operate them. The client may have to show strong leadership to get the project team to solicit the views of the building's managers, or to obtain these insights from elsewhere if the management organisation is yet to exist. PFI, and design, build, finance and operate procurement can include a consultation process that will meet this Core Principle, but firms offering a single point of responsibility can still have organisational boundaries that inhibit inter- departmental communication. In Soft Landings, such barriers need to be overcome for facilities management knowledge to be accessible to the project team.

- **Involving the end users**

Soft Landings requires occupant expectations to be obtained, understood and well managed from inception through to occupation. Clients need to instruct project teams to research the needs of known occupants (or use published evidence where the occupants are not known), and use that feedback to inform the design. The use of occupant surveys can be valuable for understanding these expectations, taking account of what they need in order to perform their tasks. This is particularly crucial where a building's systems require significantly more (or less) involvement by the end users in controlling environmental conditions. It's vital that the occupants' expectations are well managed throughout the project, so that nothing in the building comes as a shock to them after handover (see Chapter seven).

- **Setting performance objectives**

The client's objectives should include energy use (including both regulated and unregulated loads and run times), alongside other metrics such as arrangements for operation and maintenance, user training and familiarisation, and building management. Some objectives may not be precise at the start (particularly for energy and water use), so they should be revisited and firmed up as the project progresses. It's important that the project's performance metrics are outcome-focused, specific, measureable, realistic, and of clear benefit. Targets should be based on prevailing and relevant benchmarks. Soft Landings analysis tools that can be used to inform performance targets include CIBSE's TM22 Energy Assessment and Reporting Method, and the Building Use Studies (BUS) occupant questionnaire survey.

- **Communicating and informing the team**

To the extent possible, the client and main contractor should champion a policy of open (and technically intelligible) communication. Ideally, agreement should be reached that allows all parties in the contractual chain to communicate freely with one another without contractual barriers frustrating or preventing it. Partnering-type charters and contracts may provide forms of words and phraseology that clients can use in their project strategy documents. In design and build, the practice of novation means that design professionals are often contractually prevented from talking directly with the client unless they go through the builder. While this protocol may have to be followed, clients that create a spirit of openness, and who champion a no-blame culture and express it in the employer's requirements, may get a better performance from their project teams. It is also important for communication channels to include the sub-contractors, particularly performance-critical specialist contractors responsible for controls and building management systems. The obligation to communicate and inform culminates in the structured post- occupancy evaluations, and in the final project appraisal at the end of the third year of after-care. All involved have a duty to understand and communicate building performance findings – the client for its procurement policy, and the professional and building team members for use on their next projects (BSRIA, 2014).

2.5 Soft Landings as a Client-driven Management tool for Sustainability

The core principles of Soft Landings can be seen as a tool for increasing energy efficiency and producing better buildings. According to Eppler (1999), a conceptual management tool is a structured, model based way of proceeding to improve the problem solving or decision-making process either individually or for a group in an organizational context (Eppler, 1999). By this definition, Soft Landings can be regarded as a Management tool. Many of the decisions for a building project are agreed on from client and contractors' meetings with key professionals. The fact that a Soft Landings process must be specified early during the procurement stage (BSRIA, 2014) will inform all the key stakeholders of the nature of the project. How to Procure Soft Landings (HPSL, 2014) outlines the following for stage 1.

Project brief and design

- Define roles and responsibilities
- Set environmental and other performance targets
- Incentives related to performance outcomes

These have to be decided during the briefing stage, therefore the role that management plays in Soft Landings cannot be overstated. Recognizing Soft Landings as a management tool is determined from the 12 core principles (SLCP, 2014). The 12 SLCP can be divided into 3 main groups; Management, Information sharing/flow and Aftercare (Figure 2.4). The first 5 principles can be seen as decisions that have to be taken by client and managers on the project. These tools are in terms of performance measures and quality control.

The agreement that Soft Landings process has to be adopted throughout the project has to be taken by the client and management. This will be from the procurement to the post-completion stage as stated in the Soft Landings Framework (SLF, 2014). Committing to the whole Soft Landings process is a decision that has to be made by the client (HPSL, 2014). This will be decided in consultation with the project team which will include the main contractor, project manager and client. One of the conditions for using Soft Landings is that the project team will agree to adopt the five work stages of the framework.

- The provision of leadership which is a core principle of Soft Landings indicates that the client must play a significant role in steering the project into achieving its goals (Way and Bordass, 2005). The SL-CHAM will ensure this is done by reality-checking and reviewing design targets at every stage (Figure.2.4).

- Setting roles and responsibilities in addition to their traditional roles has to be led by both the client and the main contractor (Way and Bordass, 2005). The duration and the level of involvement of professionals after handover also has to be decided by the client due to costs involved (SLCP). Aftercare activities including fine-tuning and performance reviews for three years' post-completion all have to be agreed on by the client and management.

- Ensuring continuity of the process (SLF, 2014) guarantees if there is a change of partner or sub-contractor, any new parties will be informed about the process. They will also need to and be informed of all their responsibilities and agree to commit to the Soft Landings process.

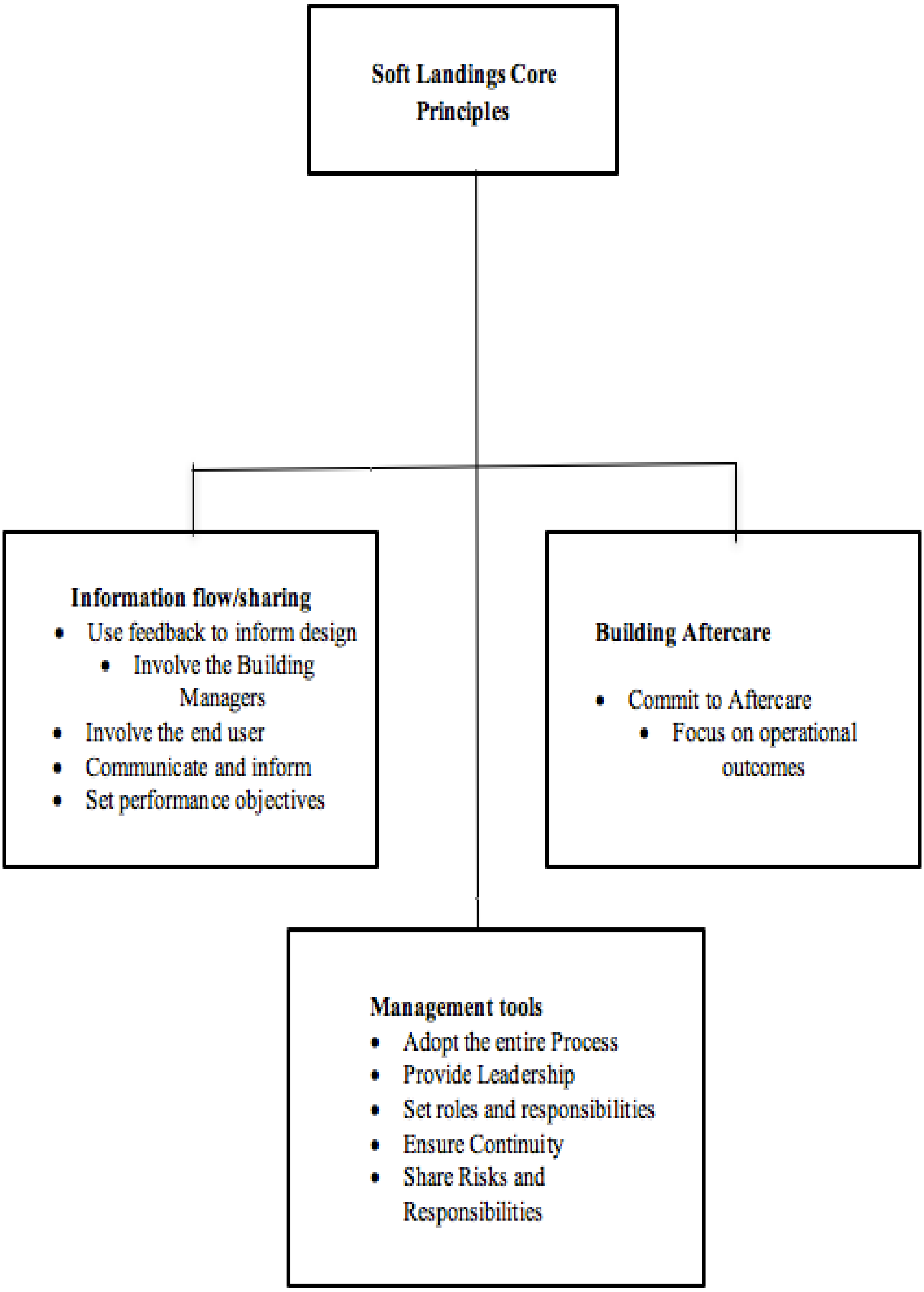


Figure 2. 4: 12 Principles of Soft Landings divided according to function.

2.6 Summary

This chapter discussed two possible solutions to increasing sustainability in buildings. The evidence that many issues dealing with sustainability can be resolved at the design stage has been outlined in chapter one. The solution is to look to the design stage generally, and design management in particular to help resolve these issues. This chapter discovered that:

- Design Management has been evolving since the 1950's to its current position in construction.

- Design Management cannot function in isolation so it needs other processes to help meet current sustainability requirements.
- Soft Landings is one of the processes which can be used to achieve this aim.
- To answer the questions posed at the beginning of the chapter, this research proposes that the next step in the evolution of design management is an amalgamation of design management with Soft Landings.

How this can be achieved is by observing projects which used Soft Landings as a means of increasing sustainability to see if they were successful.

Chapter 3

Research Design and Method

3.1 Introduction

This chapter discusses the Research design, theoretical framework, approach, and methods used in undertaking this research. It underpins the aim and objectives outlined in the research context with the arguments established and expressed in the literature review (see Chapter four). In this chapter, the methods employed will be evaluated to demonstrate their suitability. The techniques used in achieving the research objectives, will be analysed to determine if they are capable of convincingly answering the research questions.

3.2 Research Scope

Although Soft Landings is a process that stretches from inception to extended aftercare, the design stage is of vital importance because this is the first practical process in any project (Edwards & Hyett, 2005; Sebastian, 2004; Mills and Glaser, 2009; Rekola, Mäkeläinen and Häkkinen, 2012). Therefore, it can be said that the majority of the environmental impact of a building is determined during the early design stages (Halliday, 2007). This research looks at the design stage of Soft Landings projects and how they can achieve the sustainable objectives of a project. This is done by

- Reviewing how sustainability is being currently interpreted in the industry
- Providing a critical overview of how professionals use Soft Landings to deliver sustainable buildings.
- Reviewing sustainable designs of buildings with a focus on non-residential buildings.
- Discovering the impact that sustainability targets have on the design management.

Building projects have complex layers which is compounded by new regulations on $C0_2$ emissions and sustainability targets (Chappells and Shove, 2005; Zapata-Lancaster, 2014). It would be difficult to research the whole construction process given the time limit of this thesis. Therefore, this research will look exclusively at the design stage of building projects. The study focuses on the inception, briefing and design development of the projects. Case studies will be used to assess the real- life situations where Soft Landings principles were applied in design management of a project. These include collaboration with other professionals, sub-contractors and end-users. This is not to say that the construction and handover stages of these cases will not be investigated, they will be outlined to give a complete picture of the project. Design cannot be studied exclusively in isolation because it is linked with the other stages of construction. It is however possible to zoom closer on the design stage while keeping the whole construction process in context. That is how this research was conducted; looking at the design stage of Soft Landing projects but keeping other aspects of construction in focus. This approach allows for data to be robust and increases the validity of the project. The research literature (Chapter four) covers the current practices in sustainable design in the UK in general and the use of Soft Landings in particular.

3.3 Research Design

The research design is the overview of the whole research, starting from the theoretical perspective to methods and analysis. This depends exclusively on the design questions which for this research are looking for both descriptive and exploratory answers. Both can be answered in two ways; either through theory development (inductive methods) or theory testing (deductive methods) (DeVaus, 2001). While researchers can pick any of these methods in answering their questions, many have used both development and testing in their work (Bryman, 2004). In fact, many researchers using case study methodology have used both methods by starting with speculative hypothesis and developing theories as the case studies progress.

The research design, using Yang's (2009) five level of case study questions, follows the steps listed below.

- A pilot questionnaire was developed in order to test the strength of the data required for the purpose of assessing whether the collected data and information were suitable to address the initial research question.

- The pilot study was in the form of questionnaires to professionals in the construction industry. The questionnaire was targeted at all professionals in the industry to ascertain the number of professionals using Soft Landings in their projects.
- The comments and the responses given by the pilot survey participants were reviewed to develop three sets of research questions. This was as a result of the lack of information by some professionals about certain sections of the design, construction and aftercare process of the project.
- Case studies and interviews are used for data collection after reviewing the available literature about sustainability, design management and Soft Landings. The literature review allowed the researcher to discover the different methodologies used in researching similar topics. The type of data generated and the end result of such research (see table 3.2).
- Data was then collected using the revised and segmented semi structured interview method. Some of these interviews were face to face but others were by telephone.
- Data was then analysed by first coding and grouping the information and preliminary conclusions discussed.

3.4 Theoretical Framework

3.4.1 Research Philosophy

According to Loosemore (1999), "researchers must clarify their epistemological position because it determines their aim in whether they set out to test or generate theory". This provides the rationale and framework on which the research will rest (Bryman, 2008. Pg 6). Epistemology implies a personal view from a social reality, where some researchers are convinced that there is one and only one method of solving a problem. This is a positivist approach and they aim to get as close as possible with their method. This rigid and structured view of the world leads to the conclusions that theories can be tested with complete confidence. This is in contrast to a constructivist point of view which states that there is no absolute answer, that the answers are fluid and depend on the timing, location and experiences of the those involved. Their aim is by understanding the context of the research, and generate theory or premises. By this definition, the epistemology of this research is looking at the issues from a Social Constructivist's point of view.

Constructivist epistemology has to do with our perceptions of our environment. Researchers such as Mertens (2010), Lincoln et al (2011) have clarified this by saying that people who seek understanding of the world around them (in which they live and work), and need to develop subjective significances of their experiences. These experiences are as diverse and varied as the persons themselves. This will lead the researcher to look for the complexity of their views rather than a narrow view of the issues. Constructivist research is seen as relativist, transactional and subjectivist (Guba and Lincoln, 1998), which can be interpreted, as "there is no objective truth to be known". Rather, the truth is experienced in different forms of reality and the solution to a problem can be solved by looking from different points of view. This epistemology accentuates the diverse ways of interpretation that can be applied to the world. Table 3.1 compares the both epistemology using focus of the research and the role of the researcher.

The idea that the sustainability of a building can be enhanced through design is not a new one. However, the views of researchers differ on how design can be manipulated to achieve this goal. Where some have supported streamlining the design process (Latham, 1994; Egan, 1998) others have advocated for a more collaborative approach (Emmitt and Grose, 2007; Senaratne and Ruwanpura, 2016). This problem cannot therefore be solved with one absolute solution but will depend on the experiences of the professionals available. The more points of views explored in sustainable design, the newer opportunities present themselves to become solutions. A constructivist point of view is based on the assumption that people experience the same situation differently and even though they have a common background of training (Architects, Engineers, Designers), their experiences will give them different ways to arrive at a common problem; this is due to their different interactions and individual thoughts or constructed realities (Berlin, 1987).

Critics of this form of epistemology have pointed out that in order to study reality in its natural environment, a researcher has to become involved in that environment and in doing so can either influence the environment or be influenced by it (Loosemore, 1999). Therefore, a researcher has to make great effort to minimise their influence upon the process being studied. Despite this criticism, researchers in the construction industry have used this framework for their research. Straus and Corbin (1990) have pointed out that using the rigid approach of positivist research in a natural world is in direct contrast with the fluidity of the setting.

This is all encompassed in the methodology that is ‘Grounded Theory’ which according to Glaser and Strauss (1967) and Strauss and Corbin (1998) is a ‘systematic approach to the generation of theory’, which compliments a naturalist or constructivist approach. What grounded theory aims to do, is to discover and explain the underlying social processes that shape interaction and human behaviour (Nayar, 2012). Such is the process of Soft Landings which can only be successful by the close and multi-layered interaction of stakeholders. Their interactions can be seen as social interactions on all levels, i.e. a partnership (between design team and other professionals, between the team and end-users, between the client and design team and between the Soft Landings Champion and every other member of the team). Grounded theory can only be properly.

Table 3. 1: Differences between Positivist and Interpretivist Research.

Methodology	**Positivism**	**Interpretivism**
Focus of Research	Concentrates on description and explanation	Concentrates on understanding and interpretation
Role of Researcher	Detached, external observer	Researcher wants to experience what they are studying

Methodology	Positivism	Interpretivism
	Clear distinction between reasoning and feeling	Allows feelings and reason to govern actions
	Aim to discover external realit rather than creating the object of the study	Partially created what is studied, th meaning of the phenomena
	Strive to use rational, consistent verbal, logical approach	Use of pre-understanding is important
	Seek to maintain clear distinction between facts and Value judgement	Distinction between facts and value judgement are less clear
	Distinction between science and personal experience	Accepts influence from both scienc personal experience

formulated where there is an interactive and continuous process of data collection and analysis (Loosemore, 1999). The researcher has to analyse each piece of data collected as an entity and then analyse that data against other similar information. The lines between data collection and data analysis become blurred and difficult to separate (see Section 3.6). This process of back and forth gives the research a robust and dynamic perspective which will allow a theoretical theme to develop. This in essence leads the researcher through a voyage of discovery rather than a rigid scientific process. That is the reason why this outlook is best suited to research dealing with design in construction. Design itself is a fluid and constantly changing process and the best approach to research it will be to view it through a method of discovery and realities.

This theoretical perspective according to Carson et al (2001), can be known as interpretivism which is inspired by a series of qualitative concepts and approaches. It allows the focus of the research to be on understanding what is happening within a specified concept. It also takes account of the important characteristics of the research pattern on the opposite continuum from positivism and includes consideration of multiple realities, different participants' perspectives, researcher involvement and context of the study (see Table 3.1). It affords the researcher the opportunity to listen to different opinions of Soft Landings from different contexts (projects). This flow of information from professionals who have experience with the Soft Landings process to the researcher will provide the architectural world with the view on how to balance the use of design management elements with a Soft Landings approach, which will help the transition into the construction stage of any project.

The underpinning philosophy of this research is taken from Rooke et al's (1997) point of view which states that construction processes (and by extension design) are undertaken by professionals engaged in concerted social action. That even though the resulting product of the construction is a solid object (buildings), which can be physically measured and accessed, the different perceptions and experiences of the professionals involved can be seen as socially constructed phenomena (Sutrisna and Barrett, 2007). This is in agreement with the social constructivists where personal perceptions play a major role in choosing a method for their research. Crook (1997) agreed that research is a form of social interaction between the researcher and the respondent, which relies on strong communication ties. Both Rooke and Crook stressed that the aim of a researcher is to describe a situation from the perspective of the people under study and take into account the influence of the social networks in which the people were involved (in this case professionals involved with the Soft Landings process).

Social Constructivism is therefore an appropriate theoretical perspective to effectively investigate the complex nature of reality. Having to gather data and information from different professionals who are involved in different parts of a dynamic process (Soft Landings), allows the study of the process from different perspectives. Bordass (1997, 2005, 2010) who has extensively researched and written about Soft Landings has widely employed this theoretical perspective in his research. Other researchers who have also used the interpretive view in their research include Loosemore (1999), Mills and Glaser (2009) Murtagh, Roberts and Hind, (2016). Levy (2006) summarized that while positivism (which is commonly used by researchers in the natural sciences), looks at the environment with a single external reality and is thus governed by explicitly stated theories and hypotheses to secure hard, and objective knowledge, the constructivists and interpretivists look at their environment and believe that knowledge can be achieved by the experience of others who have been in the situation presently studied (Figure 3.1).

The use of interviews to collect information is one of such methods of learning from the experience of others. The fact that different data can be collected from interviews highlights the need for researchers to get the best out of the respondent's views. The questions may have to become broad and general so that the respondents have a good idea of the meaning of the situation and the context in which it occurs. This is usually achieved in interactions with respondents and by continuous refinement of the interview questions (Creswell, 2013. P8). Open-ended questions give better, more holistic answers as they allow the respondents to express themselves according to their experiences during the design stage of the project. These experiences have come about from their past interactions with other professionals in the industry. The interviews therefore serve as data collection not only about the current issue but also from past interactions. This is why Constructivists are also known as social researchers; the data collected usually results from interactions with respondents in their natural environment

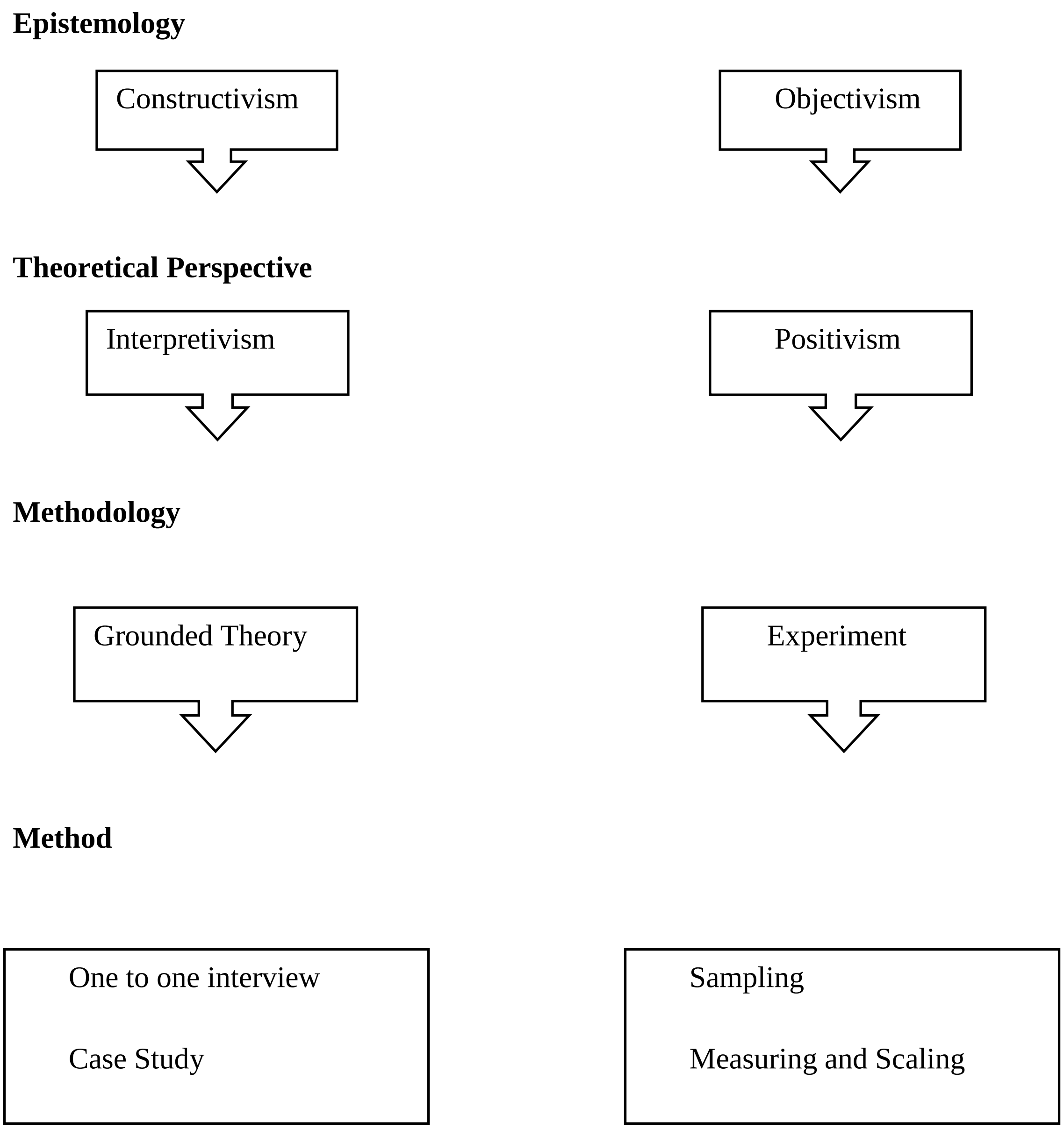


Figure 3. 1: Elemental differences between qualitative and quantitative methodologies

Adapted from Crotty (1998)

3.4.2 Developing a Conceptual Framework

According to Miles and Huberman (1994), a conceptual framework as a visual or written product is one that

> *'explains either graphically or in narrative form, the main things to be studied- the key factors, concepts or variables- and the presumed relationship among them.' (P.18)*

This research proposes a conceptual communication framework for the design stage of a Soft Landings project. The framework is based on information collected from interview findings and the analysis of documentation of the case studies (see Figure 3.2). As explained by Miles and Huberman (1994), the conceptual framework will incorporate elements borrowed from elsewhere; in this case, the project management communication framework, the design management flow of communication and the Soft Landings framework to produce conceptual distinctions. The significance of the framework will be its ability to incorporate different important elements from design management to enhance sustainability right from the design stage. It will also give design management an avenue to evolve and rise to the challenges of sustainability targets.

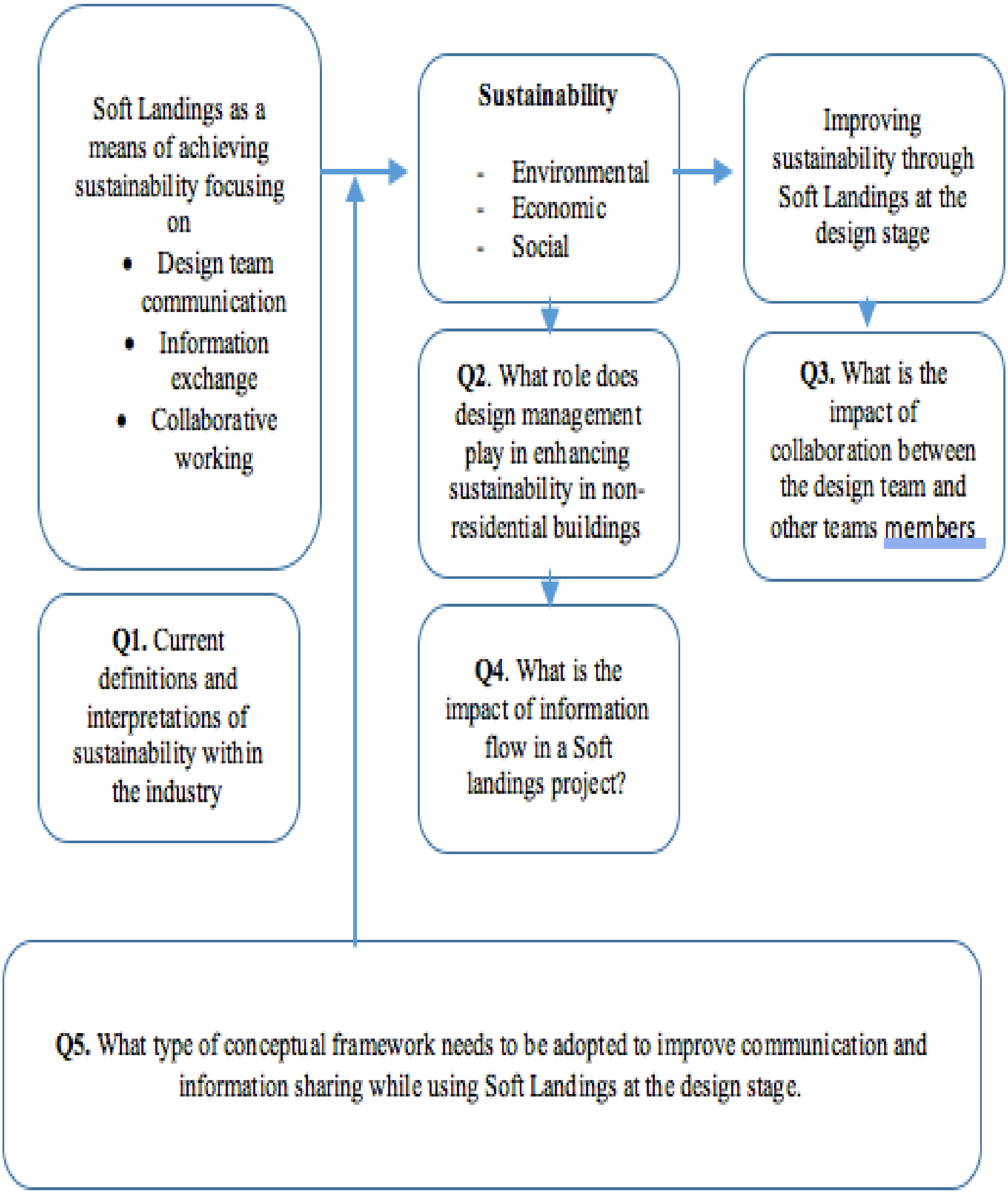


Figure 3.2: Preliminary conceptual framework identified from literature review on Soft Landings and Sustainability

3.5 Qualities of Qualitative Research

Although the above theoretical perspective was not widely used in architecture and design, recently, researchers have started to pay attention to the issues on how to approach some architectural topics such as design, sustainability and conservation (Bal, 2014). It is well known that qualitative research is widely used in Social and Behavioural research where the main aim of the researcher is to explore, discover or understand the fundamental motives of human behaviour (Kothari, 2008). According to Strauss and Corbin (1990), qualitative research is ‘any kind of research that produces findings not arrived at by means of statistical procedures or other means of quantification’. The difficulty of qualitative research is trying to ‘measure’ perception or gauge the importance of topics (Strauss and Corbin, 1990).

The apparently varied nature of conducting interviews during data collection may be worsened by the multi-disciplinary and inter-disciplinary nature of management research (Watson, 1997): a situation which is likely to discover a further increase of research questions and perspectives. Some social theorists have criticized the traditional approach to interviews as a research methodology (Scheurich, 1995). Many of them focusing their criticisms on the problems of representation of the data collected, the nature of language used during analysis, the inability of the reader to separate researcher knowledge from respondent, and the problems of writing out the analysis (Qu and Dumay, 2011). While these are all valid concerns, this research has taken steps to mitigate these issues (see Section 3.6).

In much construction-based research, the science involved is the more widely used experiment method where there are controlled conditions in which the effect of variables on other variables can be measured. This needs the researcher to have an initial prediction of how a variation of inputs will affect the results (David and Sutton; 2004). Much research into the sustainability of buildings and the environment uses a variation of this method (Bordass, 1997; Bordass and Leaman, 2005; Häkkinen and Belloni, 2011; Raslan and Davis, 2012). From this point of view, it is obvious that this research is qualitative research where the emphasis is on words rather than figures on the collection and the analysis of data. Bryman (2001) explained that as a research strategy, it is inductivist, constructivist and interpretivist but not all qualitative researchers agree with all three qualities. This research focuses on the way professionals in the construction industry interpret sustainability and the way they make sense of the Soft Landings processes in the context of achieving sustainability. Researching how a person or group of people ‘see’ or ‘understand’ a concept cannot be exclusively presented using figures and numbers. The subjective nature of the topic lends itself to qualitative research.

Several characteristics of qualitative research are fulfilled in this research. They include:

1. The theoretical framework was not predetermined but derived directly from data. This was the case with this research, the way to get a sense of how all the professionals deal with issues of satisfying the sustainability targets of their projects using Soft Landings was determined by the data collected.

2. Qualitative research is context-bound and researchers must be context sensitive. The core elements in this research were sustainability, design and Soft Landings and therefore the whole research was viewed primarily on these three issues with no deviations from the framework. These issues were explored in the context of construction projects with particular emphasis on the design stage.

3. Researchers immerse themselves in the natural setting of the people whose thoughts and feelings they wish to explore. The researcher accompanied some of the interview respondents to meetings and viewed some completed projects to get a better sense of the project.

4. Qualitative researchers focus on the ‘emic’ perspective, the views of the people involved in the research and their perceptions, meanings and interpretations. The interviews allowed the respondents to talk about the project and Soft Landings process in their own words.

5. The relationship between the researcher and the researched is close and based on a position of equality as human beings. The researcher was in close

communication with all the respondents by email and telephone before and after the interviews were conducted.

6. Data collection and data analysis generally proceed together, and in some forms of qualitative research they are interactive. Interview questions were reviewed and updated constantly.

3.6 Research Method

3.6.1 Case Study

In order to answer the research question (see Chapter one) with respect to ways of enhancing sustainability in non-residential buildings, a dynamic and fluid method that will be able to untangle the complexities that arise when dealing with design and its management needs to be employed. The problems of the UK construction industry had to be identified by an extensive literature review (see Chapter 4). These ranged from various reviews commissioned by the government to researchers dealing with issues such as client/ end user satisfaction, energy efficiency of buildings and collaborative working. To meet the research objectives, two research methods (Case studies and Interviews) are used to obtain qualitative data from the professionals who worked on the specified projects and quantitative data from records on the buildings. Writers like Bryman and Bell (2007) and Yin (2009) have stressed the significance of having more than one method of data collection to ensure that the data collected can be verified accurately and the perceptions of individuals will not be distorted or lost.

Case study methodology was selected for this research because this method has the ability to investigate complex issues such as contemporary design innovations and collaborative working that is characteristic of the Soft Landings process. This method is used in answering the research ‘how’ and ‘why’ questions. The Case study has been identified by Cohen and Manion (1989) as ‘an alternate research paradigm of research which can be both interpretive and subjective.’ This therefore gives the case study methodology a unique perspective in research. Case studies are usually classed in the interpretive paradigm category (Gummesson, 2000) which this research identifies as its theoretical perspective (see Figure 3.1).

The case study methodology also provides a phenomenological perspective of the working processes involved with the Soft Landings process. This means that the study will be able to experience from a 'first-person' point of view the real-life problems that the professionals encountered. Observation of the situation objectively, to see the results of decisions taken by the professionals is an added advantage in the use of case study. Observation is a common method employed by researchers as shown in Figure 3.1. This enables the research to study buildings constructed using The Soft Landings processes in addition to the traditional management style. The 'cases' to be studied are a variety of non-residential buildings which all used Soft Landings principles at one or more stages during construction. The advantage of using multiple case studies is that it facilitates the comparative analysis of each individual case which is an important process for developing robust grounded theory. As shown in Table 3.2, multiple case studies are usually used to compare a common subject under different scenarios.

Many researchers who have investigated the adoption of the low-carbon measures and sustainability in construction by designers and other construction professionals, have used qualitative methods such as interviews. They relied on accounts from the respondents and their retrospective reflection, to determine the professionals' perceptions and attitudes (Osmani and O'Reily, 2009 Fischer and Guy, 2009; Häkkinen and Belloni, 2011; Raslan and Davis, 2012). These researchers were interested in subjective data and the reaction of the professionals when faced with design and construction challenges. This research will not only focus on the experience of the professionals during the various stages in design but will also focus on data such as energy usage, maintenance bills and post occupancy evaluations from the buildings (see Section 4.5) This meant that interviews and questionnaires were not going to be enough to answer the research questions. The advantage of this qualitative approach (case study) is That it allows the researcher to analyse complex behaviour in its natural setting (Abowitz and Toole, 2010).

The case studies fulfilled the criteria outlined as to what qualifies as a case study.

- Complex functioning units; this is in reference to the buildings to be studied. As non-residential buildings with different functions and uses, there are different times of operation and different levels of energy usage. The process of design and construction also displays an intricate system of procurement, supply chain, sub-contractor selection and aftercare arrangement, all which resulted in the successful completion of the project.

- Investigated in its natural context with a multitude of methods; these buildings of course were investigated from the inception stage where the objectives were decided, the brief, concept and detailed design stages with the input from different professionals and even the end users. The investigation continued with a detailed look at how the facilities in the buildings are being used and managed, with end user participation using post occupancy evaluations.

- Be contemporary; these buildings will have been built in the last 8 years with the latest technologies (Yin, 2003; Gillham, 2001; Johansson 2003).

Even if the case study fulfils the above-mentioned criteria, they can be divided into two types. According to David and Sutton (2014), explanatory case studies tend to be more quantitative and deductive while exploratory case studies tend to be more qualitative and inductive. The case studies in this research are of the exploratory nature and therefore will follow a qualitative and inductive path (see Section 3.5). All researchers of qualitative methods outline important criteria for choosing to conduct a qualitative study (Yin, 1994, 2003; Gillham, 2001). They range from the research problem or question, to understand an area where there is a gap in knowledge, to make sense of complex situations, context and settings, to learn how participants interact with their world and the subject of the research, to gain a deep understanding of complex relationships and to generate theory where little exists (Creswell, 2007; Richard and Morse, 2007; Corbin and Strauss, 2008).

A major issue for case studies is the number of cases needed to achieve the research objectives. For practical reasons, how many cases will be sufficient to answer the questions? Will the criteria of the case studies affect the number of cases available? A study into previous case studies in the built environment was carried out to better understand what other researchers have achieved with time limitations. Table 3.2

summarises the results. The average time for the studies was 3 years (in many cases for PhD degrees). In that time, the number of cases ranged from 4 to 12. Most of the studies are inductive theory development with multiple cases relying on historical accounts. A strategy by Flyvbjerg (2006) about selecting cases suggests that this depends on the purpose of the research. This could either be information-oriented or random selection. Uncovering all Soft Landings processes in non-residential buildings cannot be achieved with a small number of buildings. This is because the category covers different types of buildings which cannot be easily generalised. Instead the research will add to the body of work about understanding the processes of Soft Landings during the design stage, of which there are currently very few.

Table 3. 2: Review of similar case study researches

Authors	**No. of cases**	**Type of cases**	**Methods**	**Time cases were researched**	**Discipline of researchers**	**Length of time**	**Theoretical Framework**
Hubermann and Miles (1984)	12	School improvement programmes	Ethnographic studies, observation	Real time (current)	Social Science	3 years	Inductive, theory development
Flyvberg (1998)	1	Bus terminal Planning process	Observation document analysis, semi-structured interviews	Longitudinal	Social Science	>3 years	Inductive, theory development

Authors	No. of cases	Type of cases	Methods	Time cases were researched	Discipline of researchers	Length of time	Theoretical Framework
Pinnegar (2000)	1	Research facility (Earth centre)	Ethnographic observation, interviews, document analysis	longitudinal	Social Science	3 years	Inductive, theory development
Bartlett (2005)	4	Educational buildings	Semi-structured interviews, Document analysis	1 current 3 historic	Engineering	3 years	Deductive, Hypothesis testing
Short et al (2007)	8	Arts building projects	Semi-structured interviews, document analysis, graphical analysis	Historic	Architecture/ Social Science	3 years	Inductive, theory development
Samad (2008)	>10	Educational buildings	Structured interviews,	Historic	Architecture	3 years	Deductive, hypothesis testing

			document analysis, graphical analysis				
Moncaster (2012)	4	Educational building	Interviews, documents	longitudinal	Architecture	3 years	

The availability of projects using Soft Landings also played a large part in the number of case studies used. The fact that the cases have to be viewed through an historical context using information from Building User Surveys and post occupancy evaluations meant that the buildings would have to be occupied for more than two years. This is so that the effects of the decisions taken can be sufficiently explored. For this reason, following the path of the single researcher with a time limit of three years for research, Flyvbjerg's advice on selection of cases and the number of available cases, four cases of different non-residential buildings were selected. These cases were diverse enough to generate appropriate data that will form the foundation of theory. They were also few enough to be researched with the depth and richness that will allow Soft Landings' processes to be better understood.

3.6.2 Interviews

Interviews generally follow a pattern where the interviewer asks a series of questions to a person or persons in order to understand a particular topic (David and Sutton, 2004). The approach to designing the interview questions was carefully considered with several options to be deliberated on. As the interviews were to accompany the study of buildings, they were combined with observational and archival research on the building. There was therefore no need to repeat questions that could be answered from the archival research on the particular buildings. The desire to keep the respondents interested in the interview process and avoid asking for information that can be obtained from other sources served as a guide to keeping the questions concise and to the point.

A set of semi-structured interview questions was designed to discover what happens during the design process of a Soft Landings project (see Appendix A). This method of interview was chosen because it allows both the researcher and the respondent to explore emerging themes in order to follow an idea or response in more detail (Britten. N, 1999). Although this interview format is commonly used in Social Sciences, it is slowly being seen as an alternative method of data collection by other researchers in design and construction (Pink et al, 2010).

When designing interview questions, David and Sutton (2004) stated that it was necessary to start with an outline of the investigation area; gaps in knowledge about the Soft Landings process, and the role that design and early introduction of non-design professionals into a construction project played in enhancing the sustainability of non-residential buildings were therefore identified. This was based on themes identified about the most important elements required for a successful sustainable building from information gathered during an extensive literature review, and a pilot study carried out using questionnaires in the early stages of the research (see Chapter five). When all of the important themes were identified, specific interview questions were then designed to allow a particular theme to be investigated in more detail. All the questions on that theme were then reviewed to make them as clear and as succinct as possible.

The first aspect to designing the interview questions was the decision of who should be included in the interview process. The focus of this interview is professionals who have worked on the case studies using Soft Landings. This focus is further narrowed to professionals who are involved in the design stage of the Soft Landings cases. The challenge was how to balance the selection of professionals; selecting one key design and Soft Landings Champion with the possibility of biased results or to choose several team members who were not involved in the design stage but worked on the project during the construction and aftercare stages, in order to get a more holistic view of the process. The solution was to get the view of all three teams (design, construction and aftercare) of professionals working on the Soft Landings project (see Table 3.3).

Interviewing only the professionals involved in the design stage can give rise to biased research. From the pilot study, it was observed that some of the team members did not know about the workings of some sections of the project. Some of the members of the construction team did not know the workings of the design and aftercare teams.

Another observation was that some of the project team members did not start the project from the beginning and others left the project at different times during its construction. The solution to this was to decide to design three categories of questions; one for the design team, one for the construction team and one for the aftercare team. Doing this allowed the professionals to be interviewed independently and talk about their role in the project with no questions about other stages they were not involved in. There are several questions common to all three of the interview questions with the difference being each group has questions tailored to their roles and functions during the project (see Appendix A).

Table 3. 3: Summary of respondents with designation and years of experience with Soft Landings

Project classification	**Profession**	**Designation of respondent**	**Years of experience in the industry**	**Years of experience with Soft Landings**	**Types of project**
A1	Architect	Design Team Leader	12	0	Commercial Residential Educational
A1	Civil Engineer	Project Manager	11	0	Commercial Residential Educational
A1	Electrical Engineer	Sub-contractor	8	0	Educational buildings

Project classification	Profession	Designation of respondent	Years of experience in the industry	Years of experience with Soft Landings	Types of project
A2	Architect	Architect	14	1	Commercial Healthcare Centre Residential
A2	Construction Manager	Construction Manager	19	1	Educational Residential Regeneration projects
A2	Environmental Manager	Sub-contractor	10	0	Commercial Rail Construction
B1	Sustainability Manager	Sustainability Manager	8	1	Commercial Institutional
B1	Facilities Manager	Facilities Manager	5	1	Commercial Institutional
B1	Architect	Design Team Leader	15	5	Institutional Commercial Healthcare residential
B1	Quantity Surveyor	Client Representative	11	1	Commercial Institutional
B1	Lawyer	End user	N/A	N/A	N/A

Project classification	Profession	Designation of respondent	Years of experience in the industry	Years of experience with Soft Landings	Types of project
B2	Architect	Design Manager	16	2	Commercial Residential Educational Industrial
B2	Service Engineer	Sub-contractor	8	0	Commercial Residential Educational
B2	Mechanical Engineer	Soft Landings Champion	21	5	Commercial Residential Educational Industrial
N/A	Process Engineer/ Energy Consultant	Soft Landings Champion	8	5	Commercial Residential
N/A	Electrical engineer	Soft Landings Champion	25	8	Residential Commercial Industrial
N/A	Project Manager	Soft Landings Champion	13	2	Residential Commercial
N/A	Environmental Engineer	BSRIA	28	10	Commercial Residential Educational Industrial

Project classification	Profession	Designation of respondent	Years of experience in the industry	Years of experience with Soft Landings	Types of project
N/A	Architect	Soft Landings Consultant	15	6	Commercial Residential Educational Industrial

The next challenge was the structure of the whole interview. This refers to the form and order of how the questions should be asked and how identical they are from respondent to respondent. This was so that the whole interview flows from question to question and is not disjointed and uncoordinated. All interview questions were semi structured and open ended to allow for the respondents to be able to give their own unique perspective on the project. David and Sutton (2004) explained that the more unstructured interview will want to highlight the depth validity of each individual interview. Although open answers provide greater depth and personal detail from the respondents, they are usually harder to compare numerically. The semi structured nature of the interview will therefore provide the opportunity for the interviewer to vary the questions (Table 3.4).

Table 3. 4: Potential interview challenges and solutions

	Challenge	Solution
1.	Respondents giving a narrow view of the issues	Interview a wide range of professionals who worked on the project.
2.	The respondent may be unwilling to answer questions with regard to certain confidential information	Assure the respondents that the study is anonymous and any confidential information will be treated as such.

	Challenge	Solution
3.	The respondent may have information only pertaining to their role in the project	The semi structured nature of the interview will ensure that all respondents are given the opportunity to explain their role in the project
4.	The respondent finds it difficult to recall certain situations that happened during the project	Use information from documentation to prompt the respondent and read out any data regarding the issue.
5.	The respondents decide to be interviewed as a group to save time	Mention their designations individually and asked questions pertaining to their role.
6.	The respondent may be talkative or spend too much time talking about other issues	Ensure that they are prompted with specific questions whenever they go off topic
7.	The respondents may offer only short and clipped answers	Try to ask open ended questions so that the respondent will explain more.

Although the respondents may have worked on the same project, their experiences may be different and they would have different opinions and ideas on how to solve a particular problem. Of course, they would have all agreed on how problems should be solved but it would be interesting to learn about their differences in opinion and the way it was resolved. Yin (2003) advised that human affairs should be reported and interpreted through the eyes of individual respondents because each insight is needed to build the complete picture of the Soft Landings design processes. The semi structured interview allowed each interview to have an individual impression which did not constrain the respondents if the questions were rigid or more structured.

Convenience sampling rather than random sampling was used. This means that while only companies that fit the criteria were chosen, only the companies that agreed to be interviewed were included in the research. The respondents of the interview were divided into three categories according to the recommended stages of the RIBA plan of works. The 7 stages in the 2013 plan of works have been identified to deal with 3 teams during the design and construction of the building.

- The design team,
- The construction team
- The aftercare team (both initial and extended aftercare team).

The first group is the team responsible for the design of the project; this group includes all the professionals involved at the concept design, developed design and technical design stages. Professionals interviewed at this stage include Architects, Design Managers and Project specific designers, Soft Landings Manager/Champion and Project Managers. The second group is the team responsible for the construction stage; this group will include the main contractors, Sub-contractors, Project Managers, Soft Landings Champions, Design Manager (see Table 3.3).

The third group is the team responsible for the aftercare; this group include: The Project Manager, Soft Landings' Champions, and specialist aftercare professionals. From the list above (Table 3.3), it is clear that some professionals appear in more than one group of respondents. This reinforces the importance of their roles in the whole process (from conception to aftercare) and therefore they will have to be consulted for their views and experiences about all the three stages of the project. Their questions were condensed for the three stages in order to avoid repetition. The questions were divided into the following categories:

The first were designed to investigate the background of the company and the management structure of the company. The literature reviewed revealed that, it was important to understand the background of the companies and the policies driving their sustainability targets (Bordass and Leaman, 2005b). Based on prior research, questions in this section were designed to understand how important sustainability of the buildings affects the company structure.

The questions were grouped into

- Management hierarchy – what management style is used in the company, how the chain of command is followed,

- Information flow – the use of central internal messaging services, frequencies of meetings with different departments
- Sustainability issues – reasons for adapting Soft Landings, other sustainable tools used by the company
- Terms and procedure of aftercare.

These include number of employees, how long they have been involved in Soft Landings, reasons why they adapted this process and how lines of communications were treated. Other data collected was the designation of respondent, years of experience in the construction industry, years of experience with Soft Landings.

The second section was designed to get a sense of the process of Soft Landings during the design stage. From the literature reviewed, different professionals have tried to resolve the issue of sustainable design using different methods with the introduction of different approaches.

The questions include

- How early in the design stage are other team members introduced into the design process?
- Are the stages of introduction of other team members and end users predetermined or is it a flexible process?
- Have there been objections from other team members about certain elements of design and if so how were the differences resolved?
- How feedback from other professionals and end users is incorporated into the design.

These questions help to determine not only the inner workings of the process during the design stage but also how flexible the whole process is. The next group of respondents was the construction team. Professionals that were interviewed included Project Managers, Engineers, Sub-contractors and Soft Landings Champions. The questions asked were also be divided into two groups asking preliminary questions of how long they have been involved in their present role, how long they have been involved with Soft Landings. The second part of the questions aimed to uncover their participation in the design process. Questions include

- How early they were invited into the design process?
- What contributions did they make during the design process?
- How team meetings were held; is it held in sub groups or is every team represented in all the meetings?
- How the lines of information and communication are dealt with;
- Whether there was a central messaging centre that includes all the teams involved or is information passed on only to team members that it specifically relates to,
- Was project management software used during construction? If yes, is it generic software or one specially designed for the project?
- How conflict between teams is resolved.

The third group of respondents is the aftercare team. This group were all the professionals who are involved during the initial handover and aftercare. They comprised both the teams during the construction period and the Facilities teams of the newly handed over building. Some designers and architects were also involved in the aftercare process. Questions asked include

- How the professionals for the aftercare were chosen?
- How the problems identified were resolved.
- How long into the occupation of the building was a post occupancy review carried out? And how frequently will it occur
- Has there been the need to stay up to the recommended 3-year aftercare period?

There were other questions common to all three groups which included their opinions on the soon to be launched government Soft Landings and where they think the future of Soft Landings will be. In addition to the information acquired, company documents were also required. These ranged from tender documents, building designs and variations, site meeting minutes and where possible, letters and emails to sub-contractors. Identifying problems and the manner in which they were dealt with after the initial handover is one of the most important parts of Soft Landings. Therefore, obtaining post occupancy evaluations of the buildings and actual energy usage will also be key to discovering the impact (positive or negative) of Soft Landings to the project.

Apart from the professionals who worked on the project, the researcher also interviewed a second group of respondents. This set of respondents are professionals in the industry who are currently involved with Soft Landings. Although they are using Soft Landings, none of them actually worked on any of the case studies. Some of them are Soft Landing consultants while others are members of BSRIA (Building Services Research and Information Association) with extensive knowledge of the process. They were interviewed because the researcher considered their expertise in the Soft Landings process important with some of them having more 10 years' experience (see Table 3.4). Helping to shape the Soft Landings framework and its core principles, the researcher considered their responses as a bonus to the research. Although they were not involved in the case studies, the added information from these respondents supports and sheds light on the process and helps to present a balanced debate on the process.

Following the social constructivist epistemology, the data collected from the case study professionals is subjective to their experiences within a particular time frame (duration of the project). The addition of the experienced Soft Landings consultants lends objectivity to the research by presenting a balanced view of the process with examples of their vast experiences on different projects. This helps to counter arguments of the criticism of the theoretical framework which points to the subjective nature as being biased (see Section 3.4).

3.7 Building selection Criteria

A qualitative 'case' cannot be selected randomly as prevalent in quantitative approaches which can call for statistical sampling. It has to be selected on theoretical sampling (Yin, 2009). This research had to focus on theoretically significant cases that dealt with sustainability in buildings in general and Soft Landings in particular. To undercover the process of design in Soft Landings, four cases have been found to contain all the necessary elements for answering the research questions.

The criteria for the selection of buildings has been purposeful and analytical; they are all buildings that are rich in information and unique in their composition. Non-residential buildings cover a wide selection of buildings which vary in their construction and use. This research has therefore looked at four different non-residential buildings. This gave the research the ability to examine the single issue of Soft Landings at the design stage from four different cases. Arguments about case studies have centred on whether findings from a single case can be generalised. (Flyvbjerg, 2006; Ruddin, 2006). Leaman, Stevenson & Bordass (2010) believe that a single case can shed light on new issues and processes and create hypotheses that can be tested. Flyvbjerg (2001) agreed with single case studies by stating

> *'One can often generalize on the basis of a single case, and the case study may be central to scientific development via generalization as supplement to other methods. But formal generalization is overvalued as a source of scientific development, whereas "the force—of example" is underestimated'.*
>
> (Flyvbjerg, 2001, p. 425)

Flyvbjerg established that generalization from a single case was possible depending on the case and how it was selected. Johansson (2003), also supported specific case selection by saying 'if a case is purposefully selected, then there is an interest in generalizing the findings'. This is the case with this research as trying to uncover the processes involved during design of a Soft Landings project is a key objective.

The non-residential buildings selected all used Soft Landings during their construction. Details of how accurately the core principles were followed will be discussed in chapter seven. The buildings include one educational building (Primary school) which comprises of classrooms and a dining hall. The next is a commercial building comprising offices and conference centres. The third was an institutional building which is a central government office with offices. The busiest times of the day being normal working hours (9am to 5pm). There are activities outside of these hours but they are significantly less with fewer people using the building. The final building is a commercial/ industrial building housing labs with different size offices and varying opening and closing times.

The first criteria that all the cases had to meet was the use of Soft Landings during the construction of the project. From in-depth research, it was discovered that many projects which used Soft Landings did not start from the beginning of the project (design stage). The process began at different stages of the project some due to procurement methods (see chapter seven). The challenge therefore was to find the actual use of Soft Landings during the design process. The four cases selected were found to have used various interpretations of Soft Landings from the beginning of their project (design stage). This qualified the buildings as suitable for the research. The various forms of adoption of Soft Landings will allow the researcher to investigate the process on a practical level.

3.8 Summary

This chapter provided details of the methodology adopted in this research to achieve its aims and objectives. It was important to state the theoretical framework and research philosophy before data collection. The qualitative nature of the research was explored and the justification for the methods used. Comprehensive explanations of the case study criteria and the interview procedures have been offered. It is predicted that the use of both methods will allow the researcher to uncover the processes of Soft landings during the design stages of the cases selected. The chapter discovered that:

- A social constructivist framework was suited to explore the objectives of the research
- The research qualified as qualitative because it fulfilled the criteria such as focusing on the views of the respondents and analysing data while still collecting data.
- Case studies will adequately allow the exploration of the research questions.

The next chapter discusses the literature that informed this research, looking at not only widely accepted views from past and current researchers but also at the radical opinions of others.

Chapter 4

Current Practices in Sustainable Design and application of Soft Landings in particular

4.1 Introduction

The research design and method provided a framework with which the objectives can be achieved (Chapter three). This chapter will show the different aspects of the research with past and current views on sustainability, design management and more recently Soft Landings. It will also confirm the complicated relationships that have developed because of national and international policies affecting CO_2 reductions in the UK. The chapter will Focus on the literature on the objectives of the research which are:

- identifying current definitions and interpretations of sustainability within the industry,
- reviewing that design management plays in enhancing sustainability in non-residential buildings, and
- analysing the impact of collaboration between design teams and other members of the project.

This chapter is divided into sections which highlight the opinions from past and current researchers. These include national and international policy on carbon reduction in buildings (section 4.2) and the difference between a Project Manager and a Soft Landings Champion (section 4.7).

4.2 Policy on carbon reduction

Governing bodies in different parts of the world are faced with the challenges of carbon emission reduction; despite evidence produced by scientists on both sides of the arguments, there is still a call for world governments to reduce the effects of climate change (IPCC, 2007; 2013, DECC, 2015). At the United Nations Climate Change conference held in 2015 in Paris, there was a consensus that to reduce dangerous anthropogenic interference with the environment, the global average temperature rise had to be limited to 2°C compared to pre-industrial levels (DECC,2015). Of course, for this target to be achieved, there must be a long term and sustained reduction of Greenhouse Gases (IPCC, 2013, DECC, 2015). The conference ended with 195 country representatives agreeing to 'pursue efforts to' limit temperature increase to 1.5 and for developed countries to contribute $100 billion per year from both the public and private sector to help poorer countries (DECC, 2015). This was met with approval from most members of the United Nations (Viñuales, Depledge, Reiner & Lees, 2017; Kinley, 2017). Critics of the agreement point out that the wording of many of the sections can lead to different interpretations that will not necessarily help solve the problems. They also stressed how poorly understood the focus of 2°C target is being perceived by stakeholders (Viñuales, Depledge, Reiner & Lees, 2017). Although the target was agreed on, many see this as too ambitious and unrealistic for many countries to adopt without posing a risk to their democratic processes. A new development about the Paris Accord is the decision of the United States of America to pull out of the agreement. With the US being one of the largest generators of CO_2 gas. Under the accord, the America pledged to cut its greenhouse gas emission to 26-28% below 2005 levels by 2025 and agreed to pay up to $3 billion in aid for poorer countries by 2020 (Viscidi, 2017). This opened more discussions with countries like Turkey calling on a review of the agreement.

In European Union, the target was set to reduce greenhouse gases, with the '20-20-20 goal'. This states that three main targets should be reached by 2020;

- a reduction in EU greenhouse gas emissions of at least 20% below the 1990 levels,
- the achievement of 20% of EU energy consumption from renewable resources and
- a 20% reduction in primary energy use. The 20% energy saving target was set in 2007 against a fixed baseline.

This reference was the projection of energy use for 2020 presented by the European Commission, which was close to 2,000 Million Tonnes of Oil Equivalent (Mtoe). The 20% energy savings means that, by the year 2020, the consumption of primary energy in the EU shall not exceed 1,600 Mtoe. This figure is 14% less than the amount of energy that was consumed in 2005. This huge challenge means the EU needs to implement technologies and policies to avoid the use of around 400 Mtoe. This

‘Climate and energy package’ was decided on by the European Parliament and Council in December 2008 and in June 2009, it came into law (EU Commission, 2011). Even with these ambitious targets, Glass and Dainty (2011) pointed out that the legislation from the past 30 years is mostly initiated to encourage the production of sustainable products rather than embedding sustainable practices as an essential part of cooperate and social responsibility.

The current challenge for the UK is how Brexit (The decision of the UK to leave the European Union) is going to affect these targets. The uncertainty regarding the result of the referendum suggests that nobody is sure how the UK will align with the rest of the European Union (Ward, 2016). On their 2016 report titled, ‘Meeting Carbon Budgets-Implications of Brexit for UK climate policy’, the Committee on Climate Change summarised

> *‘The carbon budgets legislated so far are at least as challenging as the EU’s commitments to tackle climate change. They must continue to be met after the UK has left the EU. New UK policies will be needed to reduce emissions where policies previously agreed through the EU no longer apply or are weakened……. The Government has stated its intention to initially convert existing EU laws into UK legislation when the UK leaves the EU. Many aspects of EU-level policy will need to be preserved or replicated at the UK level in the longer term to meet the UK’s carbon budgets. In some areas, the Government should take opportunities to improve on EU-level approaches.*

The industry welcomed the statement by the government in their response to the annual report (CIBSE, 2016) in which they re-affirmed their existing commitments to:

> *“keeping [energy] bills down for businesses”*
>
> *The “roll out” of non-domestic smart meters to “put small businesses in control of their energy use”;*
>
> *Re-affirmation of the 2015 Spending Review commitment to spend £295m on improving the energy efficiency of schools, hospitals and other public-sector buildings*

Minimum Energy Efficiency Standards for private rented non-domestic property".

(HM Government, 2016)

The Chartered Institution of Building Services Engineers (CIBSE, 2016), expressed their views by welcoming the government commitment to carbon reduction.

In the UK, the Climate Change Act was introduced in 2008 which was the world's first legally binding climate change target (DECC, 2015). The act aimed to reduce UK's greenhouse gases by at least 80% (from the 1990 baseline) by 2050. The new policies started a chain reaction where stakeholders in every sector of the economy started looking for ways to reduce carbon emissions. In order meet carbon reduction targets, the government must adopt tough and wide-ranging policies (Ekins, Anandarajah & Strachan, 2011). The interest and ongoing research on zero energy and zero carbon buildings has influenced policy and legislation. In 2014, there was talk of the government missing this target (Harvey, 2014). A review by the statutory advisers have found that the green deal which is one of the flagship programs for carbon reduction has not properly implemented due to high costs. In addition to the falling numbers of cavity walls insulation due to changes in government policy. The review warns that if the current policies remain as they are, the reduction in carbon emissions will only be about 21% -23% from 2013 to 2025 (Harvey, 2014). This is compared with the estimated reduction of 31% from the government over the same period.

Studies into zero energy buildings and homes have been undertaken by many researchers (Lützkendorf et al, 2015; Pan and Ning, 2015). The European Union Directive on the Energy Performance of Buildings states that by the end of 2020, all new buildings should be 'nearly zero energy buildings' (European Commission, 2010). This directive has opened the door for individual nations to set their own targets and adopt their own policies. The International Energy Agency working with researchers in 'Towards Net Zero Energy Solar Buildings' project have nearly 300 zero energy and energy plus building researches going on across the globe (REOB, 2013). This shows that the issue of energy efficient buildings is being tackled from different perspectives.

While there has been some effort from government and other scientific bodies, the implementation of zero carbon buildings targets have been very challenging for construction companies because the policies lack clarity and suitability which many researchers have pointed out (UKGBC, 2009; McLeod, Hopfe, & Rezgui, 2012; Pam, 2013). This has consequently made acceptance by the construction companies more difficult (NHBC Foundation, 2012; Heiskanen, Matschoss, & Kuusi, 2013). For this reason, many of the zero carbon buildings are either prototypes or demonstration of new technologies. With these problems, the government decided to scrap its regulation which stated for all new homes to be 'zero carbon' from 2016 (Ares, 2016). In July 2015, the government published this statement

> *'repeat its successful target from the previous Parliament to reduce net regulation on housebuilders. The government does not intend to proceed with zero carbon Allowable Solutions carbon offsetting scheme, or the proposed 2016 increase in on-site energy efficiency standards, but will keep energy efficiency standards under review recognizing that existing measures to increase energy efficiency of new buildings should be allowed time to be established.'* (Fixing the foundations: Creating a more prosperous nation. Government paper, published 10 July 2015).

This in effect scarped the whole scheme with no time table for new targets. Environmental groups criticized the government decision with a letter signed by more than 200 businesses to the Chancellor urging him to reconsider the government's decision. They stated

> *'The weakening of standards will mean our future homes, offices, schools and factories will be more costly to run, locking future residents and building users into higher energy bills. It also runs counter to advice from the Committee on Climate Change, impeding our ability to meet our statutory carbon targets cost-effectively at a time when we should be showing international leadership on this issue.'*
>
> (Open letter published on the Green Building Council's website; 20 July 2015).

Carbon reduction needs policy that will continuously monitor the current events and react accordingly. If carbon reduction targets are to be achieved, policies that can be readily interpreted with no ambiguity must available to all sectors of the economy. (Judson & Maller, 2014; Zapata-Lancaster & Tweed, 2014; Pam and Ning, 2015).
With the complications about interpreting policies and the current scrapping of some targets, other carbon reduction measures should be explored.

4.3 Sustainability in the built environment

The definition and the context of sustainability in construction has already being discussed in the introduction chapter with the different views of researchers on achieving and maintaining a sustainable building highlighted (Table 4.1). It has been widely accepted that the effects of construction and construction related activities has added a significant amount of CO_2 emissions to the environment and one of the largest contributors to pollution and waste (Asif et al, 2007; Pearce, Ahn, and HanmiGlobal, 2012; Ding and Forsythe, 2013). They stated that there was a clear link between construction related activities with the rise in pollution and greenhouse gases. For this reason, the main focus of research and development of many in the construction industry have been ways to mitigate the effects of construction on the environment (Spence and Mulligan, 1995; Hill and Bowen, 1997; Du Plessis, 2007; Rigby, McCoy and Garvin, 2012; Lützkendorf et al 2015). Spence and Mulligan (1995) researched the environmental impact from the construction industry. Impact ranging from atmospheric pollution and the use of fossil fuels to loss of forests and natural habitat and loss of soil and agricultural land.

While Du Plessis (2007) researched sustainable construction in developing countries, differentiating the effects on sustainable construction. Du Plessis highlights several factors that affect the relationship between humans and their environment. The quality of life, the choices made in terms of technological, political economic and other systems which play a major role in the society. This indicates that there is a complicated relationship between all sectors of the economy and solutions must consider all these factors.

Table 4. 1: Definition of sustainable construction. Taheriattar and Farzanehrafat (2014)

Reference	Definition
1st International Conference on Sustainable Construction, Kibert,1994	The creation and responsible management of a healthy built environment based on resource efficient and ecological principles
Huovila, 1999	In its own processes and products during their service life, aims at minimizing the use of energy and emissions that are harmful for environment and health and produces relevant information to consumers for their decision-making
CIB, 1999	Official definition: a way of building which aims at reducing (negative) health and environmental impacts caused by the construction process or by buildings or by the built-up environment More precise definition: the reduction in the use of natural resources and the conservation of the life support function of the environment by construction processes, buildings and the built-up environment under the premise that the quality of life is maintained

Reference	Definition
Chang et al. 2000	Low environmental impact, high contact with the environment, amenities and health
Plessis et al. 2002 (Agenda 21 for Sustainable Construction in Developing Countries)	A holistic process aiming to restore and maintain harmony between the natural and the built environments, and create settlements that affirm human dignity and encourage economic equity
Huang and Kou, 2002	Environmentally friendly construction for achieving sustainable coexistence with the natural environment throughout the stages of planning, design, construction and service life, stressing environmental ethics including consumption of minimal energy and resources, harmony with the environment and sharing with later generations

Reference	Definition
Architecture and Building Research Institute, 2003	Architectural design geared towards human health and comfort, pursuing coexistence with the global environment, and fostering the sustainability of the people's living environment. Buildings should consume relatively few natural resources and manufacture relatively little waste

Hoffman and Henn (2008) have drawn attention of the challenge of defining 'sustainable construction'. Stating that the definitions were usually framed in economic and technical terms with less emphasis on the social and psychological aspects. These missing aspects in defining sustainable construction are needed for better understanding of professionals in the industry (Murtagh, Roberts and Hind, 2016). Taheriattar and Farzanehrafat (2014) agree, maintaining that different definitions (Table 4.1) can cause confusion in the execution of sustainable buildings. Rekola, Ma˙kela¨inen and Ha˙kkinen, (2012) went further to say that a lack of common understanding of sustainability can prevent a successful sustainable project and can also make calculations of cost impacts and profitability of sustainable buildings difficult.

Empirical studies on sustainable buildings offers a means of not only protecting natural resources but also producing better and longer lasting buildings (Shi et al, 2012; Ding and Forsythe, 2013; Lombardi and Trossero, 2013). These studies have found several barriers to achieving sustainable buildings which mirror the problems in the construction industry. They include tendering and procurement processes, cooperation and networking, availability of integrated methods, costs, risks and market value (See Table 1.2).

The route to achieving sustainable buildings has been as varied and as diverse as the researchers. Ahn and Kim (2014) emphasized in their study of modular design that sustainable design and construction practices is one of the best ways to achieve sustainability in the built environment. They went further to say that the three pillars of sustainability (also referred to as 'the triple bottom line') social, environmental and economic, can be attainable with the implementation of all sustainable practice in the life cycle of a building. Others have advocated improving sustainability in construction by lean construction (Koskela, 1992; Ogunbiyi, Oladapo and Goulding, 2013). Lean construction aims to remove waste (activities not generating any value) to make the process leaner. This can be achieved by combining several lean principles such as value stream mapping, flow, pull system with the involvement and improvement of industry professionals (Ogunbiyi, Oladapo and Goulding, 2013). Researchers of lean construction are keen to point out the advantages over conventional construction methods

While according to Ahmad, Thaheem and Anwar (2016), the key notion behind sustainable buildings is low maintenance and operational costs, long life cycle and high energy efficiency. Enshassi, Kochendoerfer and Al Ghoul (2016) went further to say that emphasis should be on the life cycle of the building when considering sustainable buildings. Viewing the project life cycle in stages; inception, design, construction, operation and demolition. Rohracher (2001) argues that greater interaction from professionals, suppliers and users are key to achieving sustainable buildings. Building designers have always been tasked with solving sustainability issues with many researchers in agreement of solutions by design (Bordass and Leaman, 1997: Prasad and Hall, 2004; Halliday, 2007; Mills and Glass, 2009; Elmaulim and Gilder, 2014). The vital role of design is emphasised in all the interpretations of sustainable construction (Murtagh, Roberts and Hind, 2016).

Others are convinced that the internal organization plays a major factor in achieving sustainable buildings. Van Hemel and Cramer in their 2002 research of 77 Dutch companies with respect to eco-designs, found internal factors including new market opportunities, commercial benefits, improved image and cost reduction to affect the designs of their buildings. While Horman et al (2006) suggests the use of new delivery models referred to as design-build-operate-maintain will assist in achieving sustainability. They argue for one contract where the designers, contractors, operation and maintenance are all stipulated from the beginning of the project as is the case for a Soft Landings project.

Blutstein and Rodger (2001) earlier on stated that ‘A sustainable building requires more than identifying solutions to specific problems, but changes to attitudes, paradigms, processes and systems to deliver the project’. This is the view agreed with others above emphasising on radical change throughout the industry. Asif et al, (2007) supports a multi-disciplinary approach to be taken to deal with energy saving, reuse and recycling of materials and improved use of materials. This will start at the conception stage and continue throughout the life cycle of the building. Others such as Rice (2011) have argued for a more ‘holistic, open and flexible approach to achieving sustainability rather than a route where rigid and limited indicators benchmark the success of a created space or building.

Considering the views of different writers, Rekola et al (2012) summarized that sustainable buildings require the following

- Introduction of new methods and tools for building assessment, with better understanding with respect to interaction of components.
- Use of new materials and new technical solutions.
- Interaction of new actors (new manufacturers of new products, new services, integrative planning processes).
- Better coordination and interaction by developers, designers and construction companies.
- New competencies and new understanding of sustainable construction.
- New procedures like new ways of certification and better-quality control.

Despite scepticism expressed by Braithwaite (2007), there is a consensus that the advantages of applying sustainable principles to construction is immeasurable and should therefore be implemented wherever possible. It is now common practice to use an assessment method to achieve a certification for excellence in buildings. Most countries have a nationally accepted method; The Building and Environmental Performance Assessment Criteria (BEPAC) in Canada; The Comprehensive

Assessment System for Building Environmental Efficiency (CASBEE) for Japan, Passivhaus for Germany. The BREEAM (Building Research Establishment Environmental Assessment Method) is used in the UK and the LEED (Leader in Energy and Environmental Design) used in the US are two methods with wide spread acceptance. However, there are groups calling for a global standardised measure (Dixon et al, 2008; Reed et al, 2010). They argued that in an era of international property portfolio, rating tools should have the ability to measure buildings equally. This makes BREEAM the leading assessment tool because other countries such as Germany, Sweden, Spain, Norway, and the Netherlands have their own national BREEAM scheme operators (Fuerst and Van de Wetering, 2015).

BREEAM sets benchmarks for standard categories for building types (BREEAM education, BREEAM healthcare, BREEAM retail). It looks at environmental performance of buildings through design (specification), construction and operation. It evaluates performance using 9 categories; Energy (19%), Land use and Ecology (10%), Water (6%), Health and Well-being (15%), Pollution (10%), Transport (8%), Materials (12.5%), Waste (7.5%) and Management (12%). Each category weighted, the BREEAM score is the total number of credits weighted by category. The total number of credits is used to give a rating to the building (Schweber, 2013). The rating ranges from ‘Pass’ (worst rating), ‘Good’ ‘Very Good’, ‘Excellent’ and ‘Outstanding’ (best rating). Although it was introduced as a voluntary tool, in 2000, the government adopted BREEAM as a ‘mandatory mechanism’ for all government projects (Schweber, 2013). Some have highlighted BREEAM as a design tool for sustainability (Schweber and Haroglu, 2014). This can be attributed to its positive impact on communication and team integration (Kajikawa, Inoue, and Goh, 2011).

4.4 Challenges for conventional Construction Management

A number of researchers have suggested that the cultures and practices of the building industry (Management styles) could threaten the realisation of the targets of the Climate change act and lead to performance gaps (Latham, 1994; Egan, 1998; Sorrell, 2003; Stern, 2006; Zero Carbon Hub, 2010; Bordass and Leaman, 2012; Zanni, Soetanto and Ruikar, 2016). They have identified problems with the industry, which have hindered the progress of carbon reduction and energy efficiency. Latham (1994) focused his attention on the fragmented nature of the construction industry and recommended that partnering was a key aspect that has been overlooked. He encouraged the industry to foster relationships, which will advantageous as opposed to seeing partners as adversaries. While Egan (1998) cited low investment in research and development in the industry, inadequate training and low customer satisfaction as areas of concern. He identified five areas where progress can be achieved; these are committed leadership, customer focus, integrated processes and teams, a quality driven agenda and commitment to people. Both researches acknowledged the need for better working relations between all parties in the industry. Agyekum-Mensah et al (2012) have argued that the use of project management principles and processes as an approach to reducing CO_2 emissions and enhancing sustainability in buildings has not been fully explored. They have stressed that existing management techniques must be adapted to meet the challenge of carbon reduction. The reviews commissioned by successive governments have all outline similar problems in the UK construction Industry over the last 30 years (Latham, 1994; Egan,1998). The most intriguing connection between the reviews is the continuous persistence of common problems within the industry. Despite countless recommendations from researchers, the industry continues to be plagued with issues like poor communication and missed energy targets.

4.4.1 Poor Communication

Poor communication has dogged the industry for as long as reviews have been carried out. Many researchers have drawn attention to the quality of communication with Senaratne and Ruwanpura (2016) and Nielsen and Erdogan (2007) stressing that the quality of communication determines the success of construction projects. Dainty, Moore and Murray (2006) and Lunenburg (2010) linked poor communication to lower performance and a high turnover of staff in the workplace. Emmitt and Grose (2007) showed that integrated working relationships and collaborations can be enhanced with effective communication. They explained the complexities during a construction project highlighting the intricacies that comes from having teams with from different backgrounds and interest successfully carry out a project. Ye et al (2014) concluded that project management processes and filed management should not be all that contractors improve but that they should also work to improve communication within projects. Elements of communication such as stakeholder identification, communication planning, information distribution, stakeholder management and performance reporting are all important in the construction process (Senaratne and Ruwanpura, 2016).

What all these researchers have in common is their opinion that communication is a major factor to the success of a project, the techniques to enhancing better communication of course vary, most of the solution offered have pointed to a change or shift of emphasis on the management styles. Ye et al (2014) are advocating for more management involvement with filed and project process management; Lunenburg (2010) advised that management should provide communication in three separate directions: downward, upward and horizontal or lateral with downward communication channel including direction of project goals, superior's advice or instructions; upward communication channels sending messages from subordinate to superior usually feedback, progress and performance reports. Information sent within members of the organizational level will be classed as horizontal. The present management styles have adopted a more dynamic communication system to overcome the present problems.

Increasingly complex buildings need performance analysis tools such as BREEAM and LEED to predict and measure different parts of sustainability from early design stages (Crawley et al, 2008, Zanni, Soetanto and Ruikar, 2016). For this reason, workload for sustainable buildings becomes increasingly heavier compared to traditional design projects. This workload also must be balanced with contributions from non-core design professionals, complex levels of information exchange and communication flow to ensure the success of a sustainable building. All this has led to communication and co-ordination of multidisciplinary teams being one of the most challenging barriers to delivering successful sustainable buildings (Robichaud & Anantatmula, 2010; Zanni, Soetanto and Ruikar, 2016). Although there is progress with the availability of online collaboration platforms (e.g. Viewpoint, Conject, Asite), there is still a need to incorporate better communication channels into the industry (Bouchlaghem et al, 2005).

4.4.2 Fragmentation of the Industry

Fragmentation of the industry is one of its most identifiable characteristics from government reviews highlighting the nature of the industry (Latham, 1994; Egan, 1998) to researchers (Poirier, Forgues & Staub-French, 2016). The recommendation from all the reports advocate for greater cooperation and collaboration between stakeholders of the industry. Though collaborative working has been recommended in all reviews of the industry (Latham, 1994; Egan, 1998), there is evidence that the industry has not fully embraced the concept. Dainty et al (2006) pointed to the temporary nature of the projects where teams, groups and networks are assembled for a particular job and therefore do not have permanent working relationships. This they noted was caused by the management styles and procurement practices. Many agree that this fragmentation is due to the complex and multi-disciplinary nature of the industry (Pryke, 2004; Poirier, Forgues & Staub-French, 2016). Others like Koskela (2000), have pointed to the fact that the industry is organized in an outdated 'guild structure' which evolved from the olden days of craft production. These guilds protect their individual bodies and associations and try to keep knowledge within their circle (Chiocchio et al, 2011).

Research extolling the benefits of increased collaboration between all the stakeholders of a project as an innovative approach to more energy efficient and sustainable buildings is not new. There is a common consensus among all researchers that collaboration is the key to overcoming the limitations of fragmentation (Koskela, 1992; Dainty et al, 2007; Middlebrooks, 2008; Kent & Becerik-Gerber, 2010; Poirier, Forgues & Staub-French, 2016). Although Chiocchio et al, (2011) have pointed out the lack of formative and consistent understanding of collaboration within the industry. Collaboration can be in many areas with Koskela (1992) stressing on the use of lean design and construction to promote collaboration for successful building projects (table 4.2). Others like Taylor and Bernstein (2009) and Merschbrock et al (2012) call for new innovative expertise (such as a Soft Landings Champion and BIM manager) and a shift in current practices. Xue et al (2010) view collaboration from the organizational culture and business strategy perspective. Arguing that trust, tension, conflict and incentives all affect collaboration during projects. In trying to find the difference between collaboration and cooperation in the design process, Kvan (2000) concluded that collaboration is deeper process which is long-lasting and persistent. Emmitt (2007, 2010) sees collaboration in terms of relationships and interactions between individuals and organisations. Looking at decision-making, communication and conflict.

In all these opinions, the sense that Soft Landings perfectly complements the nature of collaborative working that all the writers are taking about is clear. Discarding former adversarial interactions in construction is the common thread in all the literature. Forming new enduring bonds and working relationships is what is currently needed.

4.4.3 Client and end user satisfaction

Client satisfaction in the industry has been shown as an important part of a dynamic and evolving end user participation (Othman et al, 2004, Othman, 2015). While some researchers have identified that a satisfied client leads to loyalty and repeat business (Martensen et al. 2000; Auchterlounie & Hinks 2001), others have highlighted the advantages of satisfied end users as a means of enhancing sustainability (Abdellatif and Othman 2006). Despite the outlined advantages, research has shown that clients and end user participation in terms of their requirements and habits have not been fully embraced in the industry (Aguwa et al, 2012; Othman, 2015). Some have suggested that this is as a result of traditional procurement methods where design is separated from construction (Othman, 2015). This shows that conventional management styles are failing to meet customer satisfaction.

The quality and standard of finishing is a major part of the construction industry where clients express the most dissatisfaction (Delgado- Hernandez, & Aspinwall, 2005). According to the Construction Statistics Annual (Department of Trade and Industry 2003b) on a scale of 1-10, in which 10 meant totally satisfied, 5-6 meant neither satisfied nor dissatisfied and 1 meant totally dissatisfied, 22% of respondents gave a score of less than eight. This means that quality checks and standards must have a uniform or common level of acceptance within the construction industry and the language must be easy enough for the client or end user to understand. The traditional and current design methods of construction seem to treat the operational phase of the project as an after-thought (Sassi, 2006; Vakili-Ardebili & Boussabaine, 2007). Meaning that in a bid to save money, many decisions that will affect the running of the building are not properly investigated which usually leads to increased energy costs for the occupants.

4.4.4 Early Introduction of Professionals

The notion that buildings can be more sustainable with the early collaboration of professionals at the design stage is not a new idea. Many researchers have recommended the early introductions of professionals not normally associated with design (Reed and Gordon, 2000; Wheeler and Malekzad, 2015) Reed and Gordon, (2000) stated that

> *"There is considerable agreement among those in the field of sustainable design that cross-disciplinary teamwork early in the design process is essential to achieve the successful integration of building, community, natural and economic systems."*

Altomonte, Rutherford and Wilson (2015) pointed out that a successful sustainable design should be the meeting of many disciplines including the input of occupants to respond to their environmental, economic and socio-cultural requirements (the three aspects of sustainability).

The success of a project depends on the interaction between team members throughout the design stage which will include other professionals who do not traditionally contribute during the design stage; therefore, interpersonal skills such as communication and compromise will be very important during this stage (BHKR, 2003). Eguchi et al (2010) also recommended a readjustment of the design team stating that closer collaboration can be achieved by better understanding. Rekola, Mäkeläinen and Häkkinen, (2009) have tackled the issue of collaborative working. They emphasized the importance of early introduction of all the professionals involved in a project. Rekola, Mäkeläinen and Häkkinen (2012) identified that 'Sustainable building design requires comprehensive understanding and command of multilevel, interconnected, and sometimes contradictory requirements and it requires ability to collaboratively create new innovative solutions that fulfil these demanding requirements'.

4.4.5 End user participation in the design process

Researchers in design have highlighted the advantages of early end user participation in the early stages of design process (Jensen 2011; Park, 2012; Payne et al 2015; Kpamma et al, 2016; Goldsmith and Flanagan, 2017). Payne et al (2015) surmised that

> '*...involving end users in the (design) process from the beginning ensures their needs and preferences can help determine the important environmental features and attributes.'*

Although the context of the research was from hospitals and health centres, this can be true of all built spaces as people who are familiar with the use and function of the building can shed light on aspects that designers would not normally deem important. Involving the end user can help the design team in the initial project design brief and the continuous communication with them will help to identify where problems can arise in the building during occupation and the way energy will be used in the building (Jensen, 2011). Initial design briefing not only satisfies needs as requirements but it also evaluates how well a design proposal fulfils the need and aspiration of the client and users (Jensen, 2011). Some researchers see design briefing as a continuous process (Van der Voordt and Van Wegen 2005; Jensen, 2006), which starts from the preliminary stage of the project up till the handover of the site for construction. This is supported by Eynon's (2012) 'three humps' diagram (Figure 2.2) which shows that continuous end user participation will yield the best results during design and handover stages.

The design stage is seen as one of the most important stage in sustainable building construction (Mills and Glass, 2009; Rekola et al 2012; Shi et al, 2012). The success of a project is usually determined at the early work and design produced by the design team (Mills and Glass, 2009; Rekola et al, 2012). The inclusion of the stakeholders early in the process has been shown to be of great advantage to the project as a whole. Unfortunately, research has also shown that in the UK, the construction industry still experiences inadequate involvement of all the stakeholders especially the end users. Inadequate communications between the stakeholders and the inadequate management of changes in design requirements (Kamara et al, 2002). Altomonte et al (2015) emphasized the key role of end user participation saying

> *'Clearly, occupants play a key role in the functioning of the built organism, hence it follows that users should be directly engaged in a scrupulous feedback loop before, during, and after the design process'.*

Echoing Janda (2011), occupants of building consume energy and not the built environment therefore their input and understanding of the building is key to achieving a sustainable building. There is evidence that early end user engagement guarantees design quality and good building performance (Van Hoof et al, 2014).

Currently majority of design teams actively seek end user participation but collection of feedback seems to be a problem. Feedback forms are collected by are poorly structured therefore important information gets lost in the structure (Goldsmith and Flanagan, 2017). Other teams use software tools to correlate end user preferences. The success of these tools will increase as more teams make them routine.

4.4.6 The difference in estimated and actual energy usage of buildings (Performance Gap)

The issue of the discrepancy between estimated and actual building energy performance, usually called 'performance gap' has been discussed by many writers (Leaman and Bordass, 2007; Zero Carbon Hub, 2014; Galvin, 2014; Johnston et al, 2016). They all found that there was a significant difference between the predicted energy and thermal performance of the buildings and the actual performance of the buildings which turned out to be much higher than anticipated. From the studies, there were several reasons for this problem, which according to Johnston et al (2016) can be classified into three main areas

a. Issues with the thermal performance of the building fabric
b. Issues with the building performance services and
c. Issues with the occupancy

The problem extends to buildings designed and built with efficient technologies and systems. Studies into many of these buildings show that their energy performance is just as bad as conventional buildings (Min, Morgenstern & Marjanovic-Halburd, 2016; Leaman and Bordass, 2007).

The reasons for the gap vary; the energy efficiency in buildings guide F (CIBSE, 2012) suggests that the use of overly complicated and complex building systems play a large role while the Carbon Trust (2012) lists failure to deliver the design intent as one of the main reasons. Others like Bordass and Leaman (2015, 2005a, 2005b), and Harvey (2009) focus on the lack Post occupancy evaluations among building professionals as one of the main reasons. They argued that adequate attention had not been given to the evaluation of buildings systems once they are handed over, and this makes learning from past mistakes difficult. On the other hand, Finch and Zhang (2013) maintain that the responsibility rests on the behaviour of the facilities managers and the end users. They stress that it is not enough to use new technology and complex systems if the facilities managers and end users cannot adequately maintain and use the systems.

Several recent research studies related to housing thermal performance and energy efficiency have focused on the upgrading of insulation and new façade design to improve indoor thermal comfort and energy efficiency (Milne and Boardman, 2000, Hong et al., 2009; Ochoa and Capeluto, 2009) and to improve indoor health conditions (Gilbertson et al., 2006; Bullen et al., 2008). Others have developed an international database of low-energy homes and the low-energy techniques applied to them (Hamada et al., 2003). For energy-efficient house design, computer simulations are becoming available as design tools (Caldas, 2006; Smeds and Wall, 2008), and some studies combine computer simulations with field study data for energy-efficient house design or improved housing thermal performance (Simonson, 2005; Tommerup et al., 2007). The issue of retrofitting has also been researched as a means of carbon emission reduction. Forecasts according to Power (2008) and Ravezt (2008), say that 75- 85% of the current building stock will still be in use by 2050. They have argued that the key to carbon emission reduction is retrofitting the already existing housing stock. Although the scope of this project is very large and will largely depend on homeowner's participation, they see it, as the best chance to reduce carbon emissions. The success of wall cavity insulation which can save almost 30% of energy bills is more economically viable to floor insulations which is seen as disruptive and is mainly carried out when the floor needs repair (Dowson et al 2012).

At present, there is still a big difference between the estimated energy usage and actual energy usage in most buildings (Leaman, 2011). The differences become obvious when there is an effort to actively compare the occupied building with estimates made at the design stage. Many researchers have pointed out the issues of the difference between 'expectations and outcomes.' of especially commercial buildings (Leaman and Bordass, 2007; Bordass, 2001). This is where one of the main pillars of Soft Landings is utilized because it means the designers and constructors of the building stay after handover to help the occupiers and the facilities departments understand and use the building as it was intended.

The construction industry has realised that it is not enough to have technologically advantaged systems in buildings, when the same problem of inefficient buildings still remains. Irrespective of the different opinions, all researchers agree that If the industry is to contribute to carbon reduction targets, the issue of the performance gap in buildings must be addressed. The solution of course remains unclear and presents a talking point with researchers in the industry.

4.4.7 The issue of Post Occupancy Evaluations

Industry stakeholders are taking notice of post occupancy evaluations and there have been different methodologies suggested by researchers (Leaman and Bordass, 2001; Watson, 2003; Bordass and Leaman, 2005; Watson and Thomson, 2005; Stevenson and Rijal, 2010; wheeler and Malekzadeh, 2015). The interest of building performance assessment in the UK has been growing steadily popular in the last 20 years (Bordass et al 2002). Studies using Post Occupancy Evaluation (POE) usually reveal aspects of the building, which have been neglected, or systems, which need to be simplified in order for the occupants to enjoy the building. This gives a better understanding of the building and improvements can be made relatively quickly. The POE exposes the procurement method of the building, organization structure of the contractor and lessons learnt can be carried over to new projects. Bordass and Leaman (2005, 2012) noted that the sustainability of a building could be improved through the reduction of waste and pollution by Researchers have argued that little thought has been given to the operational phase in building projects when using the traditional design method of construction (Sassi, 2006; Vakili-Ardebili and Boussa-baine, 2007). A better understanding is needed by the designers and builders of the project.

According to Goçer at el (2015) ‘Designers almost never review the outcomes of their design decisions.’ The need to look back at a completed project to view the impact of certain design decisions is not ordinarily carried out by the design team because of several barriers which include the funding of the Post occupancy evaluations, the time involved and where

Table 4. 2: Detailed summary of existing literature on sustainability in the built environment

Author	Year	Country of data collection	Main Findings	Methodology
Koskela	1992	Worldwide	This paper looked at design management from 3 points of view; flow of information, a process converting input to output and process of generating value.	Process Review
Spence and Mulligan	1995	Worldwide Evaluation	This paper identified and quantified the causes and effects of construction activity on the environment.	Literature Review
Hill and Bowen	1997	Worldwide	They introduced a framework of 4 principles that allows construction activities to contribute to sustainability. Social,	Conceptual paper, literature review

Author	Year	Country of data collection	Main Findings	Methodology
			economic, biophysical and technical sustainability	
Rohracher	2001	Austria	This paper showed that sustainable construction is dependent on specific technologies. Conceptual frameworks to analyse system buildings can be a tool for sustainable construction.	Qualitative analysis using a theoretical framework
Van Hemel and Cramer	2002	Holland	Innovation opportunities are key to eco design. They also act 'as an impetus for product innovation'. 10 most commonly suggested eco-design solutions seem to be the most successful ones.	Semi-structured interview of 77 SMEs,
Sebastian	2005a, 2005b		These papers on collaborative design discovered that teamwork and collaboration are more important than individually developed	Case Studies

Author	Year	Country of data collection	Main Findings	Methodology
			design solutions.	
Horman et al	2006	US	This paper looks are lean and green initiative in its early stages. It concludes that high performance buildings benefit from model process approach.	Using Penn State educational programme.
Asif et al	2007	UK	Using Life cycle assessment of a residential building, they determined that concrete and mortar are responsible for 99% of CO_2 from construction.	Evaluating process using Life Cycle Assessment.
Du Plessis	2007	South Africa	This paper concentrated on the effects of human wellbeing and eco systemic wellbeing with respects to environmental issues. Recommending a framework for sustainable construction.	Review
Dixon et al	2008	UK	The paper highlighted the increased demand for sustainable offices. Outlining factors for companies changing location. BREEAM rating seemed to have little	Telephone survey of 150 private companies.

Author	Year	Country of data collection	Main Findings	Methodology
			effect on how businesses relocate.	
Hoffman and Henn	2008	USA	The paper highlighted the difficulty experienced with adopting a LEED certification. They identified social and psychological barriers.	Review of past and current literature.
Mills and Glass	2009	UK	This paper uncovers issues with design management, which can be barriers to sustainable construction. Issues with lack of clarity of the role, unwillingness for change in the industry and lack of consideration by stakeholders.	Semi-structured interviews with design managers. Questionnaire survey.
Reed et al	2010	USA	This paper provides a side by side comparison between LEED and BREEAM. Highlighting the both their strength and weakness.	
Kajikawa et al	2011	worldwide	This paper looks at 4 Building Environmental assessment (BEA) tools.	Literature review of all assessment

Author	Year	Country of data collection	Main Findings	Methodology
			Discussing the advantages and limitation of each tool. Highlighting the difficulty in comparison because of their qualifying criteria. Acknowledging the route to achieving sustainability is still unclear.	tools.
Rice	2011	Worldwide	This paper by tracing different origins of the term 'sustainability', concludes that the current framework of sustainability is too narrow and rigid. Highlights the over emphasis of CO_2 in current terms.	Actor-Network theory (ANT)
Rigby et al	2012	USA	This paper discovers that there is agreement between academic researchers and industry stakeholders about definitions of project delivery and innovation. Acknowledges that they are still barriers between	Interviews and surveys.

Author	Year	Country of data collection	Main Findings	Methodology
			both parties	
Rekola et al	2012	Finland	This paper discovers sustainable buildings do not necessarily create more tasks but new elements are added to already established works.	Case study, interviews and focus group discussion.
Shi et al	2012	China	This paper proposed a framework for implementing sustainable construction at programme management level.	Case study,
Ding and Forsythe	2013	Australia	The life cycle study of 41 detached dwellings showed that sloping sites play an important role in energy consumption.	Case study
Lombardi and Trossero	2013	Worldwide	The paper proved that current approaches to energy consumption cannot lead to significant energy reduction in buildings.	
Ogunbiyi et al	2013	UK	The paper examines the impact of lean	Literature review of lean

Author	Year	Country of data collection	Main Findings	Methodology
			construction on sustainable developments. It concludes that lean construction can improve all aspects of sustainable buildings.	construction and sustainable development.
Schweber	2013	UK	This paper uses Foucault's theory of governmentality, the paper explores the effect of BREEAM on clients and professionals and concludes that although it provides a framework for measuring sustainability, it also contains bureaucratic complexities.	Foucault's theory
Elmaulim and Gilder	2014	UK	The paper surmised that the design manager and clients are responsible for innovation in the industry.	Questionnaire survey
Schweber and Haroglu	2014	UK	The paper discovered that communication and coordination, formal contracting methods, and prior experience with BREEAM are essential for successful sustainable	Case study

Author	Year	Country of data collection	Main Findings	Methodology
			project.	
Taheriattar and Farzanehrafat	2014	Iran	In a survey of 15 construction managers, this paper outlines the factors that affect sustainable construction. Factors like project control and management, and workforce and materials.	Statistical Comparative Analysis
Lützkendorf et al	2015	Norway	The case study concluded that energy efficient building envelope and on-site PVC systems was unable to meet the objective of CO_2 emissions.	Case study of a residential building
Fuerst and Van de Wetering	2015	UK	In a research of 19,509 commercial buildings, the paper discovered that there is a premium for BREEAM certified buildings. Their rents were higher than conventional buildings.	Data study of the rent pricing of commercial buildings.
Murtagh, Roberts and	2016	UK	The paper Interviewed 28 architectural designers	Semi structured

Author	Year	Country of data collection	Main Findings	Methodology
Hind			from 14 small firms. It concluded that reliance on extrinsic motivations such as regulation risk missing sustainability targets because the autonomous motivations of the designers were closely aligned to sustainability principles.	Interview
Ahmad et al	2016	Semi-arid climatic conditions	This paper concludes that identifying systems and techniques in a sustainable residential house are critical. Empirical knowledge and awareness are important in sustainable design decision making.	Case study of a sustainable residential house, Analytical Hierarchy Process (AHP).
Enshassi	2016	Gaza Strip, Palestine	This paper that skill shortage was the most significant challenge to community participation. Others include financial challenges and lack of interest.	Structured questionnaire survey
Zanni, Soetanto and	2016	UK	The research provided a systematic for BIM-	Semi structured

Author	Year	Country of data collection	Main Findings	Methodology
Ruikar, 2016			enabled Sustainable Building Developments (SBD) for the early design stages. Providing a framework for the multidisciplinary use of BIM.	interview of 25 professionals using BIM.

responsibility falls if serious problems are uncovered after the defects liability period. (Zimmerman and Martin, 2001). Underestimating Post Occupancy Evaluations as a mechanism for connecting feedback on new projects with the pre-design decision making process can prove to have negative consequences for the project. This common problem in the construction industry is caused by the separation of design from construction, client and end-user (Gann, Salter and Whyte, 2003).

4.5 An overview of Soft Landings

As the demand for more ‘sustainable’ or ‘green’ buildings rise, it is now widely accepted that the buildings will demand increased level of design integration between the structural envelope, M and E and architectural systems (Kratzenbach and Smith, 2003; Lewis, 2004; Magent et al, 2009). This increased collaboration has been seen by many building research analysts to be attainable using Soft Landings (Way and Bordass, 2005; Bordass and Leaman, 2013). Few researchers have written on the use of Soft Landing (Bordass, 2003; Way and Bordass, 2005; Clark, 2012 Bordass and Leaman, 2013; Gupta and Gregg, 2016). They have noticed that professionals involved with the procurement, design and the construction of buildings ‘seldom engage closely with the performance of the building they have created’. They have written on the advantages of Soft Landings as an excellent post evaluation process.

Bordass and Leaman (2005a, 2005b) have written on the link between the design and energy performance of buildings. They established that complex and complicated designs usually makes it difficult for building managers to cope with the buildings. This affects the energy performance of the building. They pointed out that both designers and clients tend to underestimate how building management systems can conflict with each other. This, they argued reduces the energy performance level to the 'lowest common denominator'. Also, lack of attention to detail of occupant's requirement usually creates uncertainty and inefficiency in their operating systems. They argued that designers and builders have traditionally shown little interest in how their buildings actually performed in use. This is made more difficult because of the reluctance of clients to pay for such services. They proposed that Soft Landings should be incorporated into the procurement process so that funds can be allocated to the service of a dedicated Soft Landings team. They will work in partnership with other members on the project team.

In their paper on post occupancy evaluations, Bordass and Leaman (2005) noticed that the post hand-over period was the most neglected part of the whole project process. They have argued that this stage should be as important as any other stage in the process as client and occupant feed-back can be immediately taken into account and solutions can be quickly offered. This is the fastest and surest way to improve the economic and environmental and energy performance of buildings.

Butera (2013) argued that architects are not usually familiar with building physics and that this usually has a negative impact on the building's energy performance and leads to low thermal comfort. He illustrated this by saying that an architect's idea of a low-energy building is to design 'as usual', and specify for higher insulation thickness and higher performance glasses as opposed to changing the design and achieving the same energy performance with lower costs. He concludes that integrated design is necessary but it was not sufficient that an 'energy expert' should be introduced during the design stage to be able to identify where energy savings can be made. This reinforces the point that a Soft Landings champion introduced in a building project will help to keep its energy efficiency targets on track.

Soft Landings aims to close the gap between estimated energy targets and end user expectations with actual energy performance of the building (Way and Bordass, 2005; Clark, 2012; SLF, 2014; Fedoruk et al, 2015). It emphasises on greater participation of the building designers and contractors during and after construction. The need for all stakeholders to achieve their objectives through cooperative working with shared risk and responsibilities. Soft Landings usually requires a high level of multi layered information exchange (SLCP, 2014) and reality-check(s) at key stages to ensure the success of the project (See Table 4.3).

Table 4. 3: Soft Landings framework compared with other frameworks

RIBA 2013 Stages	**CIC Stages 2012**	**BSRIA Soft Landings Work stages**		**BSRIA BG 6/2014 Design Framework pro-formats**
0-Strategic Definition	0-Strategic Definition	Soft Landings Core Activities	Soft Landings Supporting Activities	0-Strategic Activities
1- Preparation and brief	1- Preparation and brief	Stage 1. Briefing: Identify all actions needed to support the procurement	Define roles and responsibilities	1- Preparation
			Explain Soft Landings to all participants,	

RIBA 2013 Stages	CIC Stages 2012	BSRIA Soft Landings Work stages		BSRIA BG 6/2014 Design Framework pro-formats
			identify processes and sign off gateways	
2- Concept Design	2- Concept Design	Stage 2: Design development: To support the design as it evolves	Review past experience. Agree performance metrics. Agree design targets	2- Concept
3- Developed Design	3- Developed Design	Scheme Design Reality-check	Review design targets. Review usability and manageability.	3a & 3b Developed design
4- Technical Design	4- Technical Design	Technical design Reality-check(s)	Review against design targets. Involve the future building managers.	4a, 4b & 4c Technical design
		Optional tender stage Reality-check	Include additional requirements related to Soft Landings	

RIBA 2013 Stages	CIC Stages 2012	BSRIA Soft Landings Work stages		BSRIA BG 6/2014 Design Framework pro-formats
			procedures	
Information exchanges will vary depending on the procurement route and building contract. Designers can create a bespoke plan of work for the client's chosen procurement route in order to set out specific tendering and procurement activities for each stage.		Tender award stage Reality-check	Include evaluation of tender responses to Soft Landings requirements	
5- Construction	5- Fabrication Design		Confirms roles and responsibilities of all parties in relation to Soft Landings requirements	5- Construction
6- Handover and close	6- As constructed	Pre-handover reality-check Stage 3: Pre-handover Prepare building readiness. Provide	Include FM staff and/or contractors in reviews. Demonstrate control interfaces. Liaise with	6- Handover

RIBA 2013 Stages	CIC Stages 2012	BSRIA Soft Landings Work stages		BSRIA BG 6/2014 Design Framework pro-formats
		technical guidance	move-in plans	
		Post-handover sign-off review. Ensure all outstanding reality-checked items are complete and system is signed off and operational		
7- In Use	7- In Use	Stage 4: Aftercare in the initial period: support in the first few weeks of occupation	Incorporate Soft Landings requirement	7- In Use
		Stage 5	Set up home for resident on-site attendance	

RIBA 2013 Stages	**CIC Stages 2012**	**BSRIA Soft Landings Work stages**		**BSRIA BG 6/2014 Design Framework pro-formats**
		Years 1 to 3 Aftercare: Monitoring review, fine-tuning and feedback	Operate review processes. Organise independent post-occupancy evaluations	

Soft Landings recognises that until recently, many Architects and Designers rarely took sufficient account of how end users were going to operate the different controls in the buildings. With current buildings becoming increasingly dependent on advanced technological systems, pre-handover and commissioning must include the Facilities Managers and where possible, the end users (Way and Bordass, 2005).

Soft Landings encourages closer links and information flow between the design, construction, operation, research and development (SLF, 2014; Bordass et al, 2004, Way and Bordass, 2005). This is especially important in construction where due to procurement methods, design and construction stages are usually separated and the number of professionals involved in a project continue to vary (Rekola, Mäkeläinen and Häkkinen, 2012, Fedoruk et al, 2015). Soft Landing provides a route for Post-occupancy evaluations and feedback by stipulating them in the contract (SLF, 2014). Information shared through feedback is vital because the experience gleaned can be shared between all parties and used in new or even existing projects (Way and Bordass, 2005; Bordass and Leaman, 2007; SLF, 2014). This means that lessons learnt from past evaluation studies can be 'embedded' in design decision-making processes (SLF, 2014; Leaman et al., 2010). Soft Landings emphasises on

- Achieving the needs of the end users
- Environmental performance of the building and the efficiency of all operating systems (sustainability of the building)
- Post occupancy evaluations of buildings
- Feeding back information for current and future projects.

Soft Landings often requires the participation of a Soft Landings Champion (SL-CHAM); In some cases, one on the client's side and a second one on contractor's side (SLF, 2014). The champion is involved from the inception to aftercare stage. They provide support to set realistic energy efficiency and sustainable targets and manage the targets to completion. The targets and performance expectations will be regularly reviewed during design and construction stages to ensure that they can be achieved (See Table 4.3). During the design stage, they ensure that all members of the project are kept informed of new developments and changes to any elements of the design. During the construction stage, they are available to provide smooth transition to site.

They also help to prepare the building for handover by liaising with building facilities team and sub-contractors to provide training and operational guides. Building handover and aftercare plays a vital role in achieving energy efficient buildings (SLF, 2014). Soft Landing calls for designers and constructors to be involved in the aftercare of buildings and if necessary extended aftercare which can last up to 3 years into the occupation of the building.

During extended aftercare, the SL-CHAM will also be available to collect valuable information for use in the future.

Soft Landings can be employed to work alongside most of the standard procurement routes (Bunn, 2013; SLF, 2014, Gupta and Gregg, 2016). Soft Landings processes can be adopted in these 5 main stages

- *Inception and briefing*

The aim is to identify key members of the project and clarify their duties. This will be very important as the SL-CHAM will be introduced with all the areas of responsibility. The project goals will also be set out along with processes to manage expectations.

- *Design development and review*

The procedures established during inception and briefing will start to be implemented at this stage. The likely performance of the building will be reviewed during the design to ensure the goals can be achieved.

- *Pre-handover*

All the key members of the project team will be on hand for greater involvement at this stage to guarantee that all systems are performing as predicted.

- *Initial aftercare*

A member of the project team will be available on site to assist the facilities team and end users with the settling in period.

- *Aftercare in years 1 to 3 after handover*

This will include periodic monitoring and post occupancy reviews of the building.

Table 4.3 provides a side by side comparison of the design work stages of Soft Landings with the RIBA plan of work. In design stages 2, 3 and 4 where RIBA calls for concept, developed and technical design, the BSRIA Soft Landings work calls for design reality checks in stage 3 and technical reality checks in stage 4. At every stage of the design, reality-check is encouraged to make sure that the sustainability objectives and energy efficiency targets of the project are on track from the design stage. These are not routine in conventional design or they are adhered to in principle but not in detail.

4.6 Differences between a Project Manager and a Soft Landings Champion (SL- CHAM).

There are a great many similarities between a Project Manager and Soft Landings Champion because they both have to encourage partnering and coordination of the project falls to them (Fewings, 2005; SLF, 2011). They are both involved in the construction industry and they both have the task of co-ordinating people and important elements in order to have a successful completed project. The successful completion of any project is the top priority for all project leaders, (Smyth and Pryke, 2008) but there are also other factors that will signify the success of a project. Although researchers have maintained that project success is an abstract and subjective concept (Parfitt and Sanvido, 1993; Chan et al., 2002), there are certain critical factors that are standard in all projects. These are usually identified in the brief at the inception stage (Fewings, 2005). These critical success factors (CSFs) are as diverse as the projects differ; Chan et al (2004) identified that one of the main difficulties in managing a construction project is the failure of determining relevant CSF_s across all project stages.

The success criteria and success factors of a project are two different aspects of a project (De Wit, 1998; Cooke-Davis 2002). Both have identified that success criteria will be the measures by which the success or failure of a project will be judged; they are benchmarks that have universal appeal and will not change with time. The most common ones are time, cost and quality. While success factors refer to the components that were involved in the management process that can lead to the success or failure of a project. These are usually not constant and depend on factors like sound economic policy (EIB 2000), risk allocation and risk sharing (Qiao et al, 2001) and public expectation. For a Soft Landings Champion, one of the main success factors will be to be able to reconcile the targets of estimated energy use in buildings with the actual energy usage of the building. (Way and Bordass, 2005; SLF, 2014). This a major issue in almost all commercial buildings in the UK and Europe as a whole (Bordass and Leaman, 2005; Carbon trust, 2012; Bordass and Leaman 2015).

4.6.1 Definition of Project Management in the context of Construction Industry

In order to understand Project management in construction, the definition of ‘Project’ has to be given in the context of the construction industry. There have been several definitions and the most widely accepted ones include.

A project in this case is defined in BS 6079: (2000) Guide to Project Management as:
‘A unique set of co-ordinated activities with definite starting and finishing points, undertaken by an individual or organisation to meet specific objectives within defined schedules, cost and performance parameters.’

This definition of course covers a lot of different types of activities, in order for this to be narrowed down to a project peculiar to construction; project management has to be identified.

According to CIOB (2002), Project management is defined as

‘The overall planning, co-ordination and control of a project from inception to completion, aimed at meeting a client’s requirements in order to produce a functionally and financially viable project that will be completed on time, within authorised cost and to the required quality standards.’

The Association of Project Management (APM) have broken down this definition into areas which need the most input. It recognises the need to distinguish between commercial competencies which deals with procurement methods, supply chain options; people competencies, which deals with people and skills management, organisational competencies and strategic competencies which deals with the planning process of risk, value, quality and health and safety and control competencies which deal with time, change and information.

The American Project management Institute (PMI) have broken down the important elements into five groups. These are initiating, planning, executive, controlling and closing processes. These processes are linked to the life cycle of the project because it follows a systematic arrangement. From all the various definitions, it can be concluded that project management processes are integration management, scope management, time management, cost management, quality management, human resource management, communications management, risk management and procurement management.

4.6.2 Project Manager’s role in Construction

The Guide to the Project Management Body of Knowledge (PMBOK Guide) (Project management Institute, 2008), A Project Manager is the person responsible for the accomplishing project objectives. The manager ‘manages’ the project from inception to completion; this includes planning, execution, monitoring, control and completion of a project. Decisions at every stage of construction will be thoroughly scrutinised and in many cases the Project Manager will take the final decisions. This means that the role of a Project Manager cannot be overstated. The result of the role not being properly executed, will lead to failure of the stated objectives. (Meredith and Mantel, 2006). The management of timetables and deadlines, the budget, supply chain, sub-contractors all have to be controlled with the help of other members of the project team (Ahsan et al, 2013). A Project Manager is also involved in negotiations and managing social relations (Fewings, 2005; Georg and Tryggestad, 2009).

In many cases, the responsibility of a Project Manager depends on the form of procurement method of the project. The different methods of procurement have its own unique responsibilities for a Project Manager. The client's choice of procurement (which usually includes and is not limited to funding, partner selection method, responsibility of design and responsibility of management) implies different roles and responsibilities for all the professionals involved in the project team as well as collaboration of these professionals at different times of the project (Love et al, 1998, Eriksson and Westerberg, 2011).

In a Project Manager-led procured project, the Project Manager plays an involved and comprehensive role. This is because the responsibility of virtually every aspect of the project is controlled by the Project Manager except for specialised works in which they still have decision-making roles. The Project Manager's primary role is managing boundaries and interfaces between the various teams of the project (Emmitt 2010).

4.6.3 Soft Landings Champion's (SL-CHAM) role in Construction

The fact that Georg and Tryggestad (2009) refer to Project Managers as the 'guardians of efficiency' highlights the almost identical challenges facing both the Project Managers and Soft Landings Champions. This implies that both professionals are faced with complications that they have to solve in order to achieve the specified energy efficiencies of a project. A lot of time has been spent in developing methodologies and approaches that will enhance efficiencies in construction projects by either providing better and quicker information exchange or estimations in relation to time, cost and quality (Bowen and Edwards, 1998, Cicmil and Hodgson, 2006, Fortune, 2006). Therefore, information exchange is a key part of the successful completion of a project. One of the fundamental roles of Soft Landings Champion is the dissemination of information in a quick and efficient manner (SLF, 2014). This allows issues to be dealt with as quickly as possible.

The Soft Landings Framework (2014) advocate for a Soft Landings Champion who will ensure that the process is designed to suit the project and follow through on the core principles. The Soft Landings Champion is in the position to create opportunities for greater interaction and understanding between all project stakeholders (SLF, 2014). The Soft Landings core principles' emphasis placed on the exchange of information has led to the conclusion that one of the most important roles of a Soft Landings Champion is the management of relationships between all the different parties and interests involved in a project. The same can be implied to the Project Manager. Georg and Tryggestad (2009) explained that a project manager has to

> *'…Manage the project team culture by cultivating the values and beliefs and motivating project members to actively engage in realizing the project goals'.*

In fact, the Soft Landings Framework (2014) advises that the role of Soft Landings Champion could be carried out by the Project Manager, client representative or job architect (p17).

Here the similarities can be seen as both the Project Manager and Soft Landings Champion use information as a tool for the progression of the construction project. They are both involved in transmitting information on building drawings, contracts, and budgets to and from the client, architect, contractor as well as key members of the building team. (SLF, 2014; SLF CP, 2014; Georg and Tryggestad 2009). It is a known fact that traditionally the relationship between stakeholders and professionals in the construction industry is competitive and adversarial in nature (Latham, 1994, Cheung et al., 2003; Chiocchio et al, 2011). This may be the result of the traditional procurement procedures, which seeks to pass the risk to other parties in the project team.

A Soft Landings Champion can be any professional closely involved with the project this can be a project architect, lead design engineer or even a project manager. Their main objective will be to ensure that Soft Landings process is properly applied to the project and not just glossed over. They will act as the binding factor for the project especially during the crucial stages such as the procurement and handover stages. The Soft Landings Champion will have the responsibility of making sure all professionals understand their roles on a particular project and to observe and make certain that the crucial details such as the in-use energy performance of the building will be achieved. It is advised by BSRIA for the provision of 2 Soft Landings Champions for a project. one on the client side and the other on the contractor's side. This will help in coordinating all stakeholders. It is also stressed that the role and responsibilities should be shared between project team members (Bunn, 2013) and not handled by one team member. This is to encourage collaborative working and shared risks and responsibilities. Whoever has the role is assigned duties in line with the soft Landings Framework.

4.6.4 Differences in roles according to Conventional Project stages

The differences between the project manager and a Soft Landings Champion will be evaluated through the key stages of implementation of a construction project and will be assessed in the context of various procurement methods. The key stages of implementation.

i. Inception: - At this stage, a client who is faced with a requirement for a new building/buildings due to various reasons will start by hiring a client advisor who will be responsible for outlining the objectives of the project and carry out studies into the success factors of the project. If this will be a Project manager-led project, involvement will start from this stage where the client will have a contract with the project manager. The main responsibilities according to Fewings (2005) at this point will be to

- Guide and advise the client
- Manage the resources to carry out the project
- Build the project team
- Informing the client at every stage of inception

The duties for a soft Landings Champion are specific in trying to outline the project. The Soft Landings Framework (2014) calls for the following responsibilities:

- Define roles and responsibilities: the roles and responsibility of all project team members have to be clearly outlined form the beginning. This is useful because it can highlight gaps in roles or identify overlapping roles. If available, the client's facilities management team will be introduced to the project.
- Review past experiences: meetings and discussions with team members will highlight past experiences (good or bad) which can be useful during design and construction stages. This will help the team in setting realistic targets.
- Plan for intermediate evaluations and reality checks: meetings and workshops will enable the team develop strategies for evaluating design and progress of the project.
- Set environmental and other performance targets: the team will have the opportunity set specific targets for the project. This can also highlight the need for new expertise or sub-contractors.
- Sign gate-ways: these are entry and exit points for the project, where an issue can be signed off so that others can be introduced.
- Incentive related to performance outcomes: the champion has to set up a process by which the targets can be measured in use and how to resolve any target not met.

These duties cover the tasks for the inception, briefing feasibility and strategy stages in a traditional project.

ii. Feasibility: - This stage deals with testing the viability of the project; the risks are also identified and assessed; outlining design and a cost plan will be included at this stage in order to get an early representation of the project. Funding and payment options at this stage are also discussed (Fewings, 2005). All of these activities mostly involve the Project Manager; a Soft Landings Champion will not be involved in most of these activities. The professionals that deal with this stage are usually Architects, Quantity Surveyor and Project Manager. The activities at this stage comprise of extensive research into the type of project, the procurement method, supply chain options and funding alternatives.

After the feasibility stage, the appointment of a professional design team is the next major step. As it has been established, (See Section 2) the earlier designers are involved in the project, the greater the likelihood of the project achieving energy efficiency targets and experiencing better cooperation between the project team (Tribelsky and Saks, 2011; Hansen and Olsson, 2011; Elmaulim and Gilder, 2014). The role of both the Project Manager and the Soft Landings Champion will be assigned within the team. Communicating ideas and timelines to other members of the team.

iii. Strategy: - Decisions on the procurement method, cost control, risk management and quality management are all made at this stage. The management structure will be revealed and professionals would be trying to settle the hierarchy of the team that would best suit the project. (Fewings 2005).
The responsibility of the Project Manager at this stage is very crucial because most of the decisions made will be from recommendations to the client from the Project Manager.

As a Soft Landings Champion, involvement at this stage is typically at an advisory role. They can include guidance on setting realist energy efficiency and performance targets and reviewing procedures for reality checks (SLF, 2014). These reality checks ensure that new and critical issues arising will can be resolved early.

iv. Scheme design: - The scheme design deals with the planning application, cost plan and cost checks. Building regulations approval and health and safety co-ordination are also going to be established at this stage of preparations. If this is a Project Manager-led style, the Project Manager will be the chief coordinator at this stage in all the activities; overseeing other team member. They include the design team with an architect as the head of the team, quantity surveyor and planning supervisor. This will of course depend on the size of the project and resources available.

For the Soft Landings project the following are required (SLF, 2014)

- Review past experience: experience from past projects will help the design team think realistically in terms of building use, operation and management. The Soft Landings Champion will be responsible for prompting these reviews.

- Design reviews: meetings to review the design with other professionals and experts will be advocated by the Soft Landings Champion. Meetings with end users and facilities teams will also be encouraged. This can be carried out independently.
- Tender documentation and evaluation: The Soft Landings procedure and process have to be incorporated into the traditional contract documentation. The champion should ensure that all parties are made aware of Soft Landings and agree to sign up to its principles.

v. Construction: - This is where all the previous stages have been working to achieve. The appointment of the contractors; where a new Project Manager can take the place of the client's Project Manager, sub-contractors and suppliers have been hired and health and safety plans are all in place.

The Project Manager is there to coordinate all the processes. At this time, a Construction Manager may be added to the team depending on how large and complex the project is. A Soft Landings Champion is also visible at this stage where expertise and information dissemination is most important. The rate of information flow is absolutely important and the Soft Landings Champion is in the position to be able to effectively bring cohesion to the different teams.

vi. Commissioning and testing: - This stage sees the partial or full completion of the project. The role of the Project Manager will be to tie up the loose ends at the point. This will include testing of all the equipment and the systems in the building to ensure they are in good working order and meet the client's brief. A system's engineer and construction manager are the professionals that are usually involved at this stage (Fewings, 2005).

vii. Post project review: - There will be a review so that information can be fed back into future projects with lessons both for the client and the project manager.

viii. Occupation: - The client/user takes possession of the property. At stage the role of the Project Manager is typing up loose ends and completion of pending jobs.

This stage highlights the greatest difference in roles between the two. While the Project Manager is winding down in duties, the Soft Landings Champion prepares for the building to ready, not just physically but also ready for operation.

4.6.5 Five stages of a Soft Landings Project

The five stages of Soft Landings process as set out by the BSRIA Framework (2014) are explained below.

i. Stage 1: Inception and briefing: - This stage involves intense information exchange between the client, designers and contractors to discuss performance requirements, stakeholder's expectations and project goals. Incorporating soft landing activities in the client's requirement and tender documentation, allocating the budget for initial aftercare and post occupancy evaluation. The early introduction of other members of the project team also has an advantage of better design and construction.

ii. Stage 2: Design development and review: - This key stage brings together all the project team to review past and similar projects in order to learn from past experiences. The end user is at the center of the decisions at this stage and a lot of research goes into the expectations of the end user. The role of the Soft Landings manager at this stage will be to make sure that energy strategy, the metering and mentoring strategy and the approach to commissioning are all in the discussions and meetings included in relevant tenders. The usability and maintainability of all proposed systems will review to ensure that the best possible systems are available for use.

iii. Stage 3 Pre- handover: - This stage of partial handover allows the facilities team to familiarize themselves to the building systems and interface before full handover. Revisit the outputs from earlier reality-checking decisions and ensure the suggested actions are in place. Ensure the BMS is set up the way the client intended – energy data reconciliation and data storage, and the energy monitoring software. Also ensure the metering is working properly and will deliver real insights into energy use. The Soft Landings Framework (2014) checklist for this stage recommends the following duties which are overseen by the Soft Landings Champion.

- Environmental and energy logging review: recording data from the new systems are essential to ensure that they are working properly. The responsibilities for recording have to be agreed before the process starts.
- Building readiness program: activities such as setting up of energy meters, staff training activities have to be set up in the completion and commissioning schedule.
- Commissioning record checks: checks such as how much energy is consumed by fan motors. These are important in establishing accurate readings.
- Maintenance contract: the contract should be in place to start immediately after handover.
- Training: the building's facilities team have to be trained to take over operation and maintenance of the systems.
- Building management system interface completion and demonstration: sub-contractors must be on hand to demonstrate building management systems (BMS). The facilities staff will have an opportunity to familiarise themselves with the systems.
- Migration planning: this plan ensures that the end-users moving in are not disrupted by site activities. The design and building team need to coordinate with the occupier's program.
- Aftercare team home: the aftercare team along with the Soft Landings Champion will be visible to occupiers. An office or space should be provided where they can be in contact with the end users.
- O&M manual review: The Soft Landings Champion should ensure that the facilities team is present for a review on all building systems.

iv. Stage 4 Initial aftercare: - At this stage, the project team will be on hand for between 6 to 8 weeks to be able to deal with problems and issues with the building. This will involve the team going around, talking to the occupants and experiencing the building for themselves. This will help them determine whether the building is meeting expectations and requirements. They will be able to deal with problems quickly as they are discovered in and around the building. The Soft Landings team will report back and all the information will be retained for future projects and referencing. The checklist duties at the stage include:

Introductory guidance for building users: the task of organizing an informal meeting with occupiers will be overseen by the Soft Landings Champion. This will be a continuous effort to get the building working as anticipated.
Walkabouts: the design and building team will be encouraged to carry out a walkabout to observe the interaction between occupiers and the designed spaces. This will give them an opportunity to spot potential problems.

v. Stage 5 Years 1-3 extended aftercare and POE: - Here, the longer term and less intensive monitoring is provided by the Soft Landings team, with meetings starting monthly them becoming less frequent (depending on the results of the post occupancy evaluation). This ensures that the energy monitoring is set up well and working accordingly as planned. The team conducts systematic post-occupancy evaluation no sooner than 12 months' post-handover, repeated at 12 month intervals and culminating in a final project review at month 36. The framework (2014) suggests the following for this stage:

- Year 1 aftercare review meetings: these are meetings to check that the building is achieving its energy efficiency targets.
- Year 2 logging environmental and energy performance: the facilities team should provide information from the building systems to allow the Soft Landings team compare with early measurements.
- Year 3 systems and energy review: this will be similar to previous years to make sure that the buildings systems are performing as they should.

While the roles of the Project Manager and the Soft Landings Champion are similar at the beginning of the project, it is obvious from the duties that the Soft Landings Champion's involvement with the building extends well into 3 years after occupation.

The information flow at the final stages have to be sufficient to mobilise not just the construction team but also the client, facilities team and occupiers of the building.

4.8 Summary

The early part of the chapter traced the origin of policies affecting CO_2 reduction in the EU and UK, with arguments for and against the policies. Sustainability in the built environment and the evolution of design management. The chapter discovered that:

- The diverse opinions of various researchers on each topic shows the complexity of sustainable buildings.
- Factors contributing to lack of sustainable buildings include poor communication, fragmentation in the industry and the performance gap.
- The difference between a Project Manager and a Soft Landings Champion is most noticeable during handover and aftercare stages.

Having discovered the current arguments, the next chapter discusses the process of data analysis.

Chapter 5

Data Collection Protocol

5.1 Introduction

Collection of data for this research was carried out in stages. The first stage was a preliminary literature review to discover broad issues affecting Soft Landings and sustainable design (chapter two and four). Literature review helped to identify the nature of data/information and process of collection (chapter four). A pilot study was then carried out to find the most suitable methodology for the research. This chapter will cover preparatory and exploratory studies (section 5.2) and limitations of data collection (section 5.8).

5.2 Preparatory and exploratory studies

Preliminary studies were carried out early in the research to get acquainted with the topic. The opportunities and barriers to sustainable design was the overarching theme of the studies. After uncovering these issues, a detailed literature review identified all the areas for research. The methodology for the research was the next step; to find out the best suited methodology, a pilot study was carried out (Section 5.2.1). The result of the study exposed weakness on the first proposed methodology which allowed the researcher to refine the method. Other exploratory studies included meetings with the BSRIA team on Soft Landings and discussing the challenges facing Soft Landings in its current form. Other relevant data collection activities include attending various industry events on Soft Landings and sustainability in construction (see Table 5.1).

Table 5. 1: Preparatory Studies with dates

Date	Source	Method	Building type	Impact on research design
February 2014 (First year)	Soft landings workshop for professionals	Presentation by a Soft Landings champion	All building types	Discovered varied views on sustainability amongst professionals. Resulted in a pilot study about important elements in sustainability.
May 2014 (First year)	Soft Landings Development Manager and various professionals	Pilot study using questionnaire	Non-residential buildings	Practiced using Linkert scale to analysis answers with AHP. Following responses from a group of professionals, discovered that AHP will not be suitable for the research. Interview questions were deemed more

Date	Source	Method	Building type	Impact on research design
				appropriate.
November,2014 (Second year)	Service Engineer from BSRIA Soft Landings	Email correspondence	All building types	Collected information on the present state of soft landings in the UK. Identified potential case studies.
November 2014 (Second year)	Head of Government Soft Landings	Email correspondence		Identified Ministry of Justice as a potential case study after discussions on the general process of Soft Landings.
January 2015 (Second year)	Associate Director AECOM	Informal interview	Non-residential building	Developed a better understanding of the client's role in a soft landings project. Redefined research questions as a result of this

Date	Source	Method	Building type	Impact on research design
				discussion.
February 2015 (Second year)	Service engineer from BSRIA soft landings	Email correspondence	All building types	Discussed the impact of soft landings on sustainable buildings. Identified a primary school as a potential case study
May 2015 (Second year)	Design Manager	Formal interview	Non-residential buildings	Refined the questions for the interview. Practiced interview technique.
May 2015 (Second year)	Facilities Manager	Formal interview	Non-residential buildings	Discovered the role of building managers in soft landings. Refined questions
May 2015 (Second year)	Sustainability Manager	Formal interview	Non-residential buildings	Identified new concepts of sustainability.
May 2015	Client	Formal	Non-residential	Discovered the practical role of a

Date	Source	Method	Building type	Impact on research design
(Second year)	Representative	interview	buildings	client during a soft landings project.
June 2015 (Second year)	Soft Landings consultant	Formal interview	All building types	Discussed the process of Soft Landings during the design stage. Refined questions about the future of Soft Landings.
July 2015 (Second year)	Sustainability manager Skanska	Informal interview	All building types	Discussed the responsibilities of main contractors in a soft landings project. developed a better understanding about soft landings from the point of view of all stakeholders.
October 2015 (Third year)	Soft Landings webinar	Web Conference	All building types	Discovered the similarities and differences between government and BSRIA soft

Date	Source	Method	Building type	Impact on research design
				landings.
November 2015 (Third year)	Soft Landings overview conference	Conference	All building types	Discussed the impact of soft landings with different professionals and their understanding of the process. Discovered the level of acceptance amongst construction companies.

5.2.1 Pilot Study

One of the goals of this research was to rely as much as possible on the respondent's view on the process of Soft Landings at the design stage with respect to the sustainability of the buildings. For this reason, a pilot study was undertaken to help uncover potential problems that may arise in the course of the research. The importance of a pilot study to a researcher has been highlighted by several writers with De Vaus (1993) dramatically saying 'Do not take the risk, Pilot test First', what he was implying was the importance of testing a 'small version' of your research in order to refine several aspects of the research. This is especially useful if the research will require interviews and questions to a selected sample of respondents (Teijlingen et al, 2001).

The pilot study was conducted earlier in 2014 (second year) of research to discover the following

- Differences in opinion on the term sustainability.
- Identify the most important elements for professionals in terms of sustainability of buildings.
- Developing the research question and plan accordingly for the objectives of the research.
- Estimating the sample size of professionals currently using Soft Landings in the UK.
- Collecting preliminary data on the construction companies who have adopted soft landings along with conventional management styles.
- The relevance of the research to professionals presently.
- Identifying the best method to use in data collection.

Using Peat et al (2002) guide to conduct the pilot study, the questionnaire method was used in the study. Copies of the questionnaire were emailed to 12 companies researched and found to be currently using Soft Landings. The email sent asked the companies to distribute the questionnaire to their staff who have used Soft Landings. 3 companies forwarded the emails to their staff who filled the questionnaires and returned them. The process used to determine the important issues when using Soft Landings to enhance sustainability were:

- The questionnaire was administered to a sample of the professionals who will be involved in the main study
- Feedback was collected to determine ambiguous and difficult questions
- The time taken for the respondents to fill the questionnaire was noted
- Assessment of each response to the questions
- Assessing if the replies adequately give sufficient information
- Checked all the questions answered
- Re-wording difficult questions and revising the whole questionnaire.

5.2.2 Results of the Pilot study

The study revealed that not as many companies were using Soft Landings as previous thought. The number of respondents that were actually using it was very low. Although the companies had professionals who had been on Soft Landings training, not many of them were currently using it. Few companies were also aware that by April 2016, it will be mandatory for all companies tendering for any central government jobs to use Soft Landings. There seemed to be a lack of awareness by the companies about the new policy. The respondents acknowledged that it was the responsibility of the industry to introduce and educate their clients to Soft Landings. Only one company confirmed that they talked to their clients about the process. The definition of sustainable buildings varied with many of the respondents admitting that it was easier to follow the standardised methods of assessment (SAP, BREEAM). Many of the respondents stated that they used Soft Landings mainly for the post occupancy stages of their projects. They carried on with their design stages as usual.

It will be noted that only 7 respondents submitted their questionnaires within the time specified and that the result could not be generalised. From that results however, the research was able to identify key issues to explore including the emphasis on the design stage of the Soft Landings process. The study allowed the researcher to broaden the search from companies using Soft Landings during the all three stages of construction to companies who have used Soft Landings at any stage of their projects. The methodology was also refined to include semi-structured interviews to accompany the case studies.

5.3 Data sources

Yin proposes six distinct sources of evidence in a case study. This is in order to overcome issues with credibility and validity of the research. The sources are documentation, archival records, interviews, direct observations, participants-observation and physical artefacts (Yin, 2009; P.102). Different sources were therefore used for this research to increase the validity and credibility of the data.

For this research, evidence from documentation of the buildings including records of energy usage and post occupancy evaluations were used. Semi-structured interviews from key professionals who were involved in decision making during design stage of the project were also used. This allowed the same issue to be examined by multiple cases. Limited direct observations were used in two of the cases. According to Yin, this can be either 'formal' or 'casual' observations. The researcher was able to visit two of the case studies to personally view them. This allowed the researcher to observe the occupants of the building on how they interacted with the spaces designed for use.
Direct participant observation was not possible and was not considered to be necessary as an interview with the respondents answered any questions. The main source of data for decisions on the project case studies were from the interviews carried out by the researcher.

Table 5. 2: Research Area and Data Sources.

Data source	**Government Docs incl reports and policies**	**Published reports from BSRIA**	**Members of BSRIA and government departments**	**Published reports from building data exchange**	**Project Stakeholders**	**Project Documents**	**Public Documents**	**Site visits**
Policies on sustainable construction	Y	Y	N	Y	Y	N	Y	N
Soft Landings Process	Y	Y	Y	Y	Y	N	Y	N
Energy efficiency	Y	Y	N	N	Y	Y	Y	Y

Case studies	Y	Y	N	Y	Y	Y	Y	Y

The other source of data was from documentation from BSRIA (Building Services Research and Information) which is a UK based testing and research organisation; and the Building data exchange which is an independent platform that collects information on the built environment using post occupancy evaluations and monitoring of energy use in buildings. They were used to obtain additional data about the cases which could not be obtained personally by the researcher. This information collaborated the interviews, the researcher was able to cross check the consequences of many of the decisions that were taken by the respondents. Most of the project documentation requested by the researcher was denied as many of the respondents felt that they contained sensitive information. Further information was gathered from reports on the buildings and publically available government documents. All the relevant data sources and how they were obtained are shown in Table 5.2.

5.4 Data Management

To preserve the confidentiality of the data, each company and the buildings were identified by a combination of letters and numbers. Request for most project documents has been met with negative replies. There seemed to be a reluctance by all the companies to handover even information not deemed to be sensitive. However, every project document received has been treated as confidential and no third parties were allowed to view any of the documents.

5.5 Data Analysis

5.5.1 Introduction

The information gathered by this research showed the working processes of Soft Landings at the design stage along with other stages during construction. It showed the distinct ways that the different teams dealt with the introduction of new teams into the design process, it also showed how seamlessly or otherwise the new teams were able to join the project and how prepared they were because of the availability of early information sharing.

Several analyses were carried out in phases, both during data collection (interviews) and after its completion. This involved listening to the interview tapes, transcribing interviews and reading and rereading the transcripts a number of times each time concentrating on a small area at a time in order to extract the maximum information from the interviews

The two strategies to analysing qualitative data are analytic induction and grounded theory (Bryman, 2008; Easterby-Smith et al 2012). The analytic induction explores five qualitative approaches; Narrative Research, Phenomenological Research, Grounded Theory Research, Ethnographic Research and case study research. All five approaches follow a general process of research which usually begins with a research problem, the research questions, the data collection, the data analysis and the research report (Cresswell, 2007).

5.5.2 Coding and Cross Comparison Analysis

It is usually a challenge to find an 'analytical path' when analysing data obtained from semi-structured interviews (Fellows and Liu, 2003; Bryman and Bell, 2007). For this reason, a matrix of coding was used to identify the trends and themes from the data. According to David and Sutton (2004), Coding is a process of applying 'codes' to segments of texts so that those segments can be interlinked to emphasise the similarities or differences within and between the texts. This in turn reduces the large amount of text to themes and relationships which the researcher can focus on.

The use of coding in research can follow inductive reasoning, which is a dynamic, intuitive and creative process (Basit, 2003) or deductive reasoning which usually begins with a hypothesis. The purpose of analysing qualitative data is to establish the categories, relationships and assumptions from the respondent's view of the world in general, and of the research topic in particular (McCracken, 1988). Coding is not only labelling but also linking as well, according to Richards and Morse (2007, P13) "it leads you from the data to the idea, and from the idea to all the data pertaining to that idea." Coding can take simple forms of labelling like words and phrases or take more complex forms like metaphors (Miles and Huberman, 1994). They also explained that basic coding can be prompted by themes, causes/explanations, relationship among people and emerging constructs.

The analysis of this research used the inductive method to inform some of the themes to identify words and phrases used by the respondents during the interview, at the design, construction and aftercare stages with particular emphasis on the design stage of the projects. It also aimed to establish a clear relationship between the research objectives of finding the working process during design and the conclusions as a result of the data generated and also try to generate theory about the process from the evidence from the data.

The categories of the words and phrases used for this analysis have been derived as a result of key words from the research objectives (sustainability, design process, collaborative working) and the words that the participants have used themselves (added value, worth the effort). This is in line with Strauss and Corbin (1990) who identified that the categories of coding can come from pools of concepts already formed from professional reading or technical literature or words and phrases from the informants. The most important challenge was getting appropriate words and phrases that will capture the essence of the research without fragmenting the words into a single theoretical theme. While one of the reasons of this inductive approach is to condense wide-ranging and large amounts of data into a brief summary format, the possibility of losing and emerging of new ideas because enough participants did not highlight them has to be taken into account.

As indicated before, inductive reasoning was used in creating the codes meaning that no data was pre-coded until a large amount of the information (data) had been collected using interviews from the respondents. This data was then evaluated to look for patterns, connections and relationships between the respondents' response and the literature available regarding sustainability, Soft Landings and design management. This method of creating codes is described by Miles and Huberman (1994) and favoured by Glaser and Strauss (1967) termed as the 'grounded' approach to coding. This method was used instead of a method where 'provisional lists' were created by using hypotheses, problem areas and conceptual frameworks to form a ready collection of words and phrases. The reason for using inductive reasoning was to let the research progress at a natural pace without any preconceptions from past literature. Of course, past literature informed the research but the direction of the present research is going to be dictated by the data collected from the respondents. This is in order to eliminate bias and any assumptions that can arise from a provisional list. Although inductive reasoning was used, there was a list of phrases and words that had a recurring theme in the literature review that were highlighted and cross checked with the interview transcripts. These words were also included in the initial coding framework because of their importance in the study.

A combination of descriptive and analytic codes was used. This was done so that the emerging descriptive codes could be reinforced by the analytic codes which are made up of the Soft Landings framework. Initial descriptive codes that emerged include

- Ideas of sustainability
- Sustainability goals of the project
- Role of the Soft Landings champion
- Effects of Soft Landings process on the design stage
- Effects of the Soft Landings champion on the project.

These descriptive codes/themes were then reanalysed against the Soft Landings framework to find the meeting points. The emerging framework includes

- Providing leadership
- Setting performance objectives
- Communication
- Ensuring continuity

All these codes/themes were then reanalysed with regards to the respondent and the role of the respondent. Results of these analysis would be discussed in the analysis chapter (seven, eight and nine). As with every data analysis, there has been criticism about using coding (Atkinson, 1996; Bryman, 2008). The fact that a researcher has to suspend awareness to other theories and concepts seem to be a major issue. The difficulties of transcribing interviews and the continuous back and forth between data collection and analysis can lead to loss of narrative flow. These points were noted during analysis and the researcher making sure that all the interview transcripts were coded under different themes so that each piece of information is analysed more than three times each. Each transcript was treated to a ‘line by line’ coding where almost every line generated a coding as shown in Table 5.3 below. This allowed the initial codes to be further investigated.

Table 5. 3: Example of an Initial Coded Interview

Interview Transcript	Initial Coding Framework
Interviewer: **‘**what is your profession?’	
Respondent: **‘**I studied Engineering for my first degree; I later went on to study architecture, which I practiced for many years before becoming a soft landings Consultant.’	• **Multiple discipline training.** • **Core Soft Landing professional.**
Interviewer: **‘**Years of experience in construction’	
Respondent: ’15 years’	• **Very experienced**
Interviewer: ‘Years of experience with Soft Landings’	
Respondent: ‘6 years’	• **Experience, Level 5**
Interviewer: ‘Number of projects completed with Soft Landing’	
Respondent: ‘I have worked on 15 Soft Landings projects coming in at various stages from early on in the design stage to projects in dire need of direction. I have worked on school projects, large office buildings and smaller projects with various councils.’	• **Experienced in a wide array of different projects.** • **Commercial building.**

Interview Transcript	Initial Coding Framework
Interviewer: 'How were the Soft Landings champion chosen?'	
Respondent: 'It depends on the circumstances, sometimes the client hires a Softlandings consultant and at other times, the contractor brings a Softlandings champion into the project to provided additional values in terms of sustainability, cost savings and time.'	• **Client hires a soft landings consultant** • **Contractors also hire soft landings champion as a consultant.** • **Provide added value for sustainability, cost and time.**
Interviewer: 'How is the position of Softlandings champion funded?'	
Respondent: 'It depends on the type of project and who hires the Soft Landings champion/consultant. Most times, it is the client who funds the position of SL champion because they know the extra costs that come with a shabby building hasn't been properly designed or constructed. They are the party usually left with a badly constructed building.'	• **Flexible funding routes.** • **Depends on which party hires the consultant.** • **Generally, funded by the client.** • **They know the cost of a sub-standard building.**
Interviewer: 'Is there a pre-arranged stage for other professionals to join the design team?'	
Respondent: 'It tends to be as the need arises, with the concept design started the	• **Flexible introduction of other team members.** • **Specialists are invited early.**

Interview Transcript	Initial Coding Framework
team realises the need to add a specialist or professional who is then invited to join the design team. I remember working on a project that had a warehouse…………'	
Interviewer: 'Where are you as a Soft Landings champion located?'	
Respondent: 'I need a space on site, where I can work; usually I will have my laptop, correspondences, and drawings. I need to be visible on site so I put posters in the building stating who I am, what I do and how I can be reached in case of any problems with the project.'	• **Soft landings champion visible on site.** • **Easy access to all project team members.** • **Introduction of services on site.**
Interviewer: 'How often are your meetings?'	
Respondent: 'The frequency of the meetings depends on the stage of the project; this can range from once a month to more frequent meetings if there are issues to resolve.	• **Frequency of meetings depends on the stage of the project.** • **More frequent if there are issues to resolve.**
Interviewer: 'Who are usually present at these meetings?'	
Respondent: ' I find that the best and most cost-effective method of holding these meetings is to separate them into two groups. My work partner and I usually review the	• **Divides meetings into two groups.** • **Design and construction team in one group.** • **Client and representatives with design and construction team**

Interview Transcript	Initial Coding Framework
project workings and drawings available and then have a meeting with the design and construction teams. A second meeting then includes the client, the design team and the SL champion. The reason for splitting the meetings in two is to allow the design and construction teams to be able to speak freely about schedules, deadlines, specifications and cost given by the client. Some of the demands may be unreasonable and they need a third and neutral party to be able to analyse the drawings and arrive at a workable solution. During the technical design stage, I insist on coming to the site meetings in order to get a clear picture of the project. The Soft Landings champion at the end of both meetings will write an independent and unbiased report which many times ends up backing the professionals on issues about the time and cost of the project. The report can also highlight risks that the contractor may have flagged up and the client may have ignored. What both parties need is to know that there is an independent perspective of the whole project from the soft landings champion.’	**in another group.** • **Reason- for ease of communication, and the team members speaking without bias.** • **Soft landings champion will be a neutral party.** • **Produces an Independent and unbiased report.** • **Report can highlight risks overlooked by both parties.**

Interview Transcript	**Initial Coding Framework**
Interviewer: ‘Do you feel that there is a disadvantage to including other professionals early in the design stage of the project?’	
Respondent: ‘The design team are sometimes not happy with the Soft Landings Champion asking to see certain design details and elements. But it usually helps to have an extra pair of eyes looking through the design, this helps problems to be spotted and resolved early. An example of this is we had a project to renovate a large and very old building that had been unoccupied for decades. The design team were in the stages of initial design when we noticed that the plastering of the building used a rare plastering method; we had to invite a historic plastering expert onto the project to advice on the preservation method. This saved us a lot trouble later during reconstruction.’	• **Design team may resent others questioning certain decisions.** • **Advantage to having more professional consultations.**
Interviewer: ‘How are the lines of communication during the project?’	
Respondent: ‘The lines of communication are usually opened to me; I am privy to most of the emails of the project team. If any of the team has a problem or concerns that they want reviewed, I am contacted by email and we arrange a meeting to work with them to	• **Communications by email** • **Open lines of communication to all project team members.**

Interview Transcript	Initial Coding Framework
resolve the problem.'	
Interviewer: 'How is the end-user involved early in the project?'	
Respondent: 'There is usually a meeting with the designers, the facilities management team and the end-users of any particular building. The heads of the departments usually represent the staff or occupiers during the concept design stage and they are asked about their specific requirements for the building. I remember a project where we were in a meeting with some heads of department and a man told us that they have a machine in their department that weighs almost a ton that needs to be serviced once a year. It has to be rolled out the service door but the specifications in the brief made no reference to this obviously important equipment. We were grateful for that information which was used to redesign some of the doors and hardwearing floors. The responses of the end user are usually recorded and discussed among the team at a later meeting with best ideas used into the design. I would say during these meetings, plans or other technical drawing are not shown to the	• **End user and facilities team consultations.** • **During the concept design stage.** • **Asked about specific requirements.** • **Add important information not contained in the brief.** • **Best ideas used in the design.** • **End users may be confused by technical drawings.** • **Verbal communication best for consultation.** • **Informing users about the facilities available and positions of certain offices.**

Interview Transcript	Initial Coding Framework
end-user because this confuses them, as they do not have the expertise to interpret the drawings. I find it better to verbally communicate our ideas to them by listing the facilities that will be available and the position of certain offices.'	
Interviewer: 'Have there been objections and conflict about the design from professionals who are not core members of the design team?'	
Respondent: 'In my experience with Soft Landings projects, there hasn't been any conflict during the design stage but on other conventional projects there have been some conflict. I find that if proper information is shared to all the teams it helps to diffuse some of the problems.'	• **No conflict during the design stage.** • **Sharing information helps solve problems.** • **Communication.**
Interviewer: 'How does all these meetings affect the sustainability of a project?'	
Respondent: 'The overall sustainability of any project can be improved with more communication and collaboration. With Soft Landings, the fact that a team member is designated to keep information flowing between the teams and looking over details of the plans to see where improvements and	• **Communication can improve the sustainability of a project.** • **Collaboration also improves sustainability.** • **Flow of information adds protection to the project.**

Interview Transcript	Initial Coding Framework
savings can be made adds a layer of protection to the project and can help in achieving sustainability.’	
Interviewer: ‘Is there a definite amount of time for the post occupancy and aftercare?’	
Respondent: ‘There is not a set amount of time for the post occupancy; the client usually decides the duration, as they are responsible for the costs. During the post occupancy, I as the Soft Landings champion liaise with the facilities management team to get manual readings of the heating and cooling and electricity usage and help them on how to effectively use the building. The main focus at this point is to help in mitigating the risks identified as opposed to solving the problems.’	• **Flexible duration for aftercare.** • **Decision and costs are the responsibility of the client.** • **Soft landings champion helps the facilities team deal with energy efficiency issues.** • **Aftercare focus will be mitigating risks.**
Interviewer: ‘Has there been any major problems identified on any of the Soft Landings projects during extended aftercare?’	
Respondent: ‘There was a project where I was brought in at the later stages of the project and the building had major problems with poor details and overheating. This has thrown up an interesting point during aftercare in buildings. You are required to	• **Major problems identified during extended aftercare.** • **The balance of reporting problems to the insurance companies over costs is interesting.** • **RIBA reviewing reports of defects during aftercare.**

Interview Transcript	Initial Coding Framework
report problems to the insurance company, which may push up the premium. Of course, there is a chance of the building owners not making a claim on that particular problem but if they do and it was established that the contractors knew about the problem, it will not be covered by the insurance company. This has led to RIBA reviewing some of their clauses on insurance about reporting defects to insurance companies. Some buildings have exposed the problem of selective Soft landings where the procedures were not followed from the beginning of the project. This presents a problem for the Soft Landings champion, as they must try to find the best solutions to such problems.'	
Interviewer: 'How was the problem solved?'	
Respondent: 'We decided to report the defects to the insurance company. The project team all met several times and we came up with new ideas on how to mitigate the problems. The contractor had change several windows and reposition duct openings.'	• **Communicating with the team during aftercare.** • **Meeting on how to mitigate the problems.** • **Contractor going back to resolve the issues.**
Interviewer: 'What in your opinion is the	

Interview Transcript	Initial Coding Framework
future of Soft Landings? With the government introducing the GSL in 2016.’	
Respondent: ‘I believe that the transition will be difficult and that construction companies will struggle to adapt all parts of the soft landings guidelines. The first issue is the specification of the Soft Landings Champion, which seems to cover almost all disciplines in the construction industry, which will be difficult for one person to have. I was part of the team that advised the government panel on the Soft Landings and I fear they have taken our advice about the professions we mentioned as absolute and concluded that a soft landings champion most possess about 6 qualifications from construction.’	• **Difficult transition for construction companies.** • **Specification of a soft landings champion by the government is confusing.** • **Qualifications and experience are ambiguous.**

5.5.3 Underlying assumptions of coding used in this research.

The assumptions used in this research are reflective of general inductive approach used in coding.

The final data analysis is determined by using the research objectives (which is a form of deductive reasoning) and multiple reading and cross-examining of the transcripts’ data (inductive reasoning) (David Thomas, 2003). This means that the final codes and themes are a combination of the research objective and results of analysing the transcript data (Table 5.3).

- The major mode of analysis is the development of categories from the data generated, into a framework that captures key themes and processes considered to be important to the research. Such codes like sustainable design and Soft Landings were taken both from literature and data collected as seen in Table 5.3.
- The final codes and conclusion are generated from multiple interpretations derived from the transcript data by the researcher. Predictably, the results are shaped by the assumptions and experiences of both the researcher and respondents. In order for the results to be credible, the researcher must make decisions about which elements of the data is more important.
- Different researchers are likely to produce different results, which have non-overlapping themes.
- The integrity of the result can be assessed by techniques such as

  a. independent replication of the research,
  b. comparisons with results from previous research,
  c. triangulation within a project,
  d. feedback from participants of the research and
  e. feedback from the research results. (David Thomas, 2003). Points b, d and e were carried out by the researcher.

The interviews were transcribed verbatim which was a time-consuming exercise. The recording device had to be played several times. Certain words were very difficult to decipher which left a few gaps in the transcript. The transcripts were read several times to identify key words, themes and categories. A coding frame with initial emerging themes was developed and the transcripts coded. The transcripts were then grouped according to the stage of construction where the participant was most involved (design, construction, aftercare, all 3 stages). They were cross-examined and compared and any emergent theme in the group added to the initial coding frame. The transcripts were regrouped into the participant's level of experience with Soft Landings (from level 1 to 5) considering possible meanings and how they fit with developing themes. Any emerging themes were added to the initial coding frame.

5.6 Using Nvivo for analysis

Computer assisted qualitative data analysis software (CAQDAS) has grown in its application (Welsh, 2002; Johnston,). Nvivo is now the most commonly used software among researchers. Some writers have expressed concern with using software for qualitative analysis (Seidel, 1991) with arguments of the effects and quality of such packages. However, advocates of CAQDAS have pointed out it provides a quick and transparent way to process information (Welsh, 2002). Many have pointed to that this form of qualitative analysis adds rigour to the process by using the search button to find out the frequency of certain words or themes.

Nvivo was used in addition to manual coding for this research. The advantage to the researcher was the ease of data management. After every interview was transcribed, they were individually uploaded to the software and coded using the themes identified in section 5.5.2. Each transcript was saved under the case study and the group of interviews could be cross analysed against each other. The transcripts from other case studies were also cross analysed to find common themes. After the cross analysis, they were compared with the manual coding and analysis. Similar themes were identified by both methods. This strengthened the validity of the analysis process.

5.7 Reliability and Validity

Joppe (2000, P1) defines reliability in research as

> *…'The extent to which results are consistent over time and an accurate representation of the total population under study is referred to as reliability and if the results of a study can be reproduced under a similar methodology, then the research instrument is considered to be reliable.'*

The reliability of a research therefore questions the ability of the research to be replicated using the same methodology and arriving at the same results. Researchers continue to actively search for ways to increase the reliability of their work. It is the responsibility of the researcher to ensure high consistency and accuracy in a research (Crocker and Algina, 1986). 'Validity determines whether the research truly measures that which it was intended to measure or how truthful the research results are' (Joppe

2000). This means that the instruments of measurement (in case of a qualitative research, the methods) are accurate and whether they are actually measuring what it is meant to measure.

This is not always easy in a qualitative research where the instruments cannot be used to measure responses from participants. The credibility of a qualitative research will depend on the ability and effort of the researcher (Golafshani, 2003). Other writers advocate for different terms to be used instead of reliability and validity (Lincoln and Guba, 1985; Healy and Perry, 2000) terms like Consistency or Dependability and Applicability or Transferability. From the constructivist point of view, reality is ever changing and is usually subjective (Crotty, 1998) which means it is an indication of multiple and diverse constructions of reality. Therefore, in order to obtain valid and reliable multiple realities, we need multiple methods of gathering data. Triangulation will be the best method to establish reliability and credibility realities (Johnson, 1997). Multiple methods like recordings, interviews and observation which were all used in this research will add credibility to the research.
For this research, the following steps were taken to ensure reliability

- All the interviews were recorded by the researcher.
- The interviews were then transcribed and sent back to the respondents for verification. The respondents then expressed satisfaction with the interview before it could be used in analysis.
- The data was coded both manually and by the use of Nvivo (CAQDAS) software to increase its validity.

5.8 Limitations

All the projects in the case studies had already been completed; therefore, some of the working processes have been lost. Some professionals who were involved in the project have changed jobs and moved away. This made reaching them difficult. For those still available in the company, some had moved to different roles. There was also the tendency of forgetting certain aspects of the project. Many of the respondents used phrases like ‘I don’t really remember all of it but...’ Others recalled overplaying certain situations during the project.

Some design specific staff who were introduced to the project as advisors were no longer available for interview. Many Sub-contractors seemed to have moved into partnership with others, while others had changed their operations. The experiences of these advisors and Sub-contractors were not available for analysis. These limitations were overcome by the main focusing on Soft Landings during the design stage. All the key professionals during this stage were interviewed and therefore the lack of other professionals did not have a negative impact on the research.

5.9 Summary

This chapter provided details for how the data was collected in stages. The different sources of data were discussed.

- The reason for the pilot study was to test out different methods of data collection with the result showing that only a few construction companies were currently using Soft Landings.
- The use of coding both manually and using computer software for data analysis provided an extra level of reliability.
- Using inductive reasoning, themes such as 'experience of professional' and 'frequency of meetings' was revealed.

Finally, the steps taken to ensure reliability and validity of the research was discussed. The next chapter introduces the case studies with descriptions and their project aims and objectives

Chapter Six

Case Studies

6.1 Introduction

The case studies in this research are non-residential buildings. The building types vary because ‘non-residential’ buildings apply to a wide selection of buildings. This research studied one Educational building (Primary School), one Office/Commercial building, one Central Government building and one Industrial/Commercial building. All the buildings have already been in operation between 1 year to 7 years. This allowed the occupiers a chance to experience the building and the project stakeholders (Clients, Designers, Main Contractors, Soft Landing Champions, occupiers) to find out if the project objectives have been achieved.

This chapter provides a description of each case study with plans and photographs. The first two cases concentrated their Soft Landings activities during handover and aftercare process (these are classified as group A; see Section 6.2); While the last two concentrated their Soft Landings activities from the design stage (these are classified as group B; also see Section 6.2). Tables summarising the project objectives and how they were achieved using Soft Landings principles will provide a compact overview of the case studies. It allows the reader experience at a glance, the journey of each project from setting objectives to completion and even post occupancy evaluation. This sets up the argument for how effective (or not) the implementation of each Soft Landings principle was within the individual projects. The tables along with respondent’s opinions, facilitates the cross comparison of the case studies when using descriptive codes (Chapter seven) and will be referenced in all three of the analysis chapters. (See chapters seven, eight & nine). Full details of all interviews and documents which informed the case studies available in Appendix A

6.2 Classification Scheme

For clarity and ease of analysis, a classification scheme has been developed from the data of the four case studies. As such, they are conceptual classification schemes based on existing elements in the data, rather than theoretical classification schemes based on set properties. These schemes are important because they help reveal relationships (situationality) between the codes discussed. The first classification scheme is single-level with the case studies divided into two groups (A and B) or situationalities according to when they introduced Soft Landings into the project. Group A adopted the framework after design while group B adopted the framework during the design stage. The second classification scheme is multi-level which is contained within the first classification. Using numbers, this group specifies the case study number and a number for each respondent within a particular case study (see chapter seven). The building classification scheme is presented in Table 6.1.

Table 6. 1: Classification of Case Studies

Case Study	**Building Type**	**Group Classification**
Case Study 1	Educational	A1
Case Study 2	Office/Commercial	A2
Case Study 3	Office/Commercial	B1
Case Study 4	Industrial/Commercial	B2

6.3 Case Study 1 Castle Hill Primary School

6.3.1 Introduction

This was the first project in the Primary Capital Programme for Kingston Council. The project was to provide two additions to the school (a classroom extension and a new build Dinning Hall) both buildings were designed by ECD Architects and the main contractors were Thomas Sinden Contractors for the Royal Borough of Kingston Local Authority. ECD Architects have a good record of delivering successful sustainable buildings, they have been involved in several regenerations and retrofit projects over the past 10 years. Thomas Sinden have won awards for their high-quality work including a RIBA London Building of the year Award and have constructed several successful sustainable buildings.

The school currently had 481 pupils, it is in a suburban setting but close to Chessington North train station which runs along the south-west boundary and within 1 mile of the A3 motorway, London. In 2007, two schools integrated to become Castle Hill Primary School. The new project was to provide updated buildings where children can learn in a comfortable environment.

6.3.2 Building Overview

The new building extension was located at the northern end of the site. They were to accommodate Key Stage 2 pupils. Works advertised for were:

- 8 new classrooms to replace the temporary classes currently in use (Photo 6.1)
- a new library and ITC suite
- A SENCO office and space for a Speech and Language Specialist
- Improved staff and pupil toilets
- Roof replacement on existing building to match up with new build
- Window replacements on existing building to match up with new build
- Additional playground and community space
- Bulge classroom (a post contract variation)
- New kitchen and dining hall (Figure 6.1)
- Deputy head's office

- Family liaison room (Innovate UK, 2014).

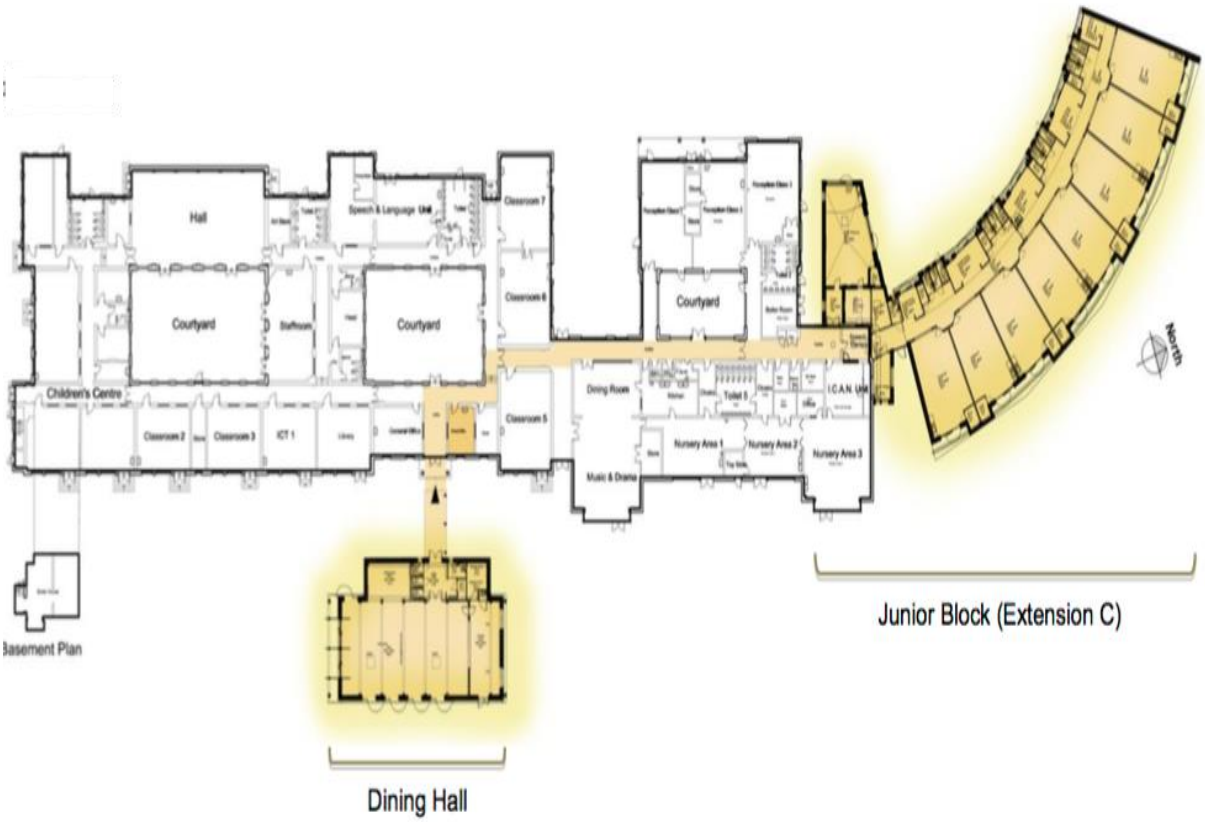


Figure 6. 1: Floor Plan Showing Dining Hall and Class Extension

Photo 6. 1: West Wing Facade of the Building

All the new classes were to be housed in the new extension and new dining hall buildings. The project was procured by a traditional ‘Joint Contracts Tribunal’ (JCT) Standard Building Contract (2005). Kingston Council who was the client was required to conduct a competition because the budget was over £1 million. The successful design was from ECD Architects; this was mainly due to the ‘fabric first’ approach of the architects who wanted to meet the 60% reduction in CO_2 emissions target. The class room extension was 817 m^2 and was completed in May 2010, while the dining hall building was $302m^{2.}$ And was completed in April 2011. They were both constructed using a combination of timber frame, brick and concrete block cavity wall construction.

Natural ventilation cowls were installed both in the classrooms and the dining hall. The heating is provided by a gas boiler system connected to the underfloor heating. There is a Mechanical Ventilation with Heat Recovery system (MVHR) connected to the toilet areas.

Both buildings are situated at the end of a residential street located to the south (Dinning) and East (Junior block) of the existing school. The new extension comprises of 9 new nursery classrooms with breakout spaces as well as toilets for pupils. It is built as a curved extrusion with timber frame and brick and block cavity walls.

Photo 6. 2: Interior of Dining Hall

The dinning block comprises of a large hall, servery, plant room and toilets. It was built with a Dutch barn style roof which provides a large double height space comprising of glulam beams and block infill (Photo 6.2). The design targeted U Values of 0.15W/m^{2}K and predicted air tightness of 10m^3/m^{2}h for both buildings.

6.3.3 Key findings from Post Occupancy evaluations.

- The buildings were assessed under part L2a and L2b of the Buildings Regulations. Although air tightness values were not required, the measurement differed considerably from the estimated target of $10m^3$/m2hr with a value of $11.85m^3$/m2hr for the Dining Hall which was worse than expect. While the nursery extension recorded a value of $8.49m^3$/m2hr which was better than expected. This was attributed to the leaks in the building fabric in the dining hall. This led to higher than expected energy consumption.

- The thermography survey of the dining hall showed 3 areas where the temperature was above limit required in BRE IP17/01 and BS EN 13187:1999. This was because of a gap between the layer of insulation and the building fabric. The survey discovered several areas in the building where airtightness and insulation were compromised causing heat loss. Thermal bridging was identified within structural elements of the building with a high level of heat loss in 2 windows.

- The Building User Survey (BUS) uncovered thermal comfort issues raised by the occupiers. They complained of thermal discomfort when moving from the newly built extension to the existing building. They felt warmer in the new extension with the temperature dropping significantly lower in the existing building (Innovate UK, 2014).

Table 6. 2: Project A1 Objectives showing Soft Landings Principles used with end results.

Project Objectives	**Relevant stakeholder**	**Process used**	**Soft Landings Principles used**	**Result**
Sustainability objectives: Air tightness and design to benefit from low and zero carbon technologies. and passive control methods. Minimise operational energy use and reduce overall CO_2 emissions. BREEAM 'Excellent' rating.	Architect Project Manager Client Head teacher Specialist sub-contractor Construction team.	Review undertaken by Project Manager	Focusing on operational outcomes	The targeted air permeability was $10m^3/hr/m^2$ @50 pa. A test revealed that the building achieved a performance of $11.85m^3/hr/m^2$ @50 pa for the dining block and $8.49m^3/hr/m^2$ for the classroom block.
Energy and Environmental Performance: Emphasis on the building fabric Daylight strategy for window positions and brise soleils.	Project Manager Specialist sub-contractor Technical assessor. Architect	A technical assessor produced an energy model which reviewed the energy outlay of in the classrooms. Review undertaken by Project Manager.	Setting out roles and responsibilities Bring key specialists to advice during the design development stage allowed a realistic target to be set for the energy performance of the space.	A gap between the insulation and building fabric caused temperatures to rise above required limit. Occupants raised issues of thermal comfort.
Functionality of the space designed:	Project Manager Architect Head teacher	Extensive workshops and presentations with all	Using feedback to inform design Involving the end user during the	The space designed met the expectations of the end user having a score of

Project Objectives	**Relevant stakeholder**	**Process used**	**Soft Landings Principles used**	**Result**
8 new classrooms that were provided natural lighting without glare. Improved staff and pupil toilets. New dining hall space.	Pupils and Parents.	stakeholders. This resulted in a lot of unstructured feedback, with little design change.	design stage.	95%. A change in the location of the entrance of the school
Facilities management and training of staff: A single caretaker and the head teacher were trained by the M&E sub-contractor.	Sub-contractor Project Manager	Producing operations and maintenance manuals for the staff.	Involving building managers	The training did not include the additional classes causing overheating in the 'bulge' classroom.
Handover: Prepare all staff for the use of new security pods Structured training of facilities team.	Project Manager Sub-contractor	Complete operating manuals for the caretaker, including the minimum requirements as described in the BREEAM manual. End users informed.	Communicating and informing the team	The transition to handover was handled smoothly. The new heating and cooling system was working correctly.
Post occupancy evaluation: Review building	Project Manager External reviewer.	The Project Manager and the architectural team conducted a	Committing to building aftercare	Complaints about difference in temperature between the old and new buildings.

Project Objectives	Relevant stakeholder	Process used	Soft Landings Principles used	Result
sustainability performance TM22 assessment		post occupancy review.		

6.4 Case Study 2 Pool Innovation Centre

6.4.1 Introduction

This project comprised of two buildings which were classified as ‘pilot projects’. They were both designed by the same team AHR (formally known as Aedas) but they were built by different Contractors. They both received a BREEAM Excellent rating with the Pool Innovation Centre winning several awards including INSIDER South West Property Awards 2010, Sustainable Development of the Year, CIBSE and Green Build performance awards.
The Tremough Innovation centre was built by Leadbitter and completed in November 2011, while the Pool Innovation centre was built by McAlphine and completed in May 2010. Although both buildings are very similar in design, this case study focuses on the Pool Innovation Centre because it was constructed first and therefore occupants had longer to adjust to the conditions in the buildings. The goal of the project was to achieve zero carbon target using the ‘fabric first’ approach. The client engaged the design team to produce the tender design package. The project was procured under a design and build contract with the main contractor chosen by the client.

6.4.2 Building Overview

The Pool Innovation centre made up of 3 floors with 51 offices in various sizes from 24m^2 to 67m^2 and floor spaces for rent. The centre emphasized on delivering flexible offices by providing raised access floors and moveable partitions. The atrium houses the reception area with access to meeting rooms and the main conference room (Figure 6.2). Other amenities include a ground floor kitchen, coffee spaces on all floors, cyclists’ drying spaces and lockers, disable WC’s and showers (Figure 6.3). There are very few offices located on the south side of the east wing ground floor so this space is utilized as show office, storage area and sometimes serves as a meeting room when other rooms are occupied.

The main wall construction is a light weight steel frame system with 150mm deep mineral wool fill and precast concrete floors, sheathing board, rigid insulation. The finishes covering the steel frames include slate, copper, and timber.

An atrium divides the building into two wings with each wing having a central corridor with light coming through glazed office doors and large windows at each end. Different strategies have been used to provide ventilation. The south side of the building is cross-ventilated using local wind chimneys and ventilation stacks with a Monodraft wind catchers that were attached to the window master system along the high-level windows. While the north side has single-sided ventilation. Apart from the glazed meeting rooms in the southernmost corner of the building, the rest of the build is ventilated naturally. The low-level windows can be operated manually while the high-level windows are connected to the BMS with a manual override (Innovate UK, 2015).

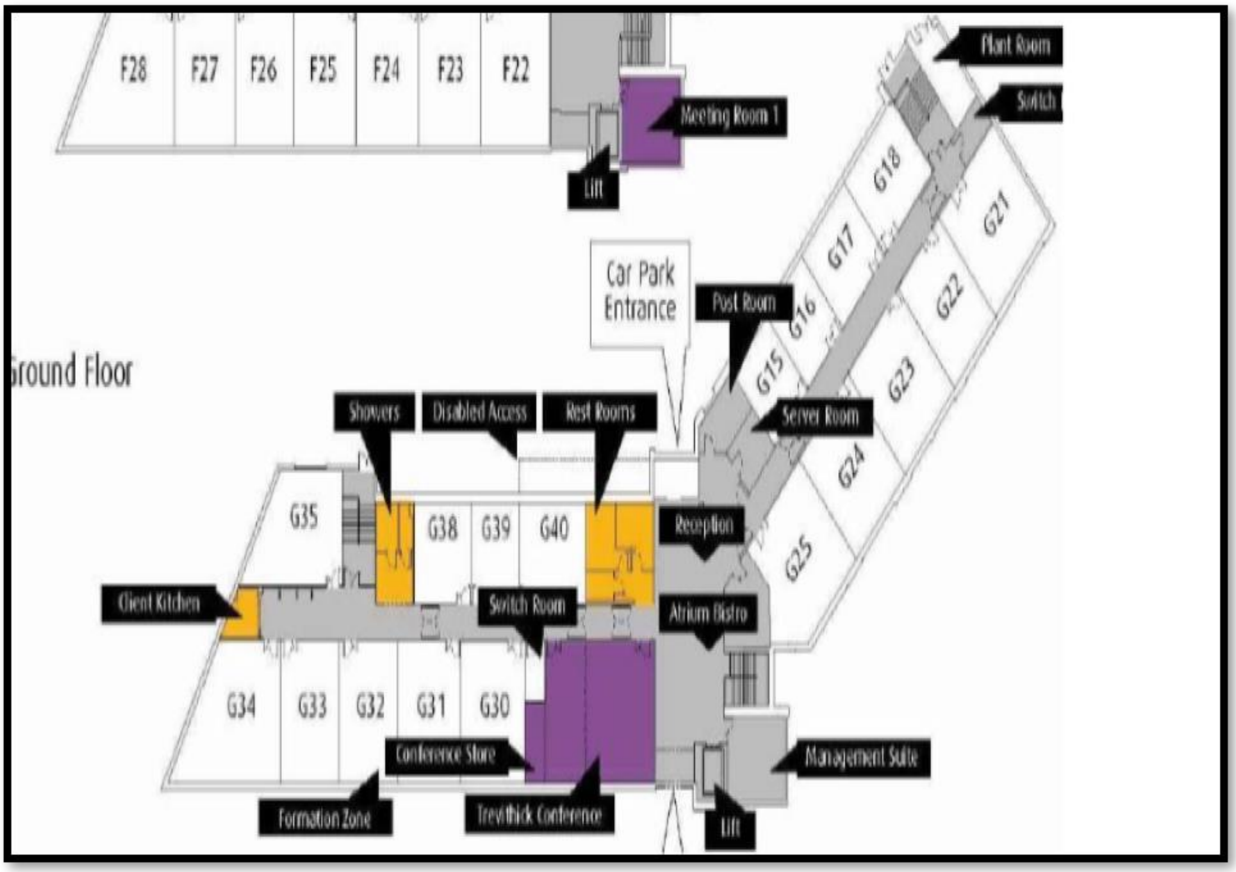


Figure 6. 2: Ground Floor Plan

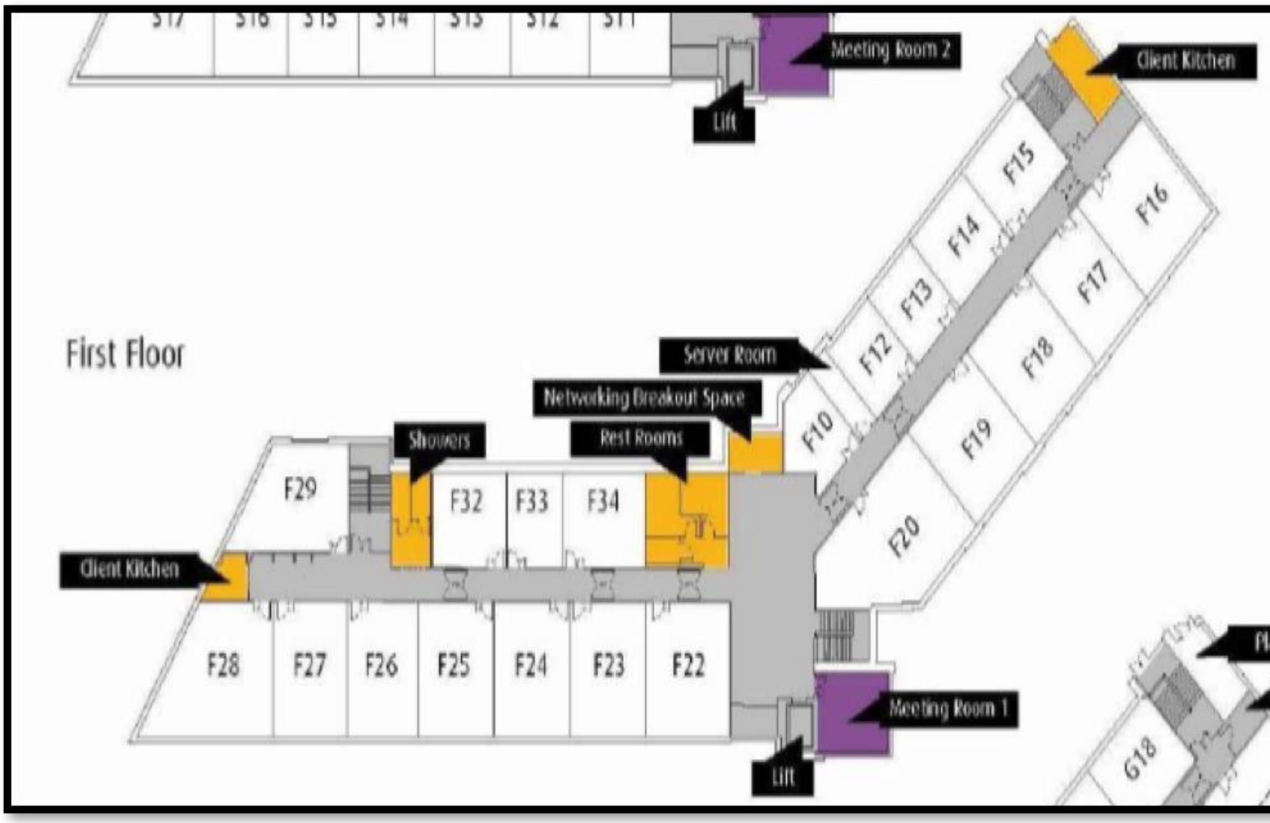


Figure 6. 3: First Floor Plan

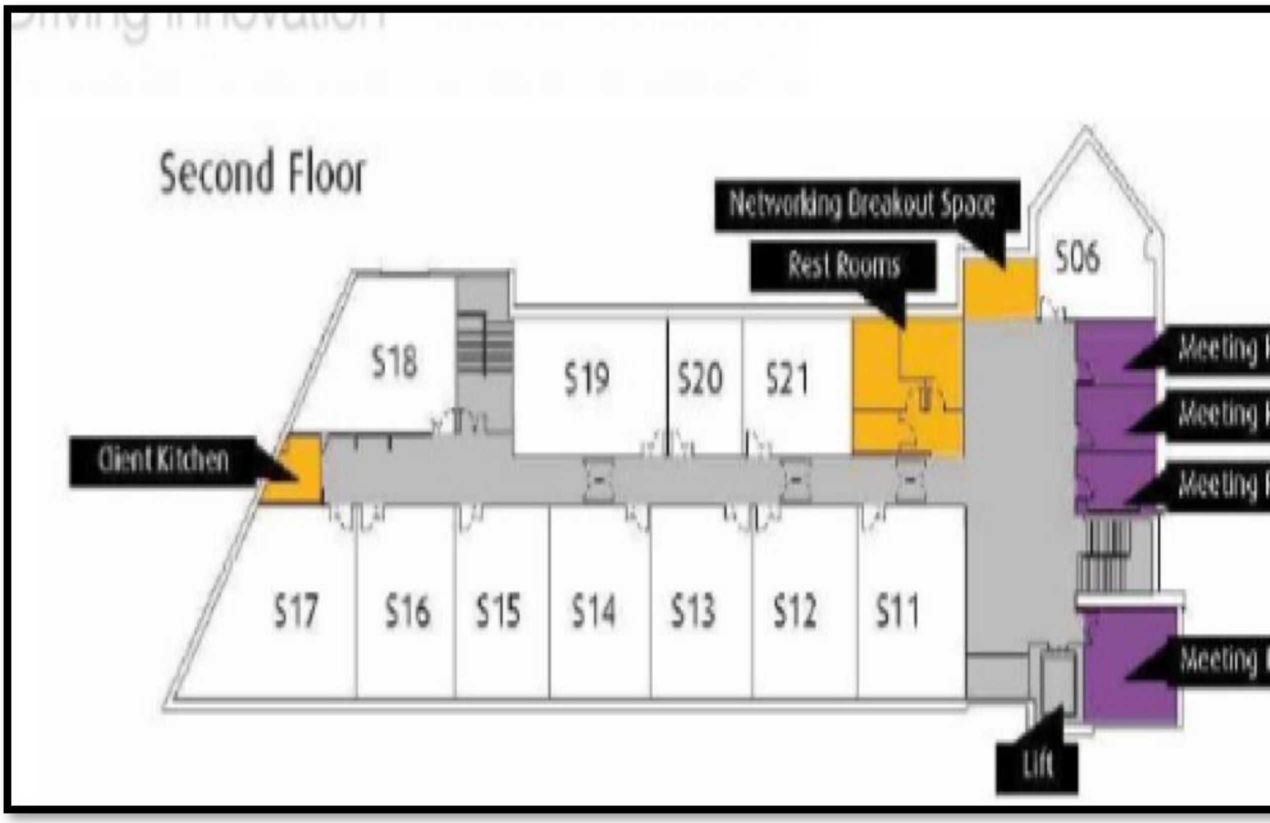


Figure 6. 4: Second Floor Plan

The lighting was by suspended luminaries with acoustic damping built into the fittings. Occupants had control to dim the lights manually. Lighting also had intelligent controls, with absence detectors programmed at 20 minutes. Biomass wood pellet boilers and backup gas boilers were installed to provide the heating and hot water for the building. The biomass boiler was housed outside in a container with pipes for blowing fuel deliveries. The boiler is monitored by an electric Building Management System (BMS) located on the ground floor control room. Each room has a thermostat on the wall to allow occupant a degree of control of the temperature.

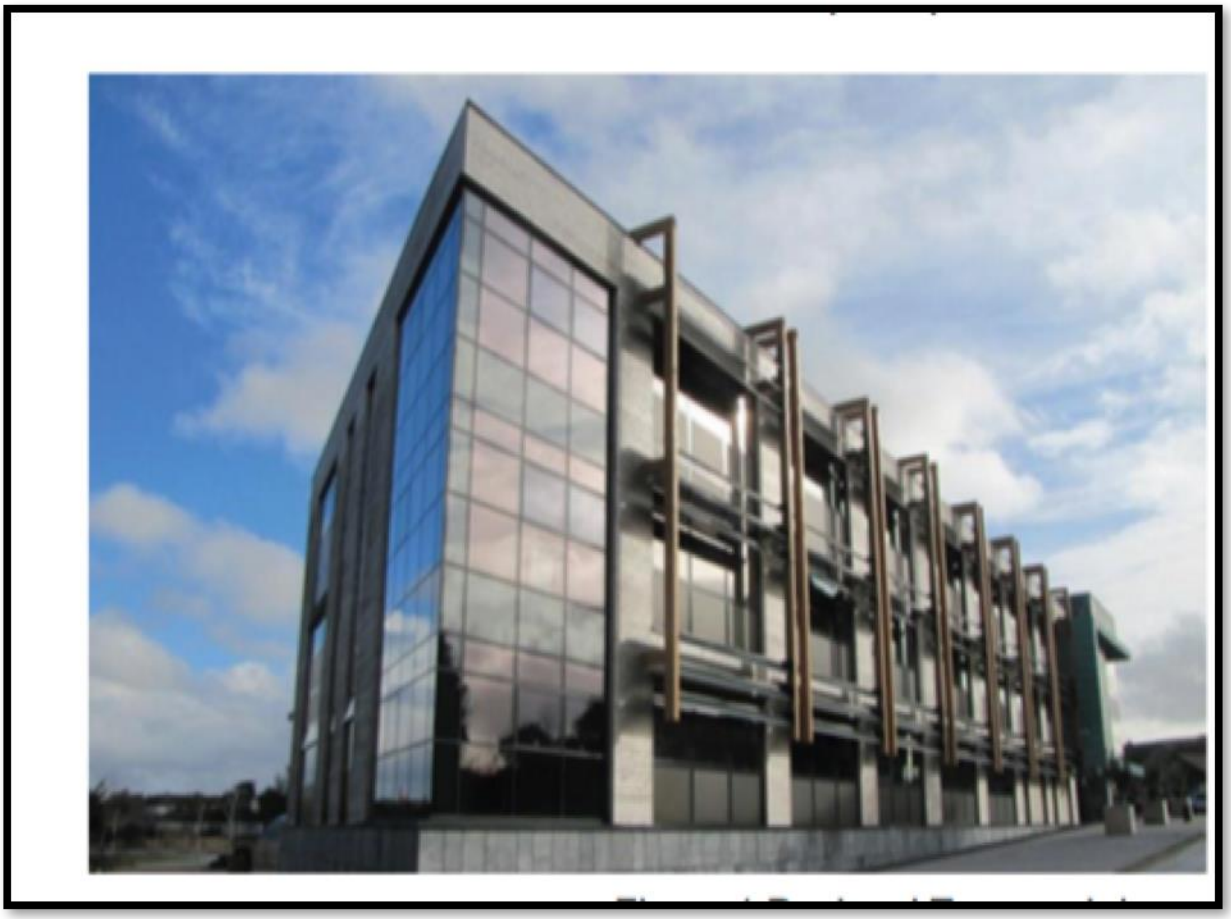


Photo 6. 3: South-eastern Facade

6.4.3 Key findings from post occupancy evaluations

- The design was widely accepted; all the occupant had positive comments about the layout of the building.
- There were complaints of excessive heat during the summer months in meeting rooms that were mechanically ventilated. This was due to a time lag between the cooling systems.
- Occupants complained about the lighting with 15% of them complaining that lighting in some rooms was too much.
- Some complains about the building systems with many occupants having problems with the automated window systems (Innovate UK, 2015).

Table 6. 3:Project A2 objectives with Soft Landings principles use with its results.

Project Objectives	**Relevant stakeholder**	**Process used**	**Soft Landings Principles used**	**Result**
Sustainability objectives: Air tightness and design to benefit from low and zero carbon technologies. and passive control methods. Minimise operational energy use with natural ventilation approach. BREEAM 'Excellent' rating.	Architect Project Manager Client representative Construction team. BREEAM Assessor	Utilizing low carbon technology solutions like automatic lighting sensors that will offer more energy efficient lighting solutions.	Focusing on operational outcomes	The targeted air permeability was $10m^3/hr/m^2$ @50 pa. A test revealed that the building achieved a performance of $8m^3/hr/m^2$ @50 pa.
Energy and environmental performance: Emphasis on the building fabric Heat and CO_2 sensors provided in each room. Provide passive natural ventilation for	Project Manager Specialist sub-contractor BREEAM Assessor. Architect Construction Manager	A BREEAM assessor was available to advice and contribute to the project.	Setting performance objectives Setting out roles and responsibilities Bring key specialists to advice during the design development stage allowed a realistic target to be set for the energy performance of	Performed better when Compared against CIBSE TM46 benchmarks. Building achieved a DEC rating of C. The building energy use was higher than expected with $67.5kWh/m^2/$

Project Objectives	**Relevant stakeholder**	**Process used**	**Soft Landings Principles used**	**Result**
the building with air curtains provided in the lobby.			the space.	Year No major breach in the building fabric.
Functionality of the space designed: Provide flexible workspaces for businesses. Lighting with intelligent controls Each wing of the building had a central corridor which transmitted light to the office spaces.	Architect Project Manager Sub-contractor Client Representative End user focus group Construction Manager	End user focus group and workshops used to provide information. Project relied on the previous experience of the design team. All suggestions were discussed and rated to ensure that all important points were noted and incorporated in the design.	Using feedback to inform design Involving the end user during the design stage.	The space designed met the expectations of the end user. Getting a BREEAM design rating of 'Excellent'.
Facilities management and training of staff: Interaction of the facilities management team with the project team members and end users. Preparation of operation and maintenance manuals.	Project Manager Building Managers Sub-contractors Design Team	Engaging with the facilities management team. Maintenance and operational issues like the position of the biomass boiler.	Involving building managers	Better understanding of the space.

Project Objectives	**Relevant stakeholder**	**Process used**	**Soft Landings Principles used**	**Result**
Handover: The Building Management System to be calibrated and configured ready for use. Structured training of facilities team.	Project Manager Building Manager Sub-contractors Design Team	A training and handover strategy was developed although some described it as inadequate. Complete operating manuals. Video training for the security staff.	Communicating and informing the team	The new heating and cooling systems were not properly synced. Complains about the building controls (temperature, lighting and BMS controls).
Post occupancy evaluation: Review building sustainability performance TM22 assessment	Building Managers External Reviewers Specialist sub-contractor. Project Manager	The sub-contractors stayed after handover to help the transition.	Committing to building aftercare	Problems with the sub-metering of the building. Problems with the use and expensive maintenance of the biomass boilers.

6.5 Case Study 3 Ministry of Justice Headquarters

6.5.1 Introduction

This project was a central government building located in London. The project was to redesign and build a new entrance foyer to the main building including the main reception area. The building which was designed by Aukett Fitzroy Robinson was completed in 1977. The 56 meters building has 14 floors providing 51,000 sq. ft. (square feet) of office space. The building has gone through several retrofitting currently a multi-services chilled beam system services the office areas and new raise access floor systems. The building won the British Council for Offices Awards London & South East (2010), for Best Refurbished/Recycled Workplace.

6.5.2 Building Overview

The design brief called for the reception to be re-designed as a light, modern space with a comfortable ambient temperature. The new space was to provide an improved energy efficiency rating and to ensure that the temperature is maintained throughout the year. The energy efficiency had been woeful with a temperature of 4 degrees Celsius recorded in 2014. There was also a need to modernize the building and improve the security by providing new security doors (pods) to respond to the directive given by government to increase security in all government buildings. Although the space was to have a row of security pods installed, it was also to provide a user-friendly space for the building users, visitors and the reception concierge staff (Photo 6.5). Ballistic glass panels were to be installed above the new security pods to add to the environmental performance of the reception area. There was an existing stack chimney in the area. The proposal was to retain the stack chimney to allow air to be drawn in through the entrance door and up into the atrium volume thereby taking away local heated air and accentuating drafts.

Photo 6. 4: South Facade

The design team were also to rectify maintenance and operational issues that exist in the reception space including

- Ceiling replacement
- Light replacement
- Additional CCTV cameras to cover blind spots
- improve overall ambient temperature of the area.

One of the objectives of the project was to achieve a BREEAM excellent rating which was achieved.

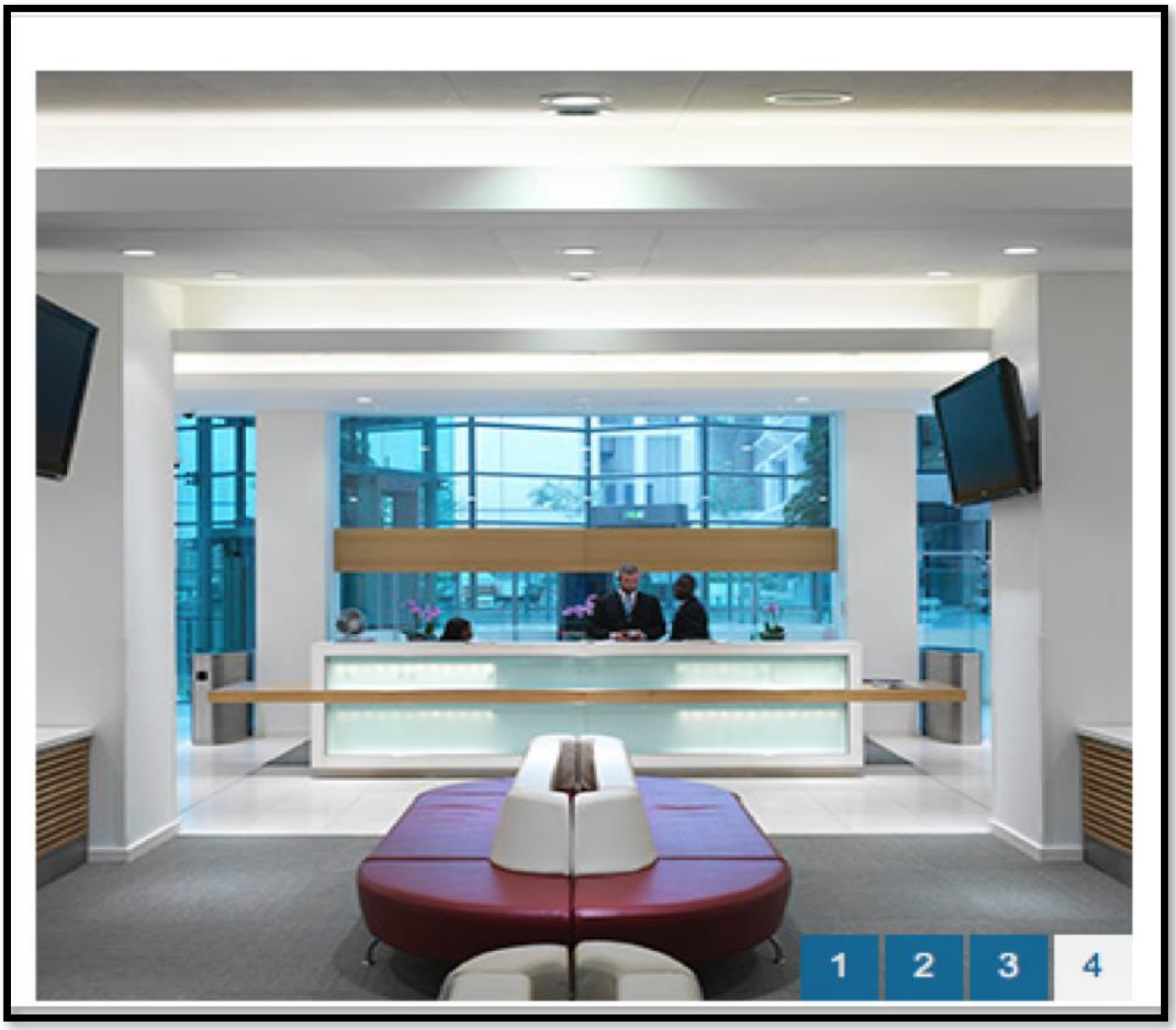


Photo 6. 5: View showing Reception and Visitor Area

6.5.3 Key Findings from Post Occupancy Evaluations

- The feedback from occupants rated the redesign highly with more than 80 percent score.
- The reception staff were satisfied with the thermal comfort of the newly redesigned space.
- Staff complained of long queues for the security doors during peak and break times.

Table 6. 4: Project B1 objectives with Soft Landings principles with its results

Project Objectives	Relevant stakeholder	Process used	Soft Landings Principles used	Result
Sustainability objectives: Air tightness and design to benefit from low and zero carbon technologies. and passive control methods. Minimise operational energy use and reduce overall CO_2 emissions. BREEAM 'Excellent' rating.	SL-CHAM Sustainability Manager Design Manager Project Manager Specialist sub-contractor Client sponsor Construction team.	Reality checking decisions at key stages of the project. Utilizing low carbon technology solutions like LED lighting replacement that will offer more energy efficient lighting solutions.	Adopting the entire process of Soft Landings Focusing on operational outcomes	The targeted air permeability was $5m^3/hr/m^2$ @50 pa. A test revealed that the building achieved a performance of $4.91m^3/hr/m^2$ @50 pa.
Energy and environmental performance: Emphasis on the building fabric The performance of the heating and cooling systems.	SL-CHAM Sustainability Manager Project Manager Specialist sub-contractor Technical assessor.	A technical assessor produced an energy model which reviewed the energy outlay of the reception area. Overhead door heaters were linked to the BMS system to reduce the indoor energy	Setting performance objectives Setting out roles and responsibilities Bring key specialists to advice during the design development stage allowed a realistic target to be set for the energy performance of the space.	Comparison against CIBSE TM46 benchmarks Bridging around the side double glazed windows. Overall the thermal comfort of the occupants achieved.

Project Objectives	**Relevant stakeholder**	**Process used**	**Soft Landings Principles used**	**Result**
		outlay and to switch them off when they are not needed.		
Functionality of the space designed: Outlay of the reception area Flow of the traffic of people Position of security pods	SL-CHAM Project Manager Design Manager Client sponsor End users.	SL-CHAM worked with the design team to ensure that each stakeholder was given adequate attention during the design stage. All suggestions were discussed and rated to ensure that all important points were noted and incorporated in the design.	Using feedback to inform design Involving the end user during the design stage.	The space designed met the expectations of the end user. The flow of traffic has been improved
Facilities management and training of staff: Interaction of the facilities management team with the project team members and end users	SL-CHAM Project Manager Facilities Manager Sustainability Manager.	Engaging with the facilities management team by weekly meetings. Maintenance and operational issues like identifying blind sports where	Involving building managers	Better understanding of the space The change in the ceiling finish materials.

Project Objectives	**Relevant stakeholder**	**Process used**	**Soft Landings Principles used**	**Result**
		additional CCTV cameras could be placed.		
Handover: Prepare all staff for the use of new security pods Structured training of facilities team.	SL-CHAM Project Manager Facilities Manager Sub-contractor	A training and handover strategy was developed with the help of the SL-CHAM Complete operating manuals. Video training for the security staff.	Communicating and informing the team	The transition to handover was handled smoothly. The new heating and cooling system was working correctly.
Post occupancy evaluation: Review building sustainability performance TM22 assessment	SL-CHAM Facilities Manager Sustainability Manager Specialist sub-contractor.	The sub-contractors stayed after handover to help the transition.	Committing to building aftercare	Complaints about the wait for security doors.

6.6 Case study 4 Stevenage Bioscience Catalyst

6.6.1 Introduction

The Stevenage Bioscience Catalyst was created as place where innovation and learning can be shared between small biotech, life sciences companies and start-ups. It was developed by start-up and Small to Medium Sized Enterprises (SMEs) and was a joint scheme between the UK Department of Business, Innovation and Skills (BIS), GlaxoSmithKline (GSK), the Wellcome Trust, the East of England Development Agency, and the Technology Strategy Board (TSB). The building was designed by Nightingale Associates who are experienced in designing health and science buildings. The main contractor was Mace who have been recognized for sustainability in the Construction Excellence Awards. The project was procured using a 2-stage design and build. The site is unique because it was designed to promote collaboration and interaction between companies working in the building.

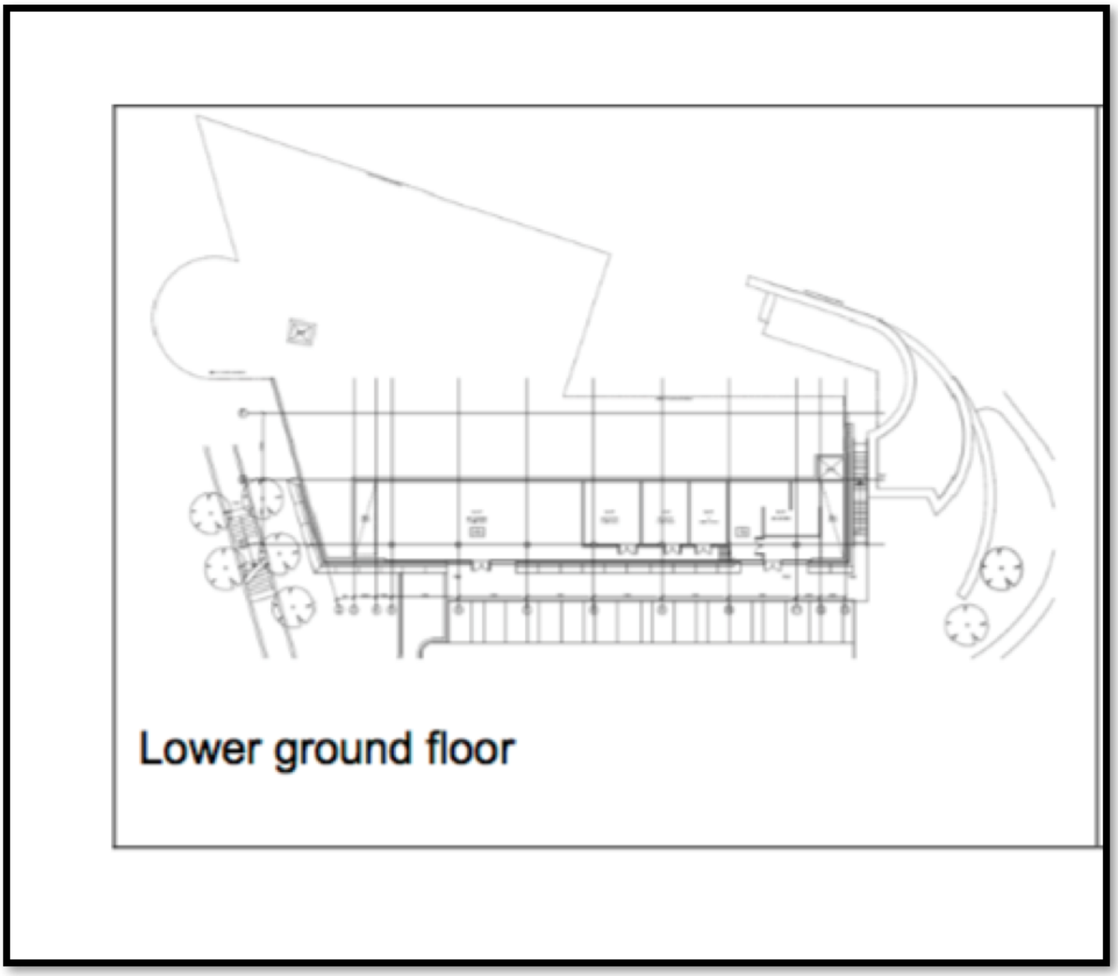
6.6.2 Building Overview

The building is divided into an office wing and laboratory wings located on 3 floors. The building covered 4,750 m^2 floor are with 60% comprising of labs and 40% comprising of offices (Figure 6.6). The two wings were connected by a central atrium which housed meeting and board rooms. The building targeted a BREEAM 'Excellent' rating and was deigned to take advantage of low carbon technologies and passive controls which includes minimizing energy use when the building was unoccupied, orientation of the building, types and sizes of glazing.

The renewable and low carbon technologies included

- 530 m^2 of façade-mounted solar photovoltaics for on-site electricity generation.
- Three 500 kW Reverse Cycle Air Source Heat Pumps to provide heating and chilled water for spaces and ventilation air conditioning

- CO_2 Heat Pumps to generate domestic hot water (Innovate UK, 2013).



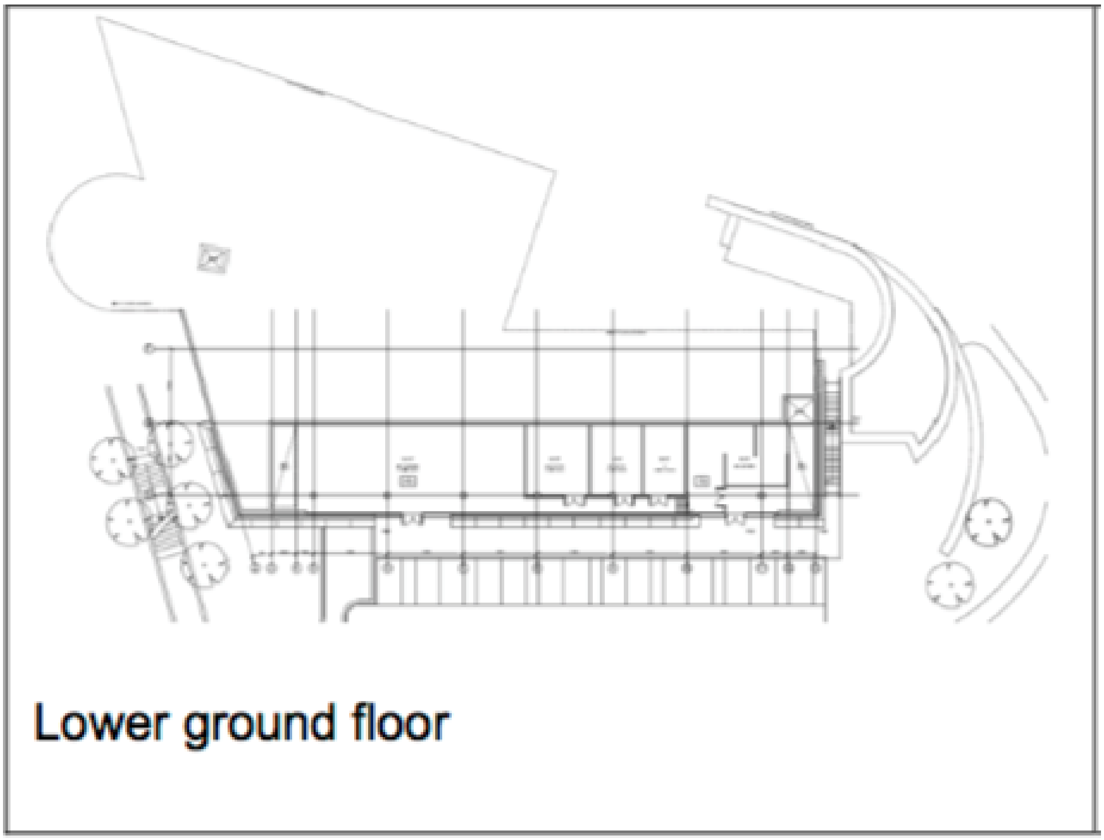
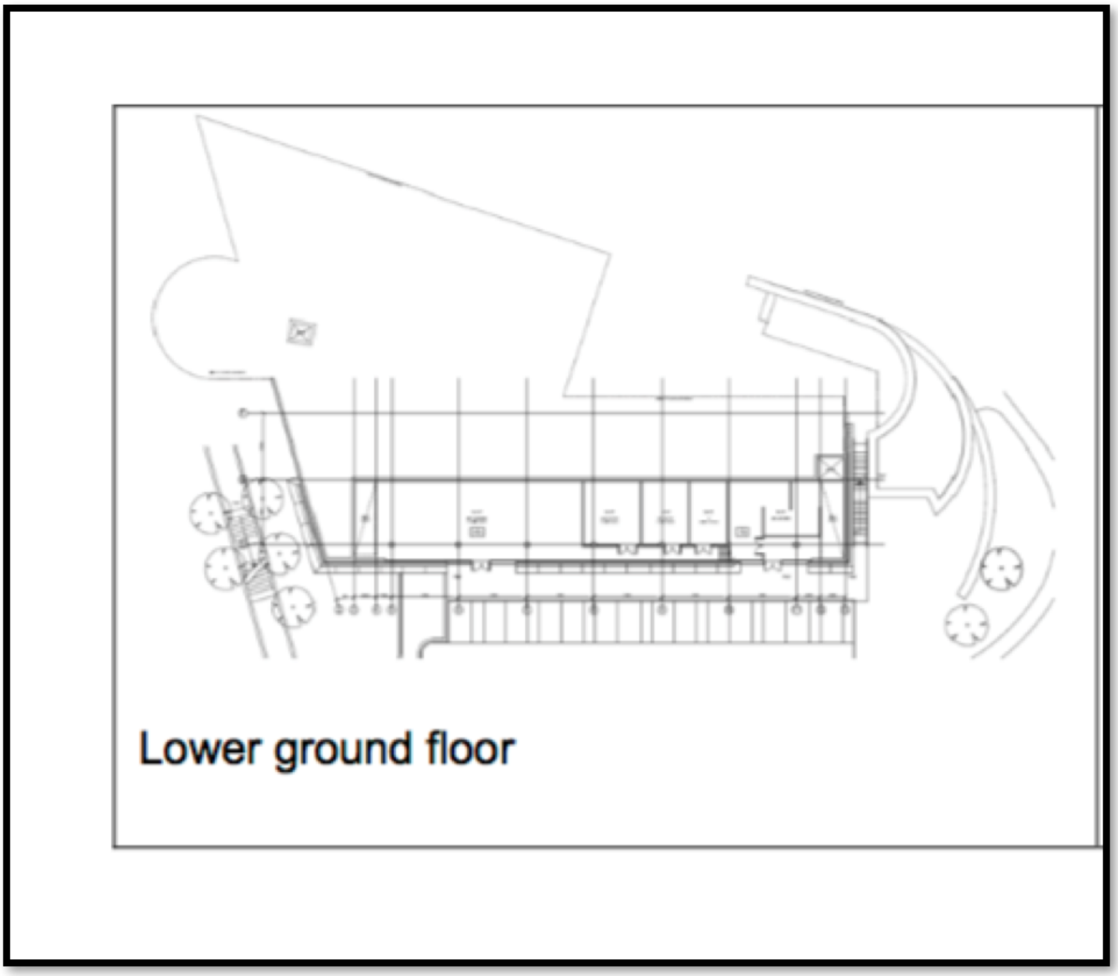


Figure 6. 5: Basement level (B2)

Other design considerations were rainwater harvesting for flushing toilets and for use of outdoor landscapes. High efficiency fume cupboards were specified in accordance with BREEAM guidelines. It is expected that this will minimise energy use by tenants as far as achievable and reduce the overall CO_2 emissions of the building thereby enhancing sustainability. The building axis runs from north east to south west, with the offices located on the northern side and the labs on the southern side of the building. It was designed with a target maximum occupancy of 375 people. The building has good access links with roads, trains (12 miles from Luton Airport, 35 miles from Heathrow Airport and 35 miles from Stanstead Airport) and cycle facilities all within a few minutes.



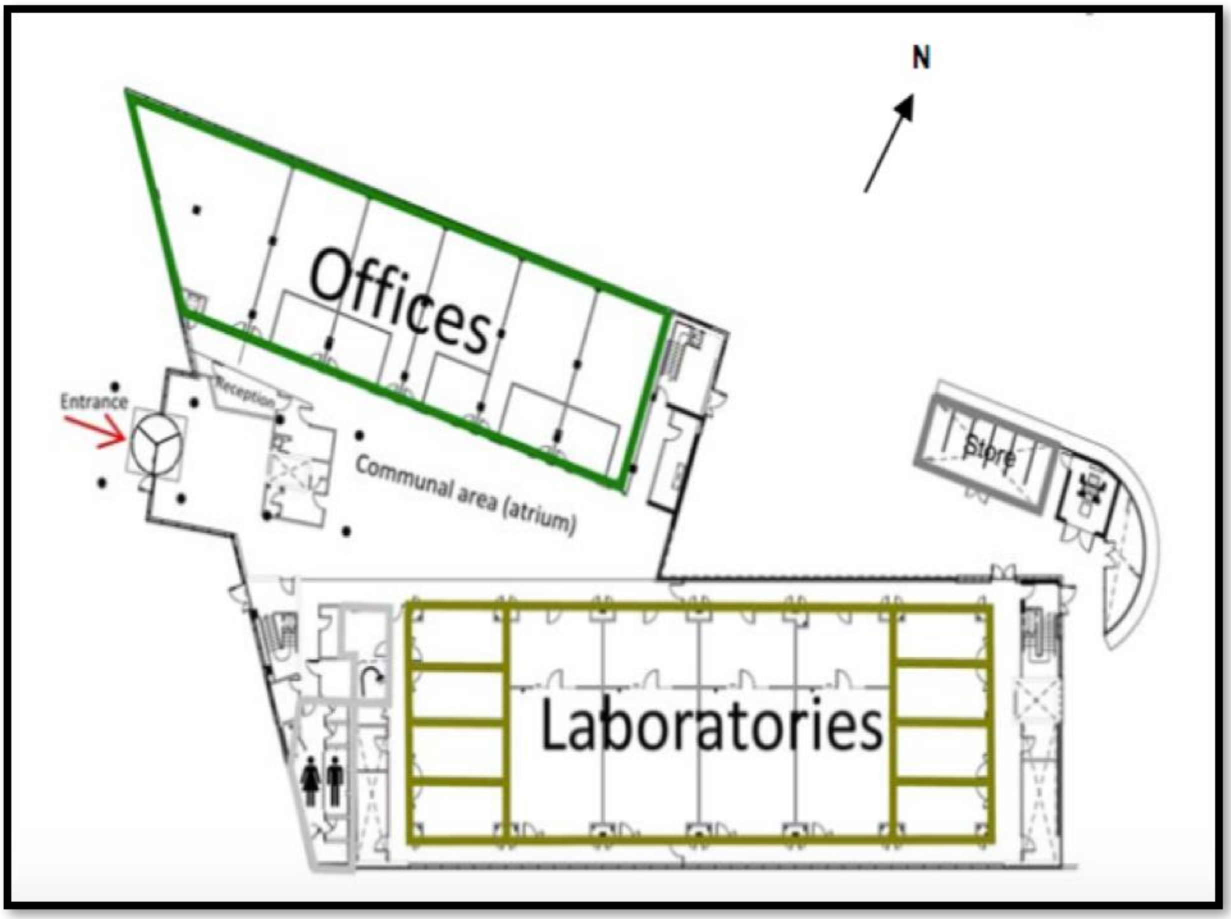


Figure 6. 6: Ground Floor Plan (B2)

The masterplan requirement was to provide a good quality of laboratory with a service routing strategy that minimizes disruption to existing tenants as other spaces are reconfigured, i.e. adaptable rather than flexible. Although the base build fit out is at this generic level, the building has the capability to accommodate more specialist needs. For example, it is capable of accommodating a number of chemistry based tenants, who will require additional fume cupboards and the larger air handling capacity that goes with them. Hence, the building is designed and built to allow for accessible risers and plant space with spare capacity (Innovate UK, 2013).

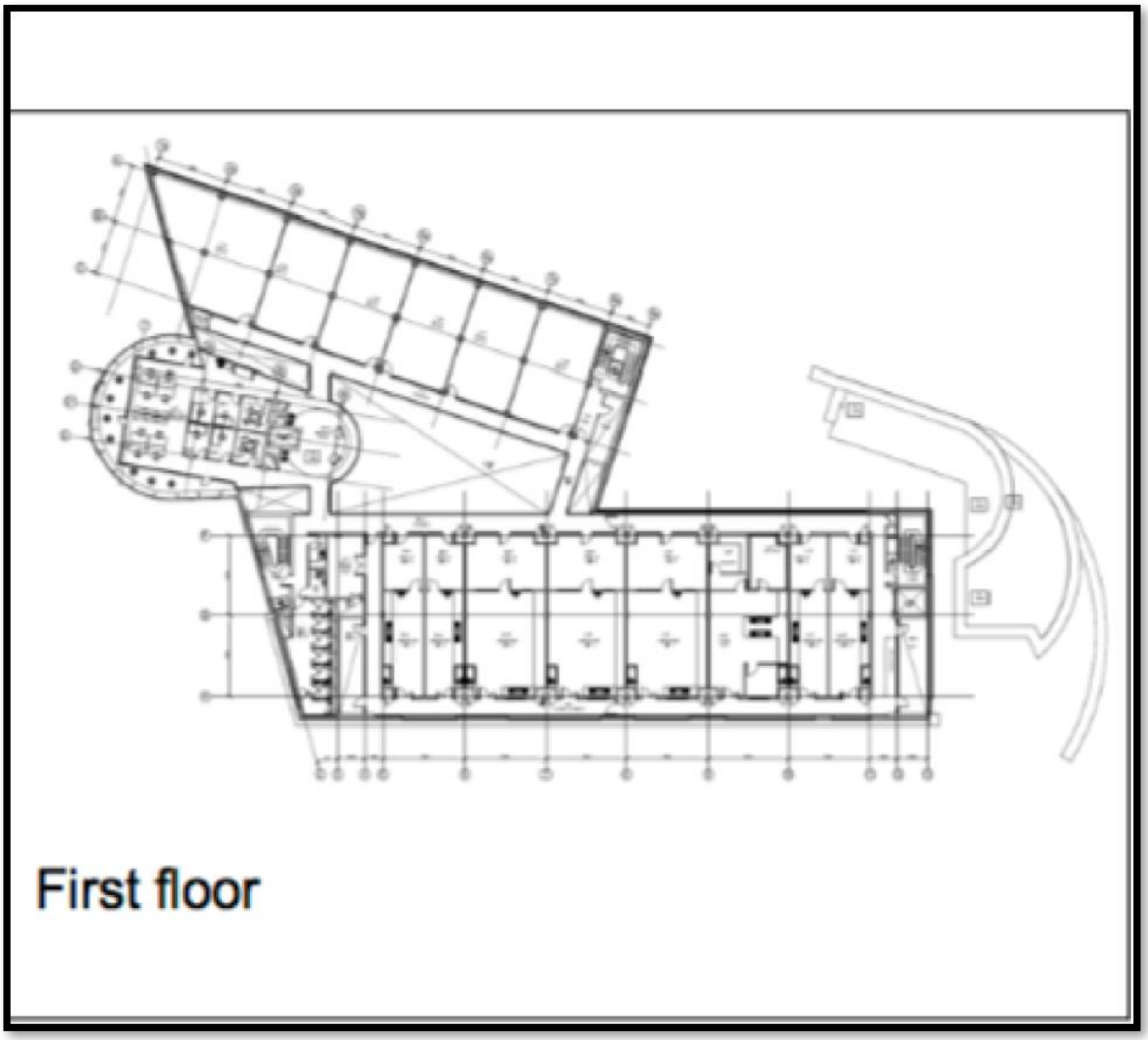


Figure 6. 7: First Floor Plan (B2)

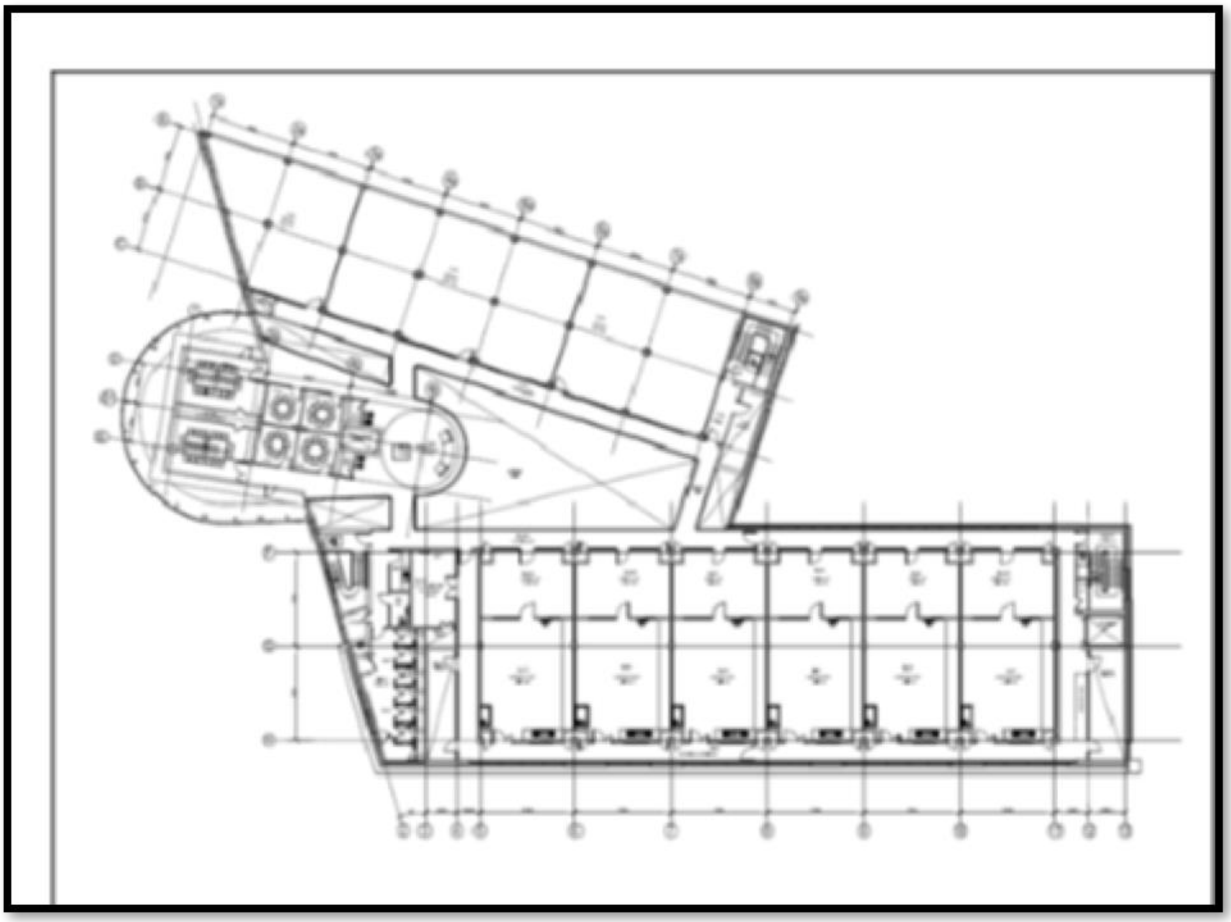


Figure 6. 8: Second Floor Plan (B2)

Photo 6. 6: North-eastern Façade

6.6.3 Key findings from Post Occupancy Evaluations

- Occupants complained of overheating in the glazed offices during sunny days; others complained of cold temperatures.
- The ventilation system was not functioning properly, leading to energy use in unoccupied labs. This may be due to inadequate training during handover.
- Problems discovered with the Building Management System (BMS) including the heat pumps and hot water systems.
- Complaints of the Building Management System (BMS) not being user friendly (Innovate UK, 2013).

Table 6. 5.: Project B2 Objectives showing Soft Landings principles used and end results

Project Objectives	**Relevant stakeholder**	**Process used**	**Soft Landings Principles used**	**Result**
Sustainability objectives: Air tightness and design to benefit from low and zero carbon technologies. Using CO_2 heat pumps, mounted solar Photovoltaics Minimise operational energy use outside of work hours. Reduce overall CO_2 emissions. BREEAM 'Excellent' rating.	Architect Project Manager Client's Team Specialist sub-contractor	Reality checking decisions at key stages of the project. Utilizing low carbon technology solutions like building orientation and glazing types.	Adopting the entire process of soft landings Focusing on operational outcomes Setting out roles and responsibilities.	The targeted air permeability was $5m^3/hr/m^2$ @50 pa. A test revealed that the building achieved a performance of $4.91m^3/hr/m^2$ @50 pa. Heat pumps had some technical problems and were not working properly.
Energy and environmental performance: Emphasis on the building fabric The performance of the heating and cooling systems (BMS).	Project Manager Specialist sub-contractor BREEAM Assessor. Architect Client's Team	A BREEAM assessor was on hand to offer expert advice. Reality checking decisions at key stages of the project	Setting performance objectives Setting out roles and responsibilities Bring key specialists to advice during the design development stage allowed a realistic target to	Building fabric, performing as expected. Occupants complained about some thermal comfort issues. Lighting systems and solar Photovoltaics working as intended.

Project Objectives	**Relevant stakeholder**	**Process used**	**Soft Landings Principles used**	**Result**
Automatic lighting systems to maximise sunlight and reduce energy use.			be set for the energy performance of the space.	Ventilation units recorded high figures of energy use.
Functionality of the space designed: Design office and laboratories in separate wings. Spaces designed to allow natural lighting and ventilation into the building. Building targeted a BREEAM 'Excellent' rating.	Architect SL-CHAM Project Manager Main contractor Client's Team End users' focus group.	SL-CHAM worked with the design team to ensure that each stakeholder was given adequate attention during the design stage. All suggestions were discussed and rated to ensure that all important points were noted and incorporated in the design.	Using feedback to inform design Involving the end user during the design stage.	The building design achieved a high mark amongst occupiers. There were differences between the specifications and as-built design.
Facilities management and training of staff: Interaction of the facilities management team with the project team members and end users	SL-CHAM Project Manager Building Manager Sub-contractors	Engaging with the facilities management team. Maintenance and operational issues were discussed in training.	Involving building managers Communicating and informing the team	Evidence of training of staff shows lack of all-round training in the Building Management systems.

Project Objectives	**Relevant stakeholder**	**Process used**	**Soft Landings Principles used**	**Result**
Handover: Structured training of facilities team.	SL-CHAM Project Manager Building Manager Sub-contractors	A training and handover strategy was developed with the help of the SL-CHAM Complete operating and maintenance manuals were available for staff.	Communicating and informing the team Involving building managers	The transition to handover was handled smoothly. Building managers unable to control fan coil units. Separate commissioning may have an adverse effect on the systems.
Post occupancy evaluation: Review building sustainability performance TM22 assessment	SL-CHAM Building Manager External reviewers	The sub-contractors stayed after handover to help the transition.	Committing to building aftercare	Complaints about overheating in some highly glazed offices. Operating manuals were not updated to reflect changes in the building systems.

6.7 Summary

This chapter discovered the following:

- Project A1 and A2 did not adopt Soft Landings from the beginning of their projects, missing opportunities for reality checking during the early stages (Soft Landings Stage 1: Inception and briefing). This would have been the point where decisions on closer collaboration would have been discussed. The process would have been especially useful for interactions between the design team, the main contractor and sub-contractors (see Chapter seven).

- The reasons for not adopting the process is different for both cases with the Architect in Project A1 explaining that at the beginning of the project (2008), Soft Landings was still in the early stages and the framework was just being developed. It was still a new process with only a handful of professionals in the industry involved at the time. While the Design Manager in project A2 citing lack of encouragement by the client as the reason it was not adopted in the beginning (see Chapter seven).
- A Soft Landings Champion may have been able to flag early issues such as the extra classroom (the bulge) in project A1where the problem of overheating was recorded during post occupancy evaluations (Table 6.2); And issues with the expensive biomass boilers in project A2 (Table 6.3).
- Project B1 and B2 had the advantage of early adoption of the Soft Landings process which allowed some of the sub-contractors to sign up to working within its framework. Although their Soft Landings Champions were appointed in different ways, they were able to provide support and open lines of communication between teams (see Chapter nine).
- The result for project B1was good lines of communication and collaboration within the team resulting in meeting a tight deadline (see Table 6.4).
- Project B2 benefitted by having the Soft Landings Champion as a neutral member during the handover of from the client's design team to the final design sub-contractor (see chapter seven). It is important to point out that the size of the projects vary and the lines of communication of smaller projects will be easier to manager than larger ones.

The analysis of the data in chapter nine will allow the research to find a framework in which every project can benefit from Soft landings at the design stage no matter their size. Analysis of how each team adopted the Soft Landings process; How the Soft Landings Champions were appointed, and how some of the design decisions were taken.

Chapter 7

Cross-Comparison Analysis using descriptive codes

7.1 Introduction

This chapter presents a cross-comparison analysis of the four case studies described in Chapter six. The theoretical framework outlined during the methodology discussion (Chapter three) is used in interpreting the decisions arrived by each group of professionals. Focus will be in the timing of the introduction of other professionals and the end users into the design stage of the buildings. The four cases are unique in their procurement and construction with the projects all interpreting the Soft Landings Framework in different ways. The method of procurement was one of the biggest factors that determined adoption of Soft Landings in each project. This chapter investigates the codes generated from the data (Section 5.5) discussing basic patterns common to the projects and differences in their adoption of the Soft Landings Framework. This will be discussed on generated descriptive themes such as 'Procurement routes for projects' (Section 7.2). The respondents have also been assigned letters for ease of recognition during analysis.

7.11 Classification Scheme

The first set of conceptual classification scheme is explained in chapter six. The case studies were divided (A and B) according to when they adopted the Soft Landings process. The second classification scheme as explained also in chapter six is multi-level and is contained within the first classification. This is used in differentiating the respondents within the case studies. Using numbers, this group specifies the case study number and a number for each respondent within a particular case study. For example, case study 1 adopted Soft Landings after the design stage so it falls under the classification 'A'. Being the first case study discussed, it was numbered '1'. Therefore, the full classification of case study 1 is 'A1'. A respondent in case study 1 is also assigned a number; For example, the Architect is labelled ‘A11’, meaning the Architect is the first respondent in case study 1 which adopted Soft Landings after the design stage. Subsequently, case study three belong to the ‘B’ classification because it adopted the Soft Landings process during design and is given a designation of ‘B1 (being the first case study in this group). The respondents in this group have their designation as ‘B11’, ‘B12’, ‘B13’ and ‘B14’. The full classification scheme is presented below.

Table 7. 1: Classification of case studies and respondent codes

Case Study	**Building Type**	**Group Classification**	**Respondents and codes**
Case Study 1	Educational	A1	Architect (**A11**) Project Manager (**A12**) Electrical Engineer (**A13**)
Case Study 2	Office/Commercial	A2	Architect (**A21**) Construction Manager (**A22**) Environmental Engineer (**A23**)
Case Study 3	Office/Commercial	B1	Design Team Leader (**B11**) Project Sponsor (**B12**) Sustainability Manager (**B13**) Facilities Manager (**B14**)

Case Study	Building Type	Group Classification	Respondents and codes
Case Study 4	Industrial/Commercial	B2	Architect (**B21**) Soft Landings Champion (**B22**) Service Engineer (**B23**)

7.2 Procurement Routes for the projects.

The procurement method of a project can have an effect on how the Soft Landings framework is interpreted. Procurement usually depends on the nature and scope of work, how risk and responsibilities are shared and the party responsible for the design. The industry has been moving away from the image where clients and contractors are seen as adversaries during procurement (Bresen and Marshall, 2000). It was therefore no surprise when the respondents agreed that their teams worked well together. Some of the professionals interviewed were not directly involved in the procurement process (as in the case of A13, A23, B14 and B23). Some worked directly with the client as consultants (as is the case of A1, A21, B12), while others worked as sub-contractors after the tendering process (as is the case in project B4).

Project B3 had a closed tendering process (Table 7.2), which all the respondents agreed made the procurement process smoother and implementing the Soft Landings Framework easier. B12 who acted as the project sponsor for the case B1 explained:

> *The ministry deals with a list of approved contractors for all their projects therefore the tendering process was a closed tender process. This makes it easier for us to get quickly through the tendering process. We have worked quite a bit with most of the registered contractors so it was really to get the best team for the job. Usually we specify our ER's (Employer's Requirements) and*

> *they come up with the designs and cost. This project was no different from others we have procured.'*

The advantage of having a closed tender is working with companies that the client has worked with before; this allows better coordination and simplifies the process. Soft Landings in its procurement guide (Bunn, 2014) calls for parties to make the process as straightforward as possible. This system worked particularly well for this project because of time constraints and allowed the adoption of Soft Landings straight from inception. The advantages are evident as the project was delivered on schedule with few operational problems (Table 6.4).

Case B2 had a more complicated procurement route (Table 7.2); the project was procured under a two-stage design and build process which prevented the early adoption of the Soft Landings framework despite the Architect having worked on previous project. The Architect **(B21)**:

> *'... I was not involved in the negotiations at this stage but in the end the agreement was the cost is going to covered by three groups, the client, main contractor and ……. So, in stage D (RIBA stage 3) it was agreed that the project was going to be involved in Soft Landings. We were going to get a Soft Landings expert (Soft Landings Champion) to advice on the process and get the teams on board…'*

In stage 1, the client's design team (consultants) and consultant engineers developed the design brief to RIBA stage D. The main contractor was appointed to design and build based on the client's RIBA stage D requirements. The Soft Landings process was not introduced till during the second stage of design. The Architect **(B21):**

> *'I remember we started at stage D (RIBA stage 3), as concept and the general outline, were already decided, we were in and out of meetings with the client representatives design team… We had the first meeting with the Soft Landings Champion when we started developing the design. Our discussions were on the expectation of the client about the buildings, the targets set from the BREEAM*

consultation from the assessor and how we can get most of it done from the design.'

The first design team did not adopt Soft Landings, the client had to be persuaded of the advantages of the process by the second design team. In this process, the project lost the chance of benefiting from early adoption of the process. Some may argue that problems discovered later during post occupancy evaluations can be traced to the fractured procurement process. This was despite the considerable experience of the Architect (16 years as a designer) and having worked on other commercial developments.

Like project B1, project A1 also had a closed tendering process; the client had a list of contractors which had with them before as the Architect **(A11**) explained:

'…Yes, it was procured under JCT … It was the XXXXX council (name of the council). *It was their framework of which we were a member and yes we had to tender for the project.'*

According to Architect **(A11)**, even though it was a closed tender, the team did not adopt the Soft Landings Framework because according to the Architect **(A11)**:

'As at 2008, I was not aware of it (Soft Landings) I can't member exactly when the Soft Landings frameworks were written but it wasn't much earlier than that. We worked within the brief and wanted sustainability to be a core objective of the project. I suppose the client (XXXXXXX) were quite keen on promoting sustainable and energy efficient buildings.'

Lack of knowledge in the process is one of the main reasons why many companies do not use Soft Landings (as discovered from the pilot study in Chapter 5). Project A2 was also procured under a JCT contract but was an open tender (Table 7.2). The client had two similar briefs and which were designed by one design team but built by different contractors. The design team did not adopt the Soft Landings process at the design stage but used some Soft Landings principles to inform design and construction. Although the two projects had different contractors, the problem issues in their post occupancy evaluations were similar. This might mean that many of the issues were as a result of the design and it did not matter how well the construction team performed.

The debate on the effect of the procurement process on sustainability continues (see Chapter 2). It is clear that some procurement routes such as closed tendering are easier for the adoption of Soft Landings. While a 2-step procurement route fragments the process, which can lead to problems especially in communication. What the process requires during procurement is setting and maintaining client and design objectives (Employer's Requirements) that are both robust and realistic; managing them through the whole procurement process and the subsequent construction stages (Bunn, 2013). It is obvious that the experience of the Architect has a negligible positive effect on the overall success of the project if the procurement method is flawed.

Table 7. 2: Summary of case studies with procurement methods and BREEAM ratings.

Project Class.	**Procurement Method**	**Airtightness Design ($m^3/h.m^2$@50 pa)**	**Airtightness Tested ($m^3/h.m^2$ @50pa)**	**Electricity kWh/m^2/ year**	**Gas and other heating fuel kWh/m^2/year**	**Technology**	**BREEAM Environmental rating**
A1 (Dinning Block)	Traditional Method; Tendering in form of competition	10	11.85	73.8	272.9	Roof-mounted Passive stack ventilators, CO_2 Sensors	Very Good
A1 (Junior block)	Traditional Method; Tendering in form of competition	10	8.49	28.0	95.7	Roof-mounted Passive stack ventilators, CO_2 Sensors	Very Good
A2	Design and Build	10	8	67.5	69.4	Biomass, Photovoltaics	Excellent

Project Class.	Procurement Method	Airtightness Design ($m^3/h.m^2$@50pa)	Airtightness Tested ($m^3/h.m^2$ @50pa)	Electricity kWh/m^2 / year	Gas and other heating fuel $kWh/m^2/year$	Technology	BREEAM Environmental rating
B1	Traditional Method; Closed Tendering	5	4.9				Excellent
B2	2 step Design and Build	5	4.91	12,135	16,453 (This only represents usage from offices)	Solar Photovoltaics Reverse cycle air source heat pumps, CO_2 heat pumps	Excellent

7.3 Soft Landings activities at the design stage

There are several similarities between all the projects at the design stage. Although two of the projects did not specifically tag their projects as Soft Landings at the beginning, they followed the principles and adopted some of the framework. There was a common thread in all four projects with the client's brief requiring high BREEAM certifications and environmental sustainability targets. This meant that right from the start the design team had to work to integrate building systems and technologies. This was confirmed by the Architect in case study A1 **(A11)**:

We worked within the brief and wanted sustainability to be a core objective of the project. I suppose the client (XXXXX Council) was quite keen on promoting sustainable and energy efficient buildings.'

At the beginning of the project, the objectives were specified to all project members. This allowed each team to focus on the how to achieve the goals. This is in line with the Soft Landings core principles of setting performance objectives. The performance objectives included user training, building and waste management and energy performance targets. The objects were outlined using BREEAM as a guide for the team. The Project Manager **(A12)** explained:

'…the objective of the project was to have the new buildings achieve BREEAM excellent standard and everyone was clear that the project was going to give attention to sustainability. The team was aware of the objectives and the client understood that we were going to do something radical to achieve the project goals.'

This situation was similar to case study 2 (A2) where Soft Landings was not initially specified. The Soft Landings Framework calls for the adoption of the entire process, from inception to extended aftercare. This way, the project can take full advantage of the process. The project did however, set performance objectives which is part of the framework. The Architect **(A21)** confirmed:

'…we put in place a system where the sustainability targets of the project can be easily monitored making them easier to achieve. The energy performance of the building will be the most important element when dealing with sustainability…'

The Construction Manager **(A22)** adds:

'…*The client had two very similar briefs for both projects with specific targets of a BREEAM excellent certification. The buildings were office buildings that will be innovative and use the latest technology to reduce the carbon footprint of the project…'*

The project had clear objectives to achieve BREEAM 'excellent' certification. This helped the project with respect to the design of the building. The design team were aware of the expectation of the design and therefore worked to achieve targets from the brief. In contrast to both case studies in group A, the respondents in group B had a Soft Landings champion as well as an expert professional to oversee the sustainability targets. The Soft Landings Champion **(B22)** in case B2:

> *'I was responsible for working with the BREEAM assessor, working through the BREEAM credits requirements. To look at the project sustainability targets and to make sure that at every step of the design those targets were on track. So, reality checks during technical and detailed designs…'*

The Soft Landings Champion assumed the responsibility for meeting the sustainability targets. The experience of the Soft Landings Champion may have given the team the confidence to entrust that responsibility to him. Having been involved with Soft Landings for six years, he was in a position to work closely with the BREEAM assessor. This allowed the design team to carry on with their task as explained by the Soft Landings Champion **(B22)**:

> *'The design was aiming for a BREEAM 'excellent' rating, which is the top sustainability target. Having a dedicated member of the team looking through these targets and discussing it with different project teams helped the design team to focus on the important elements…'*

Project B1 had a dedicated Sustainability Manager who also acted as the Soft Landings Champion at the beginning of the project; which freed other members of the team to concentrate their efforts on the design. Although this was the first time The Sustainability Manager was using Soft Landings, the design team felt confident in her ability. The Sustainability Manager discussing the responsibilities as Soft Landings Champion **(B13)**:

> *'We had a site waste management programme in place where we separated materials for recycling and landfill. We aligned our material use with lean*

construction to cut out any waste. Our outdoor heaters were also linked to the BMS system so that reduced the energy outlay when they were not required…'

The Soft Landings Champions were the main difference between the two sets of cases (A and B). Although they both had similar activities in setting sustainability targets, the professionals varied with the design teams in group A having the extra responsibility of ensuring sustainability targets. Group B on the other hand had extra people involved to take responsibility for meeting those targets.

The respondents in projects with a Soft Landings Champion (B1 and B2) agreed the design stage was relatively longer than in a tradition process. They conceded that Soft Landings process made the design process longer as more people were involved and therefore more opinions to consider.

B13: (Sustainability Manager) *'I would say the time spent in getting from the concept stage to detailed drawings was relatively longer for a Soft Landings project than a conventional project.'*

B11: (Design Team Leader) *'...it takes a lot of time and effort and patience to be able to listen to different ideas and solutions'.*

B21: (Architect) '…*Obviously, there was the very hectic schedule of trying to keep all the teams satisfied in their respects, there was the client's team of professionals which we had a lot of meetings with. That can be very time consuming, going over all the discussions and deciding which ones to incorporate in the final stages of design…'*

B22: **(**Soft Landings Champion**)** *'There no immediate disadvantage to early introduction of professionals but it takes a lot of time and effort and patience to listen to different ideas and solutions. I will say the time spent in getting from the concept stage to detailed drawings is relatively longer for a Soft Landings project than a conventional project. Having non-design professionals in this project was essential, it is now common for design teams to have non-design professionals on hand to advice on the design.'*

All the respondents considered the longer duration as a disadvantage and could stop them from recommending the process to client who will see this as higher consultancy fees.

7.3.1 Introduction of other professionals to the design stage.

One of the core principles of Soft Landings is greater involvement of all stakeholders of the project. This is evident by the introduction of non-core design professionals to the design stage. Their input can have a positive effect on the design stage. All respondents agreed that non-design professionals were involved in the design. The response to the question 'how early did you as the design team invite other professionals to the design?'

A11: **(**Architect**)** **'***Straight away, so we bid for the project with a Structural Engineer and Mechanical Engineer and a QS (Quantity surveyor).'*

A21: (Architect) *'…we had several professionals that are not core design team members on our team. We had an electrical engineering team, a mechanical engineering team, we have our site planners and landscapers on the project. I would say right after the concept design was worked out, we had meetings with our guys to discuss different parts of the design. We have different disciplines on our design team so we got the civil engineering perspective and basic M&E inputs from the team. It is now standard practice I guess; the design team seems to be growing bigger each year.'*

B11: *(Design Team Leader) 'Working within the Soft Landings principles allowed us to solve several project specific problems, the most important one being the time constraint on the project. The sub-contractor who provided the security pods was available at the second design meeting.'*

B21: *(Architect)'...No, we already met with several specialists, I remember the meeting with the cladding sub-contractor discussing the different materials we could use, we had a M&E (Mechanical and Electrical) sub-contractor who we were in talks with regarding the services. So, we had actually talked to a whole group of professionals before XXXXX showed up.'*

The introduction of other professionals to the design stage of a project is not a new concept (Reed and Gordon, 2000; Wheeler and Malekzad, 2015) but the level of involvement and collaboration at this stage has gained acceptance by more companies. A successful project must start by integrating other non-design professionals early into the design stage. A sustainable design such as the four cases needs to have all the essential professionals and sub-contractors available at the point of design to be able to utilise their expertise. Of course, this all leads back to the communication between teams. There is little use having the professionals on board if an effective communication strategy is not available to optimise the sharing of information.

This collaboration is a result of teams recognising that design cannot be left solely to design teams. For case A1, the sub-contractor **A13** (Sub-contractor) recalls:

> *'I remember the project manager in meetings with the design team; the M and E (Mechanical and Electrical) sub-contractors were also in many of our meetings. We communicated by email and funny enough I was in a lot of phone conversations with the architect.'*

While the Project Manager **A12** replied when asked about the introduction of other professionals:

> '*I received an email every time there was a meeting from the design team. I could not be there for all the meetings but I went to quite a lot of them. Other professionals were always around in the meetings, sub-contractors and even the head teacher.'*

when asked about how much influence the Project manager had over the design stage:

> *'I can say I was consulted on all the important issues, if there was a variation from the brief, I was informed. It was not a case of having power but having useful information to make decisions. I was available for the design meetings and I contributed to the design when I felt there was a need to Mind you*

For Project A2, the Construction Manager **(A22)**:

> '*…Several of our team members who were not core design team members were in attendance of most of the meetings to give professional advice while the sub-contractors were in negotiations…'*

Project A1 and A2 show that early introduction of non-core design professionals takes place even in projects not initially designated as Soft Landings projects. However, the timing and manner of information exchange is evolving; with each design team finding the right balance for each project. The Environmental Engineer (**A23)** explained their meetings as brainstorming sessions. This implies that the teams were given equal opportunity to contribute to the design.

> *'…Immediately we were contacted, our team was available for the brainstorming sessions. There was a lot to get through, there were meetings with the BREEAM assessor to set the targets and other sub-contractors as well. The design team told us what was expected of us and we advised them on the design from our recommendation report'.*

The design team recognised that for this project to achieve its sustainability targets, they had to include an expert in environmental design and construction. The design team worked with the recommendation of the environmental consultants which resulted in setting realistic targets for the project. Although there was collaboration between teams, there seemed to be lacking the leadership role with the design team filling in this role. When asked about how much influence the Construction Manager had over the design, **A22** (Construction Manager) replied

> *'I did not have too much influence over the design, we attended some meetings with discussions on different aspects which we (construction team) thought will present some challenges. These meetings usually ended with a compromise either on their part or on mine. I believe that they (design team) took on our opinions (construction team). There was a major redesign of the boiler room because of our discussions.'*

For project B1, the sub-contractor who supplied the security doors was based abroad (in Italy), it was therefore important for them to be involved in the design early in the project. The design team in collaboration with sub-contractor produced the preliminary design. This gave the sub-contractor time for early fabrication of the security doors while the final overall designs were worked out. This meant that as soon as the supporting structures were completed, the security doors were fixed into position. This deviation from the conventional process helped to cut the waiting time for the security doors significantly. This would not have taken place smoothly in the absence of a SL-CHAM, who passed the necessary information between both parties.

The Facilities Manager's **(B34)** opinion on the Facilities management team being included during the design process is that the team to had input on practical problems such as the location and position of light fittings in the main reception area.

'Our collaboration also allowed us to include a LED lighting replacement which will reduce the maintenance backlog and in turn offer a more energy efficient lighting solution for an area which is lit for the majority of the day.'

In a conventional design process, such inputs are incorporated on some occasions, however when the design is completed, it is not reviewed by the stake holders in terms of its viability and applicability before execution. The presence of a SL-CHAM opened the avenue for such evaluations. By comparison, none of the respondents in projects A1 and A2 indicated any design review after the participation of other professionals.
In project B2, the design team also collaborated with other professionals at this stage to produce the final drawings. The Service Engineer **(B43)** on when the team was introduced to the design:

> *'…The meetings with the design team were soon after we signed the contracts. That should be about stage D of the design, they were still working out details on the location of many of the building systems.'*

The sub-contractor confirmed that they were introduced to the design shortly after the design team received the concept drawings. They were therefore able to contribute to the project.

The contribution of other professionals is evident as the **B21 (**Architect**)** explains:

'…the workshops and brainstorming sessions that we have are always widely successful. They are experts in fields, the contribution of other professionals makes our job easier. We already start to get a sense of how the building will function from their input. Collaboration is very important in every project for us, we try to involve as many experts who can contribute positively to the project. of course, this all must be done with consideration of the cost of the project.'

On the question of the contribution of the non-core design team members, the design team leaders:

A11: (Architect) *'Well they were involved after the feasibility in refining the design so for instance XXXX the (Mechanical and Electrical consultants) did an overheating analysis on the dining hall block and that's why we provided solar shading on the cable land elevation and we carried out our own test as well. We made a physical model and carried out a Heliodon from UCL (University College London).'*

A21: **(**Architect**)** *'... a project of this size required collaboration from all areas. As soon the main contractor confirmed the sub-contractors, we started our meetings with them regularly. The lighting (M&E) engineers were around during the specifications of the different systems we used. Their advice was invaluable, the information about systems that we would have gone to have to investigate. They had experience with installing most of the systems which worked out brilliantly for us in the team.'*

B11: **(**Design Team Leader**)** *'we had an environment where we were open to suggestions and criticisms. We met with different teams asking them how they would like the space to function. We got a wide range of requests and suggestions. We could not incorporate all of it in the design but we got really good feedback. For our preliminary drawings, we included a rounded top to the reception workspace. During deliberations with the facilities team, they alerted us to the fact that the rounded top would be difficult for the staff to navigate. They had a storage area round the back a rounded top would not have* *worked there. We were able to change to rectangle shape which worked out really well.'*

B21: (Architect**)** *'Of course, the workshops and brainstorming sessions that we have are always widely successful. They are experts in fields, the contribution of other professionals makes our job easier. We already start to get a sense of how the building will function from their input. Collaboration is very important in every project for us, we try to involve as many experts who can contribute positively to the project. of course, this all must be done with consideration of the cost of the project.'*

All the design teams acknowledged the positive contribution to the design with many of the sub-contractors pointing out issues that were either overlooked or not even considered. In project B1, there was a complete turn- around on the shape of the main reception area because of the participation of other professionals. This was also the case in other projects, where sections of the design were changed as a result of input from others. When asked about the disadvantages of introducing other professionals to the design, the respondents talked about various reasons including the cost of hiring expert sub-contractors and other professionals, time spent on meetings with others, the fear of giving away sensitive company information and strategy,

A11: (Architect) '*The disadvantage is cost. If you are paying for somebody to be there when they do not have to be there then it's at your expense really and so if it is at the very early stage when you are taking the brief from the teachers, head teacher, the client team, the structural engineer doesn't really know how big the building is going to be yet.'*

A21: *'(Architect) As I have said, it is to our advantage that we include all the major parties as early as possible. This makes my job as an architect easier because the solutions to the design questions will have a more balanced approach. I will say giving away certain areas and strategy of the design to sub-contractors may prove sometimes detrimental to the company as sometimes we may end up bidding against each other for new projects. The cost of inviting more professionals also falls to the main contractors before the contract is signed so we have to be careful to balance initial costs.'*

B21: (Architect) *'Actually, this project had far more non-design professionals than any other I had ever worked on. Obviously, there was the very hectic schedule of trying to keep all the teams satisfied in their respects, there was the client's team of professionals which we had a lot of meetings with. That can be very time consuming, going over all the discussions and deciding which ones to incorporate in the final stages of design. XXXXX (*the main contractor*) also had the cost of all these professionals to consider, I remember a meeting with them where they pretty much told us there was going to be constraints on the cost at every stage (design and construction). So those do take the joy out of the design, there was also the BREEAM credits to consider.'*

A12: **(**Project Manager**)** *'Well there will be more people to deal with which obviously throws the discussions wider and we have to spend a little more time. This also cost more for the design team, if you are going to have experts on hand, you must pay for their time. The balance will be inviting them at the right time they are needed. Too early and they will not be much use to you. Too late and that can lead to wasted hours of redesigning and correcting mistakes.'*

The Project Manager in case A1 has raised an important issue on the timing of introduction of other professionals. As the Project Manager, he will have the responsibility of delivering the project on time and within budget. If the professionals are introduced too early, the cost implications can be substantial, if introduced too late, they might miss opportunities to make a positive impact. The presence of a soft Landings Champion can help by meeting with the design team and discussing the appropriate time for each professional to be introduced. Clearly, many in the industry face the difficult decision of appropriate timing.

It is common for different stakeholders to protect their working practices because of competition in the industry. This has been the subject of many reviews about the construction industry. In an attempt to safeguard sensitive information, individual companies working on projects often fail to give vital information to other team members. **A21** (Architect) expressed this as a disadvantage to including other professionals. **A22** (Construction Manager) adds:

'Well you get the odd complains about the time for the meetings, the locations or documentation to prepare for the meetings. You know at the beginning of the project there are so many meetings to attend and keeping on top of it all can be challenging. Other than that, things moved on well. You have to think of cost and how many people you actually need for these meetings.'

The concern of the Construction Manager of case A2 stems from the cost implications of more professionals at this stage. As the main contractors, it is in their best interest to keep costs down so they must be careful to engage the right professionals at the right time. Having cited this as a disadvantage, it will be important to address the cost implications before the start of the project.

However, **B22** who was the designated Soft Landings Champion in case B2 saw the situation differently:

'There no immediate disadvantage to early introduction of professionals but it takes a lot of time and effort and patience to listen to different ideas and solutions. I will say the time spent in getting from the concept stage to detailed drawings is relatively longer for a Soft Landings project than a conventional project. Having non-design professionals in this project was essential, it is now common for design teams to have non-design professionals on hand to advice on the design.'

This response shows that **B22** considers it important to have non-design professionals with the additional cost and time as necessary in the project.

7.3.2 Introduction of end users.

The projects fall into two groups here with the smaller projects (A1 and B1) having direct interaction with the end users. While the second group (A2 and B2) are larger projects which did not have direct contact with most of the end users. In project A1, the design team engaged extensively with the end users and project stakeholders. There were 12 recorded meetings between them. The team held a public exhibition which attracted all groups of stakeholders. They also held consultations periodically to inform and update the end users.

Interviewer: *'There is a long list of end users and stakeholders, like the pupils, the parents, was there no communication with them'?*

A11: *'We did have a couple of workshops with pupils and we did have a couple of workshops with local residents. So, we did engage with most of the people on that list really.*

The engagement with the end users yielded valuable information for the team. A major example of was the agreement to shift the entrance of the site, the end users had years of experience using the school so they could provide the team with valuable information.

A11: (Architect) *'We took feedback from the local residents and we fed it into the design. The access to the site rather than the buildings themselves. I remember there a …entrance side, the railway station side and a small fire escape on the other side of the fields. We had to change that slightly to reflect feedback but the buildings didn't really change. The buildings were very popular with everybody we spoke to we got really good feedback. Partly because of the curved shape of the classrooms and partly because of the barn. So, it was a very popular design, there was no problem.'*

Interviewer: *'How did you deal with end user concerns for the project'?*

A12: *(Architect) For this particular project, the end users were very involved. Some of our projects we are not fortunate to speak to actual end users. The head teacher of the school was very involved. He had a clear vision on his expectations. We spoke to teachers, students, parent representative and every meeting helped us gain new perspectives into the project.*
As a Project Manager, I treated the end users as team members. Their input contributed to the success of the project.

The words of the Project Manager indicated how the team engaged the end users and treated them as part of the design team. This according to Altomonte, et al (2015) is a formula for successful sustainable construction. The inclusion of the end users during the design stage sets the scene for collaborative working. This inclusion mentally prepares the end users and gives them a sense of ownership with the finished design (Jenson, 2011).

In the case of project B1, **B14 (**Facilities Manager**)** explained:

> *'The end users were introduced as soon as the concept was decided. The main users of the foyer are the security team and the checking in team. They were briefed on the concept and how the design will affect the flow of the people traffic.*

There were messaging boards all around the building and the details and dates of the consultation with the design team were made available for any interested parties to attend.'

They also organized a separate consultation targeting reception and building security staff. Such arrangement was necessary because they were the primary users of the space. The Soft Landings Champion facilitated this process by summarising and providing stakeholders with feedback to the design team. The design team also had consultation with other stakeholders. The internal stakeholders were front of house security, departmental security, Ministry of Justice disability network, Ministry of Justice fire officer, Trade Union representative, Ministry of Justice communication division, London underground, Government Art collection and the Ministry of Defence. The internal stakeholders discussed the proposals in design team meetings along with the Soft Landings Champion and Sustainability Manager to arrive at the final draft of design. It appears the design team participated only in the targeted group consultation while the Soft Landings Champion met with the wider stake holder community as well as participating in the targeted group consultation. This helped to save time on multiple consultations.

The difference between project A1 and B1 during these consultations was the presence of the Soft Landings Champion. In project A1, the design team had to attend all the consultations with the stake holders. While in project B1, the Soft Landings Champion managed some of the consultation with stake holders allowing the design team to carry on with their work. A13 (sub-contractor) remembers a lot of unscheduled feedback in project A1; This can be a problem when assessing the comments for use (Gana and Renganathan, 2017). A dedicated Soft Landings Champion would have been able to specifically work on the structure of consultations and make sure that feedback did not stray to topics not needed. Although there was a lot of feedback, the Project Manager admitted that the end users had little to do with any design changes.

Interviewer: *'How was their input incorporated into the project?'*

A12: *(Project Manager) 'Well, they had very little input in the building designs apart from telling us how the classrooms and playrooms were going to be used. They were particularly helpful when deciding the entrance of the site. We had our meetings and we noted every suggestion. During the design team meetings, we discussed the points and had to decide which ones we wanted to adopt. Of course, we had to research them first.'*

The presence of a Soft Landings Champion would have afforded the team focus on more important aspects of the project target rather than having numerous meetings with the end users. Goldsmith and Flanagan (2017) discovered this situation as the norm with design teams actively seeking end user feedback but were unable to convert this information into significant changes. This situation seems to be verified by the Project Manager from the comment above. This situation has opened an opportunity to developing a framework for end user feedback.

Project A2 and B2 were larger projects (designed for more than 300 end-user) as such the situation was very different when dealing with end-user participation. In project A2, the team had to rely on not only their experience from past projects; but also, information about the few companies already signed up to the building to inform the design. When asked about the introduction of end-users to the design stage,

B21: '(Architect)*…We had a workshop with a group of customer representatives who intended to rent office spaces in the building. The client was keen to invite top companies so we had 2 meetings to discuss their expectations of the space. Some wanted open plan offices but others were quite specific. They wanted* *specific floor finishes and lighting. I think this was before we finished the concept design. That will be after stage 1* (RIBA stage 1).

The Construction Manager **(A22)** adds:

> *'I cannot tell you exactly what stage the design team had meetings with representative groups. I think it was early while the concept was being sorted out. In these types of projects, it is difficult to get the actual end users, the marketing department was still in talks with companies interested in the building. We got a few companies already signed on so, the team (design) met with those available.'*

This is a common issue with the construction of commercial buildings, the design team does not usually have the opportunity to personally meet the end users. Most of the time, the offices spaces have not been rented. This leaves the team relying the client's brief and research into similar projects.

A21: (Architect) *'We have been involved in the design of countless office buildings and spaces so we had that experience to bring to the project. We carried out a feasibility study on the type of companies that were likely to take up residence and we used some of requirements in the design. The need for a light and open environment where the services will not interfere with their work. The client also provided us with companies they were in contact with about renting the office space. They required informal meeting spaces, flexible office spaces and an environment where staff will feel comfortable and safe.'*

As stated earlier, the design team loses an important element if they are unable to directly interact with the occupiers or end users of the building. The Environmental Engineer who was in charge of setting sustainability targets when asked about the effect the situation will have on the sustainability of the project:

A23: (Environmental Engineer) '*I guess because there was going to be limited feedback from the end user our role became even more important. The team took the brief with the estimation of the number of people using the building, and the busy times and the expectation of the design. We used this information to simulate many scenarios, working with different lighting, cooling, and* *heating specifications to give our estimation of the energy usage of the building. We worked with the BREEAM framework to assess the impact of the building to the environment. I do not think the end user would have had the impact we delivered. But you know every little helps and so on.'*

According to the Environmental Engineer, the end users' involvement at this stage will have negligible effect on the sustainability of the building. The opinion here seems to be that the job of simulations and expertise will have a greater impact than workshops with the end user. Of course, this opinion is based on this particular project and will not apply to all projects however, the post occupancy evaluations showed complaints from the end-user on issues such as thermal comfort and accessibility (See chapter six).
Project B2 appeared to use a similar strategy; The team had the added difficulty of working after the concept design **B21** (Architect) explains:

B21: *'As the design had passed the concept stage when it arrived to us, we relied heavily on notes from the client's design team. There was consultation with some of the small and medium sized enterprises group and 2 companies which had signed up to rent offices in the building. The difficulty about these projects is not hearing directly from the end user. We must rely on the employer's requirement trusting that they had a done a thorough job of their feasibility studies on the expected tenants. Having said that, we did have a meeting with XXXXX whose team was one of the first to have offices in the building. Their requirements were in line with the client's. They wanted a modern space which was flexible and easy to maintain. They were also particular about the green credentials of the building asking to see the certification when completed. So, for the project the end users had been consulted before the employer's requirements were drawn up so I would say they were involved very early in the project.'*

When asked how this affects the sustainability of the projects,

B21: (Architect) *'I will say that it affects the sustainability of the building a great deal because if the building is in conflict with the users, it cannot reach its full potential. Building systems that do not work well or not understood by the users will definitely affect the sustainability of the building. For this project, the first* *team (design) worked well with the limited resources and I believe they were spot on in their estimations and assessments.'*

While both design teams seemed to view the situation as challenging, the Soft Landings Champion had an interesting view of the situation.

Interviewer: *'How early were the end users introduced into the design process?'*

B22: (Soft Landings Champion) *'The design team had little contact with the end users on this project because the employer's requirement contained a section with an outline of the tenant's specifications. The design team used the notes from the client's design team to get a sense of the end users requirements. As with other professionals, the end users are now an important part of the design which is a double-edged blessing really.'*

Interviewer: 'Why is that?'

B22: (Soft Landings Champion) *'Well, on one hand, end users having a say in the design of the building allows both groups enjoy an interaction of taking each other seriously. Sometimes, this becomes a problem when some of their suggestions are not practical in terms of cost and know-how. Overall it is to the advantage of the design team to have an engaging end-user.'*

While the above statement might suggest that the Soft Landings Champion viewed end-user participation as problematic; On the question of how the lack of direct end user participation affects sustainability: The reply:

B22: *'The meetings with the end users usually give the team a clearer picture that is sometimes not immediately obvious from the brief. This communication helps with certain elements such as the position of ducts and lighting equipment. This in turn helps us to achieve targets in end user satisfaction by reducing problems usually associated with large buildings. The ideal situation would be to have direct access to the end-user but as with many commercial building projects it was not possible. The next best thing is the employer's requirements because they are aware of the type of client the building wants to attract.'*

Through the four cases, it is obvious that the teams view end-user participation as a chance to increase the success of the project. The level of participation however, seems to be a matter of debate, with some such as the Architects and Project Managers convinced that end-user participation is essential; While others such as the Soft Landings Champion and Engineering Manager view them as necessary but not having a big impact on the design and the sustainability. This may be due to the experience of both professionals or this could be viewed as the Soft Landings Champion suggesting that his role is to fully understand the end user requirement then convey them to the design team.

7.4 Information Exchange

Achieving sustainable design involves collaboration between multidisciplinary teams (Bouchlaghem et al, 2005). This is usually in the form of information flow between team members from the early stages of the project as this is important for a successful project. Every respondent commented on the frequency and medium of information exchange. For project, A1:

Interviewer: '*How often were your meetings with other teams?'*

A11: (Architect) '*Usually, every month, well the designers will meet every 2 weeks the meeting with the client would be once a month'*.

Interviewer: '*Were the meetings held in sub-groups?'*

A11: **(**Architect**)** *'Yes, they were held in sub-groups. The clients would never meet the sub-contractors really. The clients would meet initially, they would meet the consultants always the Project Manager and Architect, sometimes ….as well. Then when the contractor became involved, the main contractor once a month but these sub-contractors would meet the main contractor separately and sometimes the consultants would be part of that sometimes not depending on the situation.*

The Project Manager **(A12)** on the issue of Information exchange during meetings

A12: *'Our meetings were organized in such a way that the activities which took longer were discussed first. So, in this case, I was in meetings with the design* *team a lot during the early stages. I will speak to XXXXX (name of Architect) on the phone several times a day. The meeting with the design team was once a week to check on the progress of work. Later those went to once a month or when we needed to discuss something important.'*

For project A2, the Architect:

A21: *'We used a central arrangement to deal with our communication. We had details of every project member including the project email address and phone numbers. Most written correspondence is available on the project forum, everyone with access to the forum can have access to the messages. Having said that, we communicate in other forms, telephones, text messages to appropriate people. Sub contactors are always kept updated with new information.'*

The Construction Manager:

A22: *'…we always have a central messaging centre which is quick and easy. We use emails to reach teams and individuals, lots of phone calls, skype calls, conference calls. Technology has made it easier to get in touch with team members. The difficult part is getting things in writing, if you have long discussions, there is a tendency to forget some of the things you have discussed. I use a follow up email but sometimes you can get overwhelmed.'*

From the Construction Manager, it is obvious that some forms of information are more efficient than others. Although speaking on the phone is quick, writing down the conversation may be lead to some lost information. The project messaging centre is vital because all team members can receive the same information at the same time. Many large projects have central messaging centres where team members can send and receive information. The Architect:

A21: *'We had several lines of communication, I was in constant communication with the client, the sub-contractors from Italy, the other sub-contractors, and the Project Manager. The software allows you to send messages to other team members so we used it constantly. We also used our emails to communicate, we* *spoke on the phone to others. There was a lot of communication going on especially during the design stage.*

… My team met every day to discuss any new developments and to check on the progress of the design. We met other team members once every week usually to check that we were on the same wavelength. My team carried on with the design drawings while we met with other teams. The meetings reduced when construction started but we still had the important meetings monthly.'

For project B2, the Soft Landings Champion on the lines of communication:

B22: *'Well, like all projects, we had a messaging centre, we all had email addresses and job descriptions of other team members. I was in contact with almost all of the teams. We spoke on the phone, during meetings, we had minutes of the meetings as well. There was a lot of email to send and receive. I sorted the information on importance and priority, information that was needed quickly saw me reaching for the phone and discussing it before sending an email to confirm all that we discussed. If the information was not urgent, I will send an email to whoever I wanted to reach. I had to send most emails with a level of priority, urgent, high, or low. I also had a lot of face to face meetings because if I remember correctly I sat in all the design team meetings with the project manager. I was also in many of the site meetings. There were a lot of meetings.'*

From all the answers above, we can deduce that there were several levels of communication going on. The design team with the main contractor, the design team with the client, the design team with the sub-contractors, the main contractor with the sub-contractors. Each line of communication will have to be given adequate importance to avoid excluding important stakeholder or information overload. Dainty, Moore and Murray (2006) and Lunenburg (2010) discovered that poor communication can lead to lower performance. The information exchange does not only include communication between teams but also the timing of delivery. Good quality information will be 'the right information reaching the right person or team at the right time.

For project B1, the Sustainability Manager:

B13: *'We had a central email enquiry address; there was also an information board in the main atrium where not only team members could find out the progress of works but also people using the building. Our main form of communication was by email and the project management software messaging matrix.'*

A communication matrix in the software enabled them to pass the information across all project team members. The SL-CHAM played a key role in developing this matrix. This initiative helped project team members engage with other teams throughout the project. There was also a 'meet the contractor' forum where the end users could ask questions about the project. A proposed digital screen for the BIM fly through demonstrations was not provided by the client. Therefore, this initiative was relatively unsuccessful. There was an information board in the main atrium where end users were informed of new developments. The Soft Landings Champion continually updated the information on the board and made the end users aware of emails addresses where they could get in touch with any questions or comments.

This project continued to update end users by using information boards at strategic positions in the building. This was only possible because the project was not particularly large and end users had access through parts of the redesigned space. This cannot be possible for larger projects where end-users are not around the construction site. This raises the question of how sub-contractors and clients are kept informed of new developments in the project. A23 who was a sub-contractor in project A2 explains:

A23: (Environmental Engineer*) 'We were updated about any new information on the messaging centre or emails. I do not think we were left out of any information on our part of the project. we received every information we asked for and we also sent information to other sub-contractors who requested for results on simulations.'*

The sub-contractor from project A1 explains how the team was kept in the information loop:

A13: (Electrical Engineer) *'At the beginning of the project there was a lot of paper work to go through so we met nearly every day. The discussions moved on to their concepts of the design, they wanted to hear our ideas so there was a lot of* *brain storming at this stage. After all the decisions were taken, our meetings tapered off to once a month. The design team could produce their drawings. We carried on our team meeting, which was usually once a week'.*

The project sponsor in project B1:

B12: (Project Sponsor) *'I was kept informed about the progress of the project by email and was invited to some meetings which included sub-contractors. I requested for minutes from some meetings and it was emailed to me as well.'*

Even though there was open flow of information between the professionals, there seemed to be a disconnection of information flow between the project team and some end users. The position of communication boards in the corridors was not suitable as many people did not stop to read the information. One of such end users explained:

'I did not usually have the time to stand and read information pasted on the walls, the information that I received was from colleagues. Some of them went for a meeting arranged *for our department but even that meeting seemed hastily arranged.'*

When asked if they felt included in the process, one end user answered

'I felt we were not as important as some other end users and information was passed to us after many of the decisions were taken. Why wasn't the information emailed to us? I did not feel included at all'.

The building has 14 floors and houses hundreds of staff; therefore, it would be almost impossible to speak to every worker in the building. The project team outlined the major internal stakeholders and focused their interactions with those identified. The end user who felt they were not consulted worked on the 5th floor therefore the construction had minimal effect on them. The lines of communication from the four cases seems to be established on similar system.

7.5 The role of the Soft Landings Champion (SL-CHAM)

The role of a Soft Landings Champion is vital in any Soft Landings project no matter what stage the process is adopted. The Soft Landings Champions in project B1 and B2 had prominent roles to play during all the stages of the project. The two projects adopted different approaches to the Soft Landings Champion. Project B1 followed the framework by allowing a member of the team take the role. However, the role moved from team member to team member; From the Project Manager to the Sustainability Manager and later to the Facilities Manager. The Soft Landings Framework argues for a designated Soft Landings Champion who is a member of the project team. The ideal scenario will be two SL-CHAM; one from the client side and one on the project team (SLCP, 2014). The Facilities Manager explained the reason:

B14: *'There was no specific Soft Landings Champion, the role shifted from the Project Manager, because during the subsequent weeks he got too busy to attend to both roles properly so he nominated the Sustainability Manager and later on I took over the job.'*

However, as per Facilities Manager, the duties and responsibilities of the SL-CHAM did not change.

B14: *'We passed a lot of information to the sub-contractors and other members of the construction team through the Soft Landings Champion, when the role fell to the Project Manager, this was particularly handy because we did not need to have separate meetings, all our discussion and deliberations were relayed by the Soft Landings Champion.'*

The design team leader however, felt that role should be designated to one person. He expressed his opinion

B11: *'.... because this was our first Soft Landings project together, we wanted to find out how the everyone would deal with the role. For our next project, I will definitely push for one person in the designated role. That will make things easier from my perspective'.*

One of the Soft Landings Champion's tasks involved keeping the sub-contractors informed on any new changes to the design. The sub-contractors were based in Italy and were only able to attend the first few meetings; the rest of the information was passed to them through the SL-CHAM. This made the rate of information exchange quicker than a traditional project where design meetings are generally carried on without the representatives of sub-contractors. The sub-contractor did not receive the information on a 'need to know' basis but on the understanding that shared information about the project makes changes quicker to adopt.

The lack of a dedicated SL-CHAM may have impacted negatively on the project. Team members had to take turns in assuming the role which would have led to their original roles suffering as a result of the extra workload. In response to how other professionals fulfilled the role, the design team leader stated this:

B11: *'The Soft Landings Champion was particularly handy when the Facilities Manager took over. The project was still in the construction stage, the Facilities Manager was involved with the design and construction and discussed options with the sub-contractors.'*

While a traditional Project Manager mainly focuses on the highly technical aspects of the project, the SL-CHAM focuses on the 'soft' side of project management like bringing awareness to the end users, highlighting policy issues to team members and assessing each project decision from a sustainable point of view. For project B2, there was a designated Soft Landings Champion who was tasked with overseeing the smooth transition of work through the main stages of work. When asked for the responsibilities during the project, the Soft Landings Champion:

B22: *'I was responsible for working with the BREEAM assessor, working through the BREEAM credits requirements. To look at the project sustainability targets and to make sure that at every step of the design those targets were on track. So, reality checks during technical and detailed designs. I also relayed information to team members, if there was a meeting and certain people were not available, it was my responsibility to make sure that they were informed of any discussion and new developments.'*

From the responses, the role of the Soft Landings Champion seems to be working as an intermediary between teams and relaying information to the appropriate person. When asked how the role of a Soft Landings Champion affected the design stage, the Architect:

B21: (Architect) *'At the time he was introduced, the first design had settled on the concept of the design. We had also agreed with the concept especially the bubble design. We were still discussing the material to be used for the bubble. Immediately after our first meeting, it was obvious that we needed to continue meetings with XXXXXX (the first design team). This fell to the Soft Landings Champion to be the middle man, he was available for all our meetings, discussing a variety of options for materials and even suggesting sub-contractors from previous project. There was a lot of back and forth during this stage, he freed us to get on with the design while he made sure every team was on board with their contributions to the design. The problem was the design had already been through a few changes and it was quite difficult for others to keep up with the change and control. The Soft Landings Champion helped to bridge that gap that would have otherwise occupied our time. It was a good collaboration. He kept asking questions about the targets set by the employer's requirement to make sure we didn't lose sight of that.'*

7.6 Preparations for handover

The Soft Landings framework calls for activities that prepare occupants and building managers for handover. Activities such migration planning, maintenance contract, compiling building guide for occupants. On the question on how the teams prepared for handover, the Architects for each project:

A11: '*There was a little bit but not much, maybe half a day with the M&E sub-contractor. We had produced the building user guide and expected them to acquaint themselves with it. We did our best to write everything in quite simple and layman's terms.'*

A21: *'Well, we worked with the building managers to prepare the building for handover. The building managers were partly responsible for informing any new occupant about the building systems. The sub-contractors all prepared their operation manuals. The boilers were especially difficult because the boiler used wood pellets with a backup gas boiler the building managers needed days of training.'*

B11: *'We were all very much involved during pre-handover and handover stages. The Soft Landings Champion asked that all O&M be produced and submitted for discussion before handover. The teams could sit down and discussion preparations for training and handover.'*

B21: *'All sub-contractors were expected to produce their O&M (operation and maintenance manuals). The sub-contractors trained the building managers for handover of the building.'*

In the four projects, the design team all seemed to be involved with preparation of handover. The most common activity was preparing operation and maintenance manuals for the facilities management and end-users. However, their level of participation and preparation differs in each project because of various reasons. For project A1, the Project Manager:

A12: *'Well at the time of handover the project had gone longer than expected because of the extra classrooms and what not…. so, I suppose time was not taken to properly instruct the two men (Head teacher and caretaker). I remember a training on the day with the manuals written for them. They were quite basic but really, we needed them to understand the building systems as quickly as possible. We do thing differently now.'*

For project A2, the Construction Manager:

A22: *'It was a very stressful time, we had a brief overrun because of some off the site issues we had to deal with. The finishes were being rushed to accommodate the client's need to take over the building. There were also a hundred different things that need attention at once. The team worked overtime to accomplish the tasks we had.*

…As I said earlier, a handful of companies were ready to occupy the building. The team made sure that all sub-contractors met the deadline for preparing their operation manuals. There was a meeting with each of them to discuss the best way to train the building managers. We drew up a time table to test each system to make sure they were working properly. There was training for the electronic building management system and connections to the thermostats…'

The effects of the absence of a dedicated Soft Landings Champion in both projects (A1 and A2) can be seen here. The Construction and Project Managers were having a difficult time trying to meet deadlines and prepare for handover. A dedicated Soft Landings Champion would have been able to take charge at this stage and organise the activities for handover while the Managers can be free to continue on the finishing stages of the project. The architect of project A1 acknowledged training of staff and the use of guides but these activities seem to be performed as a checklist exercise. There seemed to be no proper strategy for the handover following the Soft Landings Framework.

This was not the case for project B1 and B2 as they had Soft Landings Champions to oversee the preparations for handover. The Facilities Manager acting as the Soft Landings Champion in project B1:

B14: (Facilities Manager*) 'We had about a week with different sub-contractors training the team about the heating and cooling systems, the lighting system, the security pods and backup systems'. The team had meetings during that week discussing how the new systems worked and how to operate them. They were new systems and different from the ones we had before so all of us were eager to find out how to use the new easier systems.'*

This was similar to project B2 with the Soft Landings Champion:

B22: (Soft Landings Champion) '*There was an agreement with every sub-contractor on the commissioning programme it was to let them know when they were to come in and train the facilities team. We also produced a flow chart detailing when and how each sub-contractor will meet the groups. They were to prepare their operation and maintenance manuals and give presentations and demonstrations to the team. We had an issue with video training, the Project Manager was under the impression that a lot of the sub-contractors will produce video showing how to operate many of the systems but none of them came up with that. It seemed it was discussed in the beginning of the project but was never finalised. The sub-contractors complained about the cost of producing the material which wasn't covered in the payment to them.*

We had several days of training, the facilities team just a skeletal staff of 3 people, I felt more people should be in for the training but 3 staff were all that took part in the pre-handover training.

These two projects (B1 and B2) were better prepared to train Building Managers and Facilities teams on the use of the building systems. There was a clear strategy and timetable on how the trainings were to take place. In project B1, the facilities team also prepared the occupiers for handover as explained by the Facilities Manager:

B14: (Facilities Manager) '*Our plans for the new phase were communicated to the users by email, picture boards which provided a step by step guide to operating the pods (security doors) were placed in the reception area to educate them on how to use the security doors. The issues of fire safety were also explained because in the event of a fire, the pods cannot be used as a means of evacuation.'*

Despite the Soft Landings Framework advising the design team to be involved with during this stage (SLF, pg20), the design teams in all four projects did not seem to be actively involved. To the question if they were actively involved

B11: (Design Team Leader) *'I was not personally involved for the training but we had discussed those with the sub-contractors. I remember the email informing us that the facilities team had been trained for the heating and light control systems. The security team had intense training for the security pods and the systems that power them.*

B21: (Architect) *'Our activities during the pre-handover were limited, we had practically finished our part in the project, but due to the Soft Landings activities, we were around for some meeting during the handover. We had the walkthrough with the building operators. I was around for 2 days of training with the operating team, we found some minor issues this way which was handy because we could start sorting it out. So, we did participate in the handover activities. The Soft Landings Champion continued emailing us on the progress of the trainings so we knew what was going on.'*

It can be argued that project B1 and B2 did not need the active involvement of the design team because the Soft Landings Champion was available to oversee these activities. However, the point of Soft Landings is for teams to collaborate at each stage of the project so that they can learn from these experiences. There seemed to be a detour from the Soft Landings framework in project B1 as the design team should be actively involved in the training of staff along with the Facilities Manager. Although the design team discussed the training before hand, they chose to allow the Facilities Manager take charge of the procedure. At this stage, the Facilities Manager had the role of the Soft Landings Champion which could lead important issues to be overlooked. The Soft Landings framework calls for static commission which includes inspections of airtightness and visual checks of all openings.

The lack of direct involvement of the design team could be responsible for some of the issues outlined in the post occupancy evaluations (see chapter six). One of the issues was the observation from the post occupancy team that the commissioning of the Building Management System in project B2 was not adequate. They noted that the direct supplier was not available to train the facilities staff. The direct supplier was in contact with the design team during the early stages of the project and the presence of any of them would have provided clarity for the handover team. This led to the heating system being poorly calibrated which would have a negative effect on the overall sustainability of the building.

7.7 Initial and Extended Aftercare

The Soft Landings framework calls for initial aftercare for the building and extended aftercare if required. Activities such as: providing technical guidance and schedules walkabouts are recommended for a comprehensive building analysis. The Architects when asked about aftercare activities explained under what circumstance they returned to the building.

A11: (Architect**)** *'…as a design team trying to establish the building performance as it was handed over. And we identified issues as you can see in the report, issues with the ventilation, issues with PV, the metering and sub metering, all those issues which we identified post-handover…. We got the main contractor to come back to fix it. It took a long time because the M&E sub-contractor was very* *poor and was not responding to our requests. So, they were still under contract, it was still within the defects liability period.'*

A21: (Architect) *'The schedule for our involvement was light, we had a couple of meetings with the building managers and introduction of the sub-contractors. They had some questions for us which we answered. We also had to provide some extra working drawings to them.'*

B11: (Design Team Leader) *'It was agreed that a period of 4 weeks should be sufficient for the aftercare period; any difficulties later will be solved by call outs to the contractor.'*

B21: (Architect) *'Not personally, the team had a walk-through the building before handover noting changes in the design. The main contractor and other sub-contractors were involved.'*

As for the case of pre-handover activities, the projects' approach seems to differ along the lines of a Soft Landings Champion. Project B1 and B2 design teams did not seem to be involved in the aftercare of the building because they had a designated Soft Landings Champions but as stated earlier, there is a need for them to be involved so that they can learn from current projects. This situation unpins the argument from Bordass (2005) on why Soft Landings should apply throughout all the stages of the project. Learning from the project could give the design teams a different perspective on new projects. This leads back to the sustainability of the building; wherever there is a break in communication between teams, the sustainability of the building is likely to suffer.

The Soft Landings Champion in project B2 on the aftercare process:

B22: *'The aftercare period depends on how technically challenging the project is predicted to be. There will be a specified period of time stipulated in the contract and we work within the given time frame. This is after the limited liability period has expired so most of the problems will have been sorted out. We are usually in constant communication with the facilities management department so we able to have a presence in the building when the situation calls for it.'*

On how this affects the sustainability of a project:

B22: (Soft Landings Champion*) 'Enhancing the sustainability of a building is an on-going process. This starts long before the design of the building with certain parameters in place. Definitely I feel that the fact that will are on hand to help work out the kinks in the occupation and operation of the building eliminates the issues that may lead to major problems later. This counts towards increasing and maintaining the sustainability of a building.'*

All four projects carried out the initial aftercare which ran at the same time as the defects liability period. They were able to identify and solve certain issues with the buildings. Extended aftercare is however more difficult to identify their involvement.

7.8 Summary

This chapter provided a cross comparison of the four case studies using descriptive codes generating from the data. The cases were distinct in their procurement and how they implemented the framework. Several situations became obvious from the analysis:

- Experienced professionals did not seem to view end user participation as particularly beneficial.
- The complex interactions during the projects were visible through the lines of communication between the teams.
- Even projects that adopted Soft Landings from inception seemed to lag during the transition periods of the project.

These observations may have been responsible for some of issues that plagued the projects after occupation. This will have a direct effect on the sustainability of the buildings as they miss their design and operational targets. The next chapter analyses the relationships between the cases and the Soft Landings Core Principles.

Chapter 8

Cross Comparison Analysis of case studies using themes generated from coding and Soft Landings Core Principles

8.1 Introduction

While chapter seven analysed the descriptive themes that emerged from coding the data generated from semi structured interviews with the project professionals. This chapter will further analyse the collaboration between teams from the Soft Landings Framework perspective. The way the case studies interpreted and adopted the framework at different stages with the consequences of their actions. The core principles (discussed in chapter two) are supposed to act as guidelines to professionals and clients intending to use Soft Landings.

This chapter also sees the introduction of data collected from five Soft Landings consultants who have experience in the process. Three of these consultants contributed to setting up the Soft Landings Framework and writing the guidelines for the procurement for a Soft Landings project. Their responses give this analysis chapter further perspectives about the Soft Landings process compared to the case studies (see chapter 3). The sections follow these principles paying attention to how their interpretation affected the projects. Evaluating how the teams adopted the Soft Landings process and setting performance objectives (section 8.2). The identification codes from the previous chapter remain the same with the addition of the five Soft Landings consultants (C01 to C05).

Table 8. 1: Summary and respondent code of Soft Landings Consultants

Profession	Designation	Years of experience with Soft Landings	Respondent Code
Process Engineer/ Energy Consultant	Soft Landings Champion	5	C01
Environmental/Service Engineer	BSRIA User Group	10	C02
Project Manager	Soft Landings Consultant	2	C03
Environmental Engineer	Soft Landings Champion	8	C04
Architect	Soft Landings Consultant	6	C05

8.2 Adopting the Soft Landings Process and Setting Performance Objectives.

The Soft Landings process is not intended to be only an add-on to the project, it is designed to be central to any conventional construction project (SLCP, 2014). But adopting the process halfway or towards the end does not fully take advantage of the process. This can be seen in project A1 and A2 and to some extent B2. The four cases adopted the project at various stages due to their procurement methods (see chapter seven) which negatively affected collaboration and flow of information. Adoption of the whole process depends on the client's experience, and their willingness to pay for the additional cost of implementation. All the Soft Landings consultants agreed that it depended on the requirements of the client.

C04: (Environmental Engineer*) '...I had one client who two weeks after handover said I am willing…let's make this a Soft Landings project which at that point I said it's a bit too late………and he wasn't interested beforehand he was interested once he'd seen the things that can go wrong……. I think that really showed the clients I have worked with when you start telling them there is another way, they are very wary about spending more money…'*

Respondent **C01** points out that adoption of the process depends on the client:

C01: (Energy Consultant) *'…sometimes it's only on stage 3 and stage 4 items and sometimes its jus the POE (Post Occupancy Evaluations) so it just depends on the details of the project and the client's requirements...'*

C02: (Service Engineer) *'Soft Landings can be used with most current contract types; it just has to be requested by the client in the brief that the project is required to be a Soft Landings project…here the client plays the major role in specifying the type of project they require…'*

Their responses establish Soft Landings as a client-driven management tool (see chapter four). The respondents all felt that the responsibility falls to the client as additional funding will be needed for the process especially during extended aftercare and post occupancy evaluations. However, professionals will have to introduce the client to the process as Soft Landings is not standard practice. This raises the question about how informed clients have to be during their projects. Their consultants have the responsibility to advise them on new technologies and processes to use.

C03: (Project Manager) *'…the main contractor usually suggests to the client the need for a Soft Landings Champion and a member of the team is nominated as a dedicated Soft Landings Champion.'*

C04: (Environmental Engineer) *'...I have Soft Landings experience people come to me and employ me to involved in the design earlier on, and part of my recommendation is about adopting Soft Landings. It's not that they want soft landings so they come to me.'*

Interviewer: ‘So, it’s a recommendation from you’

C04: (Environmental Engineer) *‘Yes, it is recommending good practice… Now the problem is a lot of clients especially new clients even the experienced ones, the experienced ones want to do it like they did the last time. The inexperienced ones haven’t read up on the it before so they are overwhelmed with all the learning and they are like ‘Soft Landings? What does that mean? We are at a stage where we are trying to provide awareness of Soft Landings’*

From the responses, the adoption of the Soft Landings process depends on the experience of the main contractor and their ability to successfully convince the client to agree to the process. Project A1 had the professionals with the least experience in Soft Landings; The project started in 2008 and the process was still in its early stages, the Architect of project A1 when asked why SL was not introduced to the client:

A11: (Architect) *‘As at 2008, I was not aware of it (Soft Landings) I can’t remember exactly when the Soft Landings frameworks were written but it wasn’t much earlier than that…’*

This project only adopted SL during the handover stage of the project. This resulted in problems with the design of extra classroom; Although they had a sub-contractor simulating thermal conditions for the building for the first design, subsequent classroom designs were left unchecked which resulted in thermal bridging and issues with thermal comfort (see Table 6.2). Adopting Soft Landings at the design stage would have recognised the need for reality checking with any addition to the design.
Project A2 also missed the advantages of a Soft Landings Champion during the design stage because the client did not want to fund the process at the beginning. The Construction Manager said something similar to the Architect in project A1:

A22: (Construction Manager) *‘In 2008 when we first started, there were just a few companies getting involved with Soft Landings. I remember there was talk about it some months earlier when I went for a conference but since the client did not specifically ask for SL we just followed the brief.’*

This gives credence to the earlier assumption that Soft Landings is a client-driven management tool for sustainability (see chapter four). At the start of the project, the client was unaware of the Soft Landings process to include it in the brief. The design team felt that they could deliver the building and achieve their objectives without it. When asked why the process was not adopted earlier in the project, the Architect replied:

A21: (Architect) *'Apart from having a Soft Landings staff or representative, I believe that we were in line with the whole concept of SL. We knew that it was going to be a challenging project. Trying to get all the different systems working right was going to be difficult. Of course, we had to work closely with others especially the sub-contractors to produce a design that worked for everybody.'*

Some Soft Landings consultants had to introduce the process and outline the advantages to new clients. This was the case in project B2 where the second design team introduced the process to the client. Although the design had passed the concept stage, the client was convinced of the advantages enough to agree for the adoption mid design. The stage at which Soft Landings is introduced is vital to the success of any project (SLCP, 2014). If not introduced early enough the process will not be as effective because of missed opportunities of reality checking and independent reviews. If a client is already aware of the process, it makes the adoption easier as seen in project B1, where the government (client) specified for the project to be Soft Landings from the beginning.

B11: (Design Team Leader) *'My team was charged by the client to lead this process; we have had some experience with Soft Landings so we were on familiar ground. When we had a meeting with the client they mentioned their interest in Soft Landings and they were willing to listen to our advice about how to go about the project. from the start, they were clear about what they wanted which made our jobs a little bit easier than if we were to try to convince them on our own.'*

The client had a clear idea of what the Soft Landings process entailed. One of their goal was to achieve a BREEAM 'excellent' rating for the new design. This meant the overall sustainability of the project was important to the experienced client. This is from the Project Sponsor

B12: (Project Sponsor) *'In our brief we had several objectives that we wanted the project to achieve. Primarily, we wanted to redesign the reception area as a light modern space with a comfortable ambient temperature. We had complaints from the staff about how cold the foyer gets during the winter months. This was a main concern for us. We also wanted to improve the energy efficiency of the building, we wanted to achieve a BREEAM rating 'very good' or 'excellent' for the project.*

We also needed to finish the project on schedule because of the general elections coming up.'

Even though the sub-contractors did not know of the process, they signed up and were able to work within the framework to produce a successful project. Although some will argue that the client's use of closed tendering with repeat business was the reason why the project was successful, noting the collaboration of the stakeholders in past projects. Of course, this is what previous government reviews (Latham, 1994; Egan, 1998) encouraged the industry to embrace in their interactions. The ability to be comfortable with stakeholders in a project so that risks and responsibilities are shared equally. Although lack of partnering and long-term relationships is still observed in the industry (Moore and Abadi, 2011), the environment that Soft Landings creates allows the stakeholders more freedom to fully engage in the project.

Many clients are unwilling to engage the professionals because of additional costs and the opinion that the process is just 'good practice'. They see the addition of more professionals as more costs for the project.

A11: (Architect) *'We tried to engage clients but they don't want to pay for it because it can extend well beyond the 3 months minimum through to 2 years. With a few of exceptions, most clients say no. Compared to BIM which is obviously mandatory at the same time, clients are more interested in that. We do talk to* *clients about it and explain the benefits to them but they often say, 'but it's your job anyway'.*

Adoption of the process however is not enough to guarantee the success of a project. The right professionals must be introduced at the right time. This was the case in project B2, which the procurement process may have hindered early adoption. The Soft Landings Champion:

B22: *'By the time I got to the project, the design had gone through several phases. I believe the project was procured by some sort of 2 step D&B (Design and Build) method. For my first meeting, the main contractor who were the project managers, the lead designer, several sub-contractors were all in the first meeting.'*

The Services Engineer:

B23: *'…Well, there was the main contractor who were the project managers, the design team, many of the sub-contractors. We had a separate meeting with the project managers and the design team as well.'*

We note that the Architects met the client and representatives in their first meeting but not the Soft Landings Champion or the Service Engineer. This could be because they were sub-contractors and therefore did not deal directly with the client. This is typical of a conventional project but as this was later designated as Soft Landings project, it would have been beneficial for the project for the client representatives to meet some sub-contractors.

Performance objectives in a Soft Landings project should include targets on energy use (SLF, 2014). Soft Landings calls for a clear and effective method when setting performance objectives with the client's brief providing a context for the project with expectations on environmental, social and economic targets (SLF, 2014). It calls for directions for the client's expectations using space requirements, operational characteristics, and the building systems. Setting these targets allows the client's team to find out if the project needs expertise and specified roles (SLF, 2014). When asked how the teams set their performance targets:

Project A1:

A12: (Project Manager) *'...the objective of the project was to have the new buildings achieve BREEAM excellent standard and everyone was clear that the project was going to give attention to sustainability. The team was aware of the objectives and the client understood that we were going to do something radical to achieve the project goals.'*

A13: (Electrical Engineer) '*…It was good to see that the client and the team were not paying lip service to sustainability targets and were more interested than just ticking boxes.'*

For project A2:

A21: (Architect) *'We had been working on sustainable buildings for years and this project was one that called for extensive sustainable measures to offset any carbon emissions. We knew it was going to be a challenge but we already had several buildings with outstanding BREEAM certification so we just carried on as usual.*

A22: (Construction Manager) *'...From the BREEAM certification guidelines, there is a lot of checking and rechecking of each decision we take. Including others in the design and construction means we have more people to do the checking and looking over. Sometimes important things can be overlooked. It takes collaboration to achieve positive results.'*

A23: (Environmental Engineer) *'...There was a lot to get through, there were meetings with the BREEAM assessor to set the targets and other sub-contractors as well. The design team told us what was expected of us and we advised them on the design from our recommendation report.'*

Research has outlined the advantage of early introduction of environmental and sustainability objectives during the design process; With the success of the project depending on the decisions made at this stage (Russell-Smith, Lepech, Fruchter and Littman, 2015; Elforgani and Rahmat, 2012).

For project B1:

B11: (Design Team Leader) *'We had a site waste management programme in place where we separated materials for recycling and landfill. We aligned our material use with lean construction to cut out any waste. Our outdoor heaters were also linked to the BMS system so that reduced the energy outlay when they were not required. We finally used our older management system to measure present energy usage against the estimated usage…'*

For project B2, the main sustainability target of the project was to achieve the BREEAM rating 'excellent' in both design and construction. The procurement route of a two-stage design and build involved several companies some of which had adopted Soft Landings in previous projects (see chapter seven). The first part of the project did not include Soft Landings activities like design reality checks. Consequently, the client's design team missed the early opportunities that could help with setting sustainability targets.

B21: (Architect) *'…. Our discussions were on the expectation of the client about the buildings, the targets set from the BREEAM consultation from the assessor and how we can get most of it done from the design.'*

B22: (Soft Landings Champion) '…*I was responsible for working with the BREEAM assessor, working through the BREEAM credits requirements. To look at the project sustainability targets and to make sure that at every step of the design those targets were on track.'*

B23: (Service Engineer) '…*For this project, we had the BREEAM outlines to work with…the brief specified some of the energy efficiency targets.*

All the projects set out their performance targets at the beginning of the project, the method to arriving at the targets differ from one another. BREEAM played a significant role in all the projects showing the effect of the 'mandatory mechanism' government adopted in 2012 (Schweber, 2013). Although Schweber and Harty (2010) point to its flexibility in interpretation for its popularity; there a chance that the projects adopted BREEAM for other reasons such as symbolising environmental prestige (as in the case of projects A1, A2 and B2) or justifying certain design decisions (as in the case of project B2).

Once again, the client's role in stating their expectation of their project enables the design professionals to concentrate on solving the environmental challenges facing the project. All the professionals seemed comfortable with the assessment system and the design team especially worked with the BREEAM assessors.

8.3 Evaluating how the Soft Landings Champion provided leadership

The Soft Landings Champion (SL-CHAM) plays a vital role in a designated Soft Landings project. The role itself presents challenges for professionals who are not familiar with the process. The Soft Landings Champion is available in the project to bring a sense of cohesion to and bridge the gap between professionals at different stages of the projects (see chapter four). The two different groups of cases (group A and B) shows the difference a Soft Landings Champion plays in the project. The two projects in group B employed different systems for their SL-CHAM. Case B1 moved the role between professionals of the project.

B11: (Design Team Leader) *'Picking an individual was difficult because this was our first Soft Landings project together, we wanted to find out how the everyone would deal with the role…'*

B13: (Sustainability Manager) *'There was no specific Soft Landings champion, the role shifted from the Project Manager, to me to the Facilities Manager. The role moved around because of the workload of the team.'*

B14: (Facilities Manager) *'There was no sole Soft Landings champion, the role shifted from the Project Manager, because during the subsequent weeks he got too busy to attend to both roles properly so he nominated the Sustainability Manager and the Facilities Manager. This was because we all worked in the same place and we were able to coordinate with each other easily.'*

For this project, the shift in the role seemed to give the professionals a new perspective in the project. Instead of working in their traditional roles, they were able to assume the role and provide a different service than the one they were used to. The project Manager was the first to assume the role during the design stage. A time that clear leadership was needed in the project, helping with the performance goals and objectives. Having a close working relationship helped the team pass on the role when the current SL-CHAM was unable to continue. The design team leader discussing the role of the SL-CHAM:

B11: (Design Team Leader) *'The Soft Landings champion was particularly handy when the Facilities Manager took over. The project was still in the construction stage, the Facilities Manager was involved with the design and construction and discussed options with the sub-contractors. This takes some pressure off the team because we know that systems in place look over everything we have done.'*

This indicates that the role provided an option to the team, to continue with reality checks and reviews at each stage of the project. Having an individual dedicated to the keeping the project on track and providing direction on the issues affecting the sustainability of the project helped in achieving the project objectives. For case B2, there was a single dedicated SL-CHAM who described his role:

B22: (Soft Landings Champion) *'…we had a lot of meetings during the early stages of the design. The first meetings were to understand their concept and development sketches. Subsequent meetings were about updating them on any new developments about the design. We met quite often…*

I was responsible for working with the BREEAM assessor, working through the BREEAM credits requirements. To look at the project sustainability targets and to make sure that at every step of the design those targets were on track. So, reality checks during technical and detailed designs. I also relayed information to team members, if there was a meeting and certain people were not available, it was my responsibility to make sure that they were informed of any discussion and new developments.

These duties showed that the role was not created to tick checklists but the SL-CHAM is actively involved in the project providing solutions to problems affecting the project. Making sure that as the design develops, emerging solutions are tested against the project objectives. Taking charge during the important stages of the project (inception, design, construction and handover). The SL-CHAM should be seen as a leader. **C02** explains:

C02: (Service Engineer) *'…They have to be a senior member of the team to be able to carry some authority but most importantly, they have to have very good communication skills as they will need that to discuss with the client and their representatives, the end users, the various sub-contractors and different members of the project team. What I feel is that the champion must have a passion for effective energy use and sustainability in buildings.'*

As discussed earlier (in chapter four), the role of a SL-CHAM is similar to that of a Project Manager; with the mobilisation of people and the transmission of information. A Project Manager must motivate and manage people, not only in their organisation but also sub-contractors and stakeholders of a project (Slattery and Summer, 2011; Parker and Skitmore, 2005). The SL-CHAM however, provides more support with the Soft Landings Framework calling for the role to be active from inception till extended aftercare. C04 discusses the role during aftercare:

C04: (Service Engineer) *'…, Soft Landings shouldn't be about defects but that was one project, there were other aspects, we did do it building readiness program there were all sorts of things we did do that we got right; the only thing was about the after-care service, this comes back to the team; one of the team members just decided that they were going to make some money out of it and didn't deliver on what they promised…'*

The number of meetings and interactions by the SL-CHAM shows the importance of the role in the project. Having one person in the role seems to provide stability in the project with the design team leader from project B1speaking in favour of it.

B11: (Design Team Leader) *'For our next project, I will definitely push for one person in the designated role. That will make things easier from my perspective.'*

One of the designers of the Soft Landings framework however feels that circumstances make having more than one SL-CHAM ideal:

C02: (Service Engineer) *'What you must understand is that a building project takes many years to complete. In that time people will have moved on to new jobs or* *roles or cannot carry on in their present jobs, for this reason it is incredibly difficult to have the same Soft Landings Champion from the beginning to the end of a project. There will be changes at some point due to any number of reasons but the important thing is that they are briefed from the beginning of the main energy targets and objective or it could be someone who has been in the project team but not as a soft landings champion can now take over. They will need to have all the qualities that I mentioned before so that the continuity of the project is not disturbed. It will be great to have the same person from start to finish but that rarely happens***.'**

The decision to have a dedicated SL-CHAM will depend on the project and should be left to the client's team. If they feel the project will benefit from having different Soft Landings Champions, they must make sure that each person taking the role fits the description. This is evident in the responses from the Soft Landings Champions:

C01: (Energy Consultant) *'Again I think it depends on the project, I am probably a Soft Landings kind of specialist within the business. I do get involved in projects which have strong Soft Landings requirements just to help and advice my colleagues in the business but normally on all of our projects there is a different degree of Soft Landings involvement sometimes it's only on stage 3 and stage 4 items and sometimes its jus the POE (Post Occupancy Evaluations) so it just depends on the details of the project and the client's requirements.'*

C03: (Project Manager) *'The main contractor usually suggests to the client the need for a Soft Landings Champion and a member of the team is nominated as a dedicated Soft Landings Champion'.*

C05: (Architect) '*It depends on the circumstances, sometimes the client hires a Soft Landings consultant and at other times, the contractor brings a Soft Landings Champion into the project to provided additional values in terms of sustainability, cost savings and time.'*

Each project must decide the best way that a Soft Landings Champion will add value to their project. What is certain is that the process yields the best results when adopted from inception as show in the case of project B1.

8.4 Assessing the involvement of the Building Managers

It is usually to the advantage of a project if the design team can involve the building or facilities Managers during design. This may be difficult on many projects because the building managers may not have been hired by the client. This presents an opportunity for future Project Managers to advice the clients to hire Building Managers during the tendering process. Of course, PFI (Private Finance Initiative) and DBFO (Design, Build, Finance and Operate) contracts offer package deals to maintain buildings; Allowing a single point of responsibility for both construction and maintenance. This option offers the project a viable chance to achieving its sustainability targets but can also be limited due to communication between the design team and the Building Managers (SLCP, 2014). In whatever form of procurement, clients should lead by setting out requirements and procedures (Jensen, 2009). This is important because Building/Facilities Managers can be the missing link between building design and building operation (Jensen, 2009). C04 who is one of the architects of the Soft Landings Framework reiterates the importance:

C04: (Environmental Engineer) '…*there is clearly a responsibility to get people involved earlier on and the parties who wouldn't normally be involved like FM (facilities management) to be inputted so there is more investment in time and money in getting the right people together…'*

The four projects all involved the building/facilities managers during the construction of the buildings. For Project A1, the school building was a relatively small project (costing just under 3 million pounds) so the facilities team consisted of the head teach and the caretaker who were involved during the design stages.

A11: (Architect) *'Oh yes, the head teacher came to almost every meeting. Well every meeting on site…'*

The size of the project made it easy to interact with the 'facilities team'. They were both able to attend meetings with the design team and workshops with the end users. The result of this was satisfaction about the design from both sides and understanding of why design features such as the roof-mounted passive stack ventilators were added.

For project A2 which was a project which is significantly larger than the first one (costing 12 million pounds), the Architect discussed the inclusion of the facilities team as part of non-core professionals invited for design briefings.

A21: (Architect) '…*We had several professionals that are not core design team members on our team. We had an electrical engineering team, a mechanical engineering team, the building representative or manager I should say, we have our site planners and landscapers on the project…'*

A22: (Construction Manager) '…*Several of our team members who were not core design team members were in attendance of most of the meetings to give professional advice…'*

The facilities representative attended design meetings with the team; The meetings seemed to consist of all the non-core design professionals together. It is therefore difficult to know the extent of the collaboration or their contribution to the design. The facilities company was changed during the handover which could have led to delay in setting up a maintenance schedule. There was also complain from the occupiers about the facilities team being around only for 8 hours a day while the building operates for 24 hours. These issues could be traced to lack of adequate discussions during the design stage.

For project B1, the facilities team were fully involved in the design and construction of the new space. Even though the project was relatively small (costing nearly 8million pounds), their interaction shows what can be achieved with between both teams. From the beginning of the project, the facilities team were in the called in meetings with the design team. The design team leader:

B11: (Design Team Leader) *'...I remember the building managers (facilities Manager) being there, the sustainability team, some sub-contractors were invited because the tenders are usually a closed affair so there was a select few of them…'*

The facilities Manager:

B14: (Facilities Manager) *'… 'The design team introduced the contractor and the sub-contractor after the concept stage 2… We (the facilities team) were also invited at this stage discuss our design expectations.*

…our collaboration also allowed us to include a LED lighting replacement which will reduce the maintenance backlog and in turn offer a more energy efficient lighting solution for an area which is lit for most of the day.'

The collaboration of both teams had a positive impact on the project, allowing changes that would have been otherwise overlooked such as the placement for light fittings. Although collaborations between both teams can yield success, others are wary of whom is invited to the design.

C04: (Environmental Engineer) *'The other thing I have seen going wrong a number of times is it's one thing getting someone who is going to operate the building around the table but that person needs to be the right calibre of person, when you ask the question maybe to be seen from a design perspective because they have never been involved in design they are involved in operation, they often can't see it, like I said if you look at it from a slightly different way, the architect is not trying to create in a lot of cases what's already done they are trying to create something very different, otherwise why would they want to build something new?*

The respondent is talking about the downsides of inviting the facilities or building managers to the design because of the difference in training and experience. He brings up an important issue where the facilities team may want to do things the way they are used to while the design team are trying to create something new and different. This can bring about conflict from the early stages which can derail a project. This situation once again emphasises why the role of a Soft Landings Champion is important in construction. Communication between teams must be able to bridge differences in training and profession. Despite meetings and brainstorming sessions, if teams cannot adequately get their ideas across, there is bound to be miscommunication. Other team members should also be able to communicate their ideas without the feeling that others may not understand their professional position.

The fact that one of the main characteristics of a Soft Landings Champion is to be a good communicator, shows that the framework is trying to address the problem. A problem that seems prevalent in the industry, but many professionals are unwilling to discuss. This gives better understanding when placed in the context of 'bridging the gap'; where the Soft Landings Champion seeks not only to reconcile estimated and actual building targets but to also 'bridge the gap' between professionals and teams.

8.5 Exploring the impact of collaboration between design teams and other team members

The success of any project depends on complex decisions and design processes from different stakeholders (Wallhagen, Malmqvist and Eriksson, 2017; Gana, Giridharan and Watkins, 2017). These stakeholders can influence each other while making the project objective a reality by communication and exchange of ideas (Wallhagen, Malmqvist and Eriksson, 2017; Elforgani and Rahmat, 2010). Although the concept of collaboration is widely discussed in theory, full collaboration in the construction lags behind other sectors such as the financial sector (Bresnen and Marshall, 2000). Of course, no project can succeed without team work; evidence seems to suggest that teams are usually reluctant to share information and expertise with others from different companies (SLF, 2014). All the respondents indicated that there was close collaboration between teams on their projects. For Project A1, the architect confirmed the inclusion of non-core design professionals

A11: (Architect) **'***Straight away, so we bid for the project with a Structural Engineer and a Mechanical Engineer and a QS (Quantity surveyor).'*

The Project Manager explained about the inclusion of other professionals at the design stage.

A12: (Project Manager) '*The very first meeting had other members of our team, I remember the structural engineer, the M&E guys, myself. There were more but I am sorry I can't remember them right now.'*

For project A2, the development of the design at RIBA stage C and D consisted mainly of the design team. The team had already developed the design before any non-design professionals were involved.

A21: (Architect) *'We have different disciplines on our design team so we got the civil engineering perspective and basic M&E inputs from the team. We find that we can get through the initial design stage quicker this way……. of course, the M&E sub-contractors were involved as soon as we had the basic structures in place.'*

Interviewer: '*So this was an internal group, what about the sub-contractors hired by the main contractor?'*

A21: (Architect) *'Yes, this was our own company group, the main contractor was still in the process of sorting out the sub-contractors. We were engaged before any of the other sub-contractors so we had to carry on with our jobs. We had meetings with the others to discuss the design when they were hired and we had to amend some parts of the design from time to time.'*

The Construction Manager in reply to the inclusion of non-core design professionals

A22: (Construction Manager) *'The design team was obviously the first time to be assembled. We hired XXXXX* (Architectural Team) *to produce the designs after we satisfied the employer's requirements. There were many consultations with the design team while the designing was going on. Several of our team members who were not core design team members were in attendance of most of the meetings to give professional advice while the sub-contractors were in negotiations.'*

When asked about the involvement of the Project Managers:

A22: (Construction Manager) *'We were in touch with the Project Managers during the initial design We had several meetings updating them on the various stages and the different technologies we specified in the design. As the design progressed, we were more in contact with them discussing the location of both buildings on the account of the slope of the site.*

For project B1, the project was procured as a Soft Landings project from the beginning, therefore the design team had no problems with introducing sub-contractors during the design stage. All the respondents confirmed the inclusion of non-core design professionals during the design development stage. This was especially important because one of the sub-contractors was in Italy.

B11: (Design Team Leader) *'Working within the Soft Landings principles allowed us to solve several project specific problems, the most important one being the time constraint on the project. The sub-contractor who provided the security pods was available at the second design meeting.'*

One of the main objectives of the project was to reach completion before the general election therefore the design team collaborated with the sub-contractors to produce the preliminary designs. This enabled the sub-contractors to start work on producing the security pods while the final design drawings were produced. The collaboration at this early stage enabled the security pods to be finished and installed during construction. The

B13: (Sustainability Manager) *'The security doors were from Italy and they had to be included very early in the design because the whole project revolved around the entrance foyer where the security doors played a very central role.'*

As discussed in section 8.2, the early adoption of the process and signing up to the framework gives the teams the knowledge of shared roles and responsibilities and the sharing of risks; which presents them with the freedom to freely exchange information (meetings and emails) thereby making collaboration easier.

For project B2, the procurement method fragmented the teams in this project (see chapter seven). The complicated nature of the two-stage design and build procurement method makes it difficult to determine how the design was developed from the client's design team point of view, however, the architect confirmed the inclusion of non-design professionals during the design stage.

Interviewer: '*Was the Soft Landings Champion the first professional introduced into the design?'*

B21: (Architect) *'No, we already met with several specialists, I remember the meeting with the cladding sub-contractor discussing the different materials we could use, we had a M&E (Mechanical and Electrical) sub-contractor who we were in talks with regarding the services. So, we had actually talked to a whole group of professionals before XXXXX* (Soft Landings Manager) *showed up.'*

The Soft Landings Champion had this to say about the early inclusion of non-design professionals.

Interviewer: *'How early did the design team involve other professionals in the project?'*

B22: (Soft Landings Champion) *'I believe XXXXX who were the consultant engineers were with the design team at the beginning of the project. The design had gone through several consultants before the tendering stage. When I arrived, the design was in stage D (RIBA stage). I was a non-core design professional called to advice the project on Soft Landings. I believe the design team needed specialist input from the very start so in stage 1.*

The interviewer discussed the inclusion of non-core design professionals with the sub-contractor.

Interviewer: 'When were you introduced to the design stage of the project?

B23: (Service Engineer) *'We understood that the design was in its second phase. We for to several meetings with the design team discussing the building systems. We were going to install the air source heat pumps and the positions were very important. The meetings with the design team were soon after we signed the contracts. That should be about stage D of the design, they were still working out details on the location of the systems.*

The collaborations yielded positive results in the projects, all respondents confirmed this. When asked about the contribution of other professionals in the design stage, the Architect (A11) answered that early in the design process, the design team discussed the task of energy modelling with experts where the use of sub metering and energy savings were used in other school projects. This is in line with the Soft Landings Framework of learning from past projects to inform new design. Understanding future occupants'/end user expectation is a core Soft Landings principle. About the contribution of other professionals to the design stage:

A11: (Architect) *'Well they were involved after the feasibility in refining the design so for instance XXXX the* (Mechanical and Electrical consultants) *did an overheating analysis on the dining hall block and that's why we provided solar shading on the cable land elevation and we carried out our own test as well. We made a physical model and carried out a Heliodon from UCL* (University College London).*'*

An investigation was carried out by the Bartlett School of Architect for the design team. A daylight analysis was carried out at the University's Heliodon. It helped the design team to develop a daylight strategy. Its results influenced the decisions of the design team with regards to the positioning of louvered windows and the angle of the brise soleils. It also allowed the design team to design with a daylight factor high enough not to need artificial lighting during the summer terms. The involvement of other professionals allowed the design team to produce an award-winning design.

Other collaborations included the design team preparing a RIBA stage C concept design for the M&E sub-contractors so that modelling could be done to check compliance with part L. U value calculations were also carried out with the results influencing the size of PV array that was required to meet the 60% CO^2 reduction target required by the brief. This was also done to achieve the BREEAM Very Good design rating.

For project A2, the Architect noted the contribution of other professionals during the design stage.

A21*:* (Architect) *'We got good feedback from the M&E on the placement of certain services, the heat pumps mostly especially were proving problematic. They were able to give us some analysis report which we eventually used in the final designs and specifications. We used their drawings to update some of our amendments.*

The lighting engineers were around during the specifications of the different systems we used. Their advice was invaluable, they had information about systems that we would have gone to have to investigate. They had experience with installing most of the systems which worked out brilliantly for us in the team.'

Making other teams feel part of the design process is as important as their participation. Emmitt and Grose (2007) highlighted the importance cohesion in a project team, noting that each member must be made to feel that their contributions will a positive factor in the project. This project was able to achieve that with the respondent sub-contractor.

A23*:* (Environmental Engineer) *'I think our team was one of the last to be taken on. Most of the preliminary work had been done by the time we arrived but we were still able to produce our drawings and discuss the design we were given. We sat on many of the meetings with the energy specialists, discussing things like the weight of the biomass boiler and the positioning in the building. We had some input I will say.'*

For project B1, the project had the unique opportunity that many members of the team had already worked together so they were familiar with the working practices. The group all spoke positively of each other and the contributions that they brought to the project. When asked about the contribution of other professionals during the design stage, the design team leader:

B11: (Design Team Leader) *'We had an environment where we were open to suggestions and criticisms. We met with different teams asking them how they would like the space to function. We got a wide range of requests and suggestions. We could not incorporate all of it in the design but we got really* *good feedback. For our preliminary drawings, we included a rounded top to the reception workspace. During deliberations with the facilities team, they alerted us to the fact that the rounded top would be difficult for the staff to navigate. They had a storage area round the back a rounded top would not have worked there. We were able to change to rectangle shape which worked out really well.'*

B14: (Facilities Manager) 'Our collaboration also allowed us to include a LED lighting replacement which will reduce the maintenance backlog and in turn offer a more energy efficient lighting solution for an area which is lit for the majority of the day.'

Although their contributions might seem small in comparison with the scale of the project, it is well documented that little issues such as the position of lighting and control buttons usually lead to bigger problems for the end users during the occupation of the building (SLF, 2014). Therefore, such contributions have a positive effect on the sustainability of a building.

For project B2, it was clear, that the design team involved non-core design professionals from the early stages when the concept design was being prepared. When asked about the contribution of other professionals to the design and if this affects the sustainability of the project.

B21: (Architect) 'Of course, the workshops and brainstorming sessions that we have are always widely successful. They are experts in fields, the contribution of other professionals makes our job easier. We already start to get a sense of how the building will function from their input. Collaboration is very important in every project for us, we try to involve as many experts who can contribute positively to the project. of course, this all must be done with consideration of the cost of the project.'

Interviewer: *'How do you feel this affects the sustainability targets of the project?'*

B21: (Architect) *'Well, I don't think that it has a massive effect, we get advice when designing and the specialists are usually spot on in many of their assessments. I know there will be some differences in how things should be done but I think the* *design team is able to work within the confirms of the advice and produce a good design. Many firms use BREEAM as a standard for their sustainability targets so do we. It makes things easier and we can work to achieve the targets with the professionals we have on hand.'*

While the architect notes that including non-core design professionals does not have a great effect on sustainability targets, he acknowledges their contribution to the design. He seems to imply that assessment tools such as BREEAM has made it easier for design teams to work within set targets. Schweber and Haroglu, (2014) have consistently referred to BREEAM as not only an assessment method but also a tool to achieve sustainability. Kajikawa, Inoue, and Goh, (2011) going further by saying its positive impact on communication and team integration allows for more sustainable buildings. The sub-contractor for project B2:

Interviewer: 'Did you feel your team contributed positively to the design?'

B23: (Service Engineer) *'Every piece of information that helps with the design is like a puzzle piece. The designers focus on certain aspects of the brief dealing with aesthetics and positioning of certain elements, it is our responsibility as sub-contractors and specialists to focus on aspects of the design that will not be apparent but has a big influence on the success of the building and project. I believe that we contributed positively to the project our meetings were always informative and they were very keen to take our suggestions.'*

The respondent used an interesting analogy of the design being like a puzzle, with every contribution helping to complete the picture. Many researchers agree with this point of view (Reed and Gordon, 2000; Wheeler and Malekzad, 2015; Altomonte, Rutherford and Wilson). It is obvious that industry professionals also agree in principle but in practice, there seems to be hesitation on the part of some teams to including others in their processes. Given the obvious advantages of including non-design professionals in the design process why is there a reluctance to embracing this philosophy which Soft Landings is clearly trying to foster? Respondent C02 had this to say about the issue:

C02: **(**Service Engineer) *'You have the increased number in meetings and correspondences and adjusting to a system of authorisation… everybody just has to readjust their philosophy because most of Soft Landings is changing the philosophy in the construction industry to focus on outcomes and targets.'*

A21: (Architect) *'I will say giving away certain areas and strategy of the design to sub-contractors may prove sometimes detrimental to the company as sometimes we may end up bidding against each other for new projects.*

The cost of inviting more professionals also falls to the main contractors before the contract is signed so we have to be careful to balance initial costs.'

This response echoes the calls for the industry to adjust their philosophy to shift from confrontational processes to more collaborative workings. Respondent A2 was candid in talking about giving away their strategies to companies who may be competitors for later projects. This is a common perception in the industry (Damodaran and Shelbourn, 2006); Each company wants to protect what they feel is unique to them to give them a competitive edge over business rivals. Collaboration is more than transferring data between teams (Damodaran and Shelbourn, 2006), it is a continuous, creative process of sharing skills and expertise (Wilkinson, 2005) which can leave companies feeling vulnerable. Soft Landings counters this by creating a culture of shared risks and responsibility between all teams so that every team is protected. This is done by each party signing up for the whole process (SLF, 2014), with the assurance that their unique positions are protected during the project.

This is however difficult to achieve in practice, which is where once again the role of the Soft Landings Champion comes into focus. If the teams know that they are dealing with a neutral party who is unlikely to reveal any confidential information or strategies, they could be willing to share for the success of the project.

The respondents when discussing the disadvantages of including others in the process:

A11: (Architect) *'The disadvantage is cost. If you are paying for somebody to be there when they do not have to be there then it's at your expense really and so if* *it is at the very early stage when you are taking the brief from the teachers, head teacher, the client team, the structural engineer doesn't really know how big the building is going to be yet.'*

C01: (Energy Consultant) *'The only drawback will be some small additional cost to the client to potentially employ Soft Landings advisor or professionals at the early stages... Of course, once there is an extra person involved in the project, there will be more meetings and more people included in the emails and correspondences.'*

C03: (Project Manager) *'I personally don't think there is any disadvantage to including any team member, all teams have to be made aware of who is in charge of the process and final decision falls to them. Everybody's input will be considered in a controlled manner but ultimately the final decisions will fall to the design team.'*

C04: (Environmental Engineer) *'No I don't to say no downsides, there is clearly a responsibility to get people involved earlier on and the parties who wouldn't normally be involved like FM (facilities management) to be inputted so there is more investment in time and money in getting the right people together. The other thing I have seen going wrong a number of times is it's one thing getting someone who is going to operate the building around the table but that person needs to be the right calibre of person, when you ask the question maybe to be seen from a design perspective because they have never been involved in design they are involved in operation, they often can't see it, like I said if you look at it from a slightly different way, the architect is not trying to create in a lot of cases what's already done they are trying to create something very different, otherwise why would they want to build something new?'*

C05: (Architect) *'The design team are sometimes not happy with the Soft Landings Champion asking to see certain design details and elements. But it usually helps to have an extra pair of eyes looking through the design, this helps problems to be spotted and resolved early. An example of this is we had a project to renovate a large and very old building that had been unoccupied for decades. The design team were in the stages of initial design when we noticed that the* *plastering of the building used a rare plastering method; we had to invite a historic plastering expert onto the project to advice on the preservation method. This saved us a lot trouble later during reconstruction.'*

The answers from respondent C04 and C05 opens new dimensions to including non-core design professionals. From C04, the design team has to revise the level of each respondent and interact with them according to their expertise. It is not enough to involve others in the design process; they have to develop a system where only the necessary professionals are involved to avoid wasting valuable time and effort (see Section 9.4). This is reinforced by C05 when talking about the right expert to include in the team.

The cost of engaging other professionals seems to be a drawback to the teams as with all projects, they want to keep the costs down. For a Soft Landings Champion, initial costs can be added to the initial contract sum which is why it is crucial to adopt the system from inception of the project.

8.6 Analysing the impact of end-user participation on the design

Having discovered the advantage of engaging the end users in the design process, design teams have embraced this practice (Park, 2012; Payne et al 2015; Kpamma et al, 2016; Goldsmith and Flanagan, 2017). End users hold a unique knowledge that many design professionals seem to overlook (Christiansson et al, 2011). Extracting this knowledge and translating it to meaningful data requires a systematic and coherent approach. All the respondents agreed that it is to the advantage of the project to involve the end users early.

C02: (Service Engineer) *'There is a responsibility for the design and construction teams to involve representative of the end user in the early stages of the project. It immediately informs the teams on the types of end user habits…'*

C04: (Environmental Engineer) *'...so on all my projects FM (Facilities Management) and end users and occupants, I am always trying to get their input, get their buying, the earlier I can have a meeting with the end user the better…'*

However, the timing of their introduction and calibre of the end users is also crucial to the success of this engagement (Payne et al 2015).

C02: (Service Engineer) *'Of course the right calibre of person has to be involved; if an operational person is introduced to the design, there is usually a tendency to confuse things. An example is a laboratory that I worked on, the end users were consulted on the design and spatial arrangement of the lab floor, they had a XXXXXXX system which is like a big vending machine that transport goods from the lower floors to upper floors. They complained about the machine and wanted it reduced for more floor space. It was later that we found out that the machine needed to be that size in order to reach the upper floors. Because the end users did not understand the mechanical workings of the machine, their suggestions were not quite correct.*

This scenario shows why some professionals are reluctant to engage with end users. During their interactions, they have to suspend their technical know-how to listen to suggestions on the project. The end users seem to be concerned with their own personal situation while the professionals have to keep the project objectives in focus during such interactions. Payne et al (2015) talking about the calibre of end users advises professionals to always weigh end user expectations against project objectives.

C02: *Another example is the XXXXX headquarters*, (a major supermarket) *we engaged with the facilities management team, who spoke with the guys who work and service the radiators who complained about the atrium. On further inspection, we discovered that the atrium was not only for aesthetics purposes but in fact served a very important purpose of providing light for the floors below. At the end of the project they were upset that their opinions were not listened to but when we explained to them, they finally understood.'*

Project A1 and B1 were fortunate to have direct access to the end users. The design teams used workshops and brainstorming sessions to learn end user expectations. This gave the team viewpoints, from which they could develop the design in relation to end user expectations. When asked about the timing of the introductions:

A11: (Architect) *'The very first meeting? There were several people from the client's side, there was the head teacher…'*

B11: (Design Team Leader) *'The end users were introduced as soon as we decided on the concept…consultations with them (reception and security staff) we asked about their expectations for the new space, and elements that they did not enjoy in the former space…'*

Both design team leaders agreed that the end users were involved early in the project with the head teacher of the school available for the first design meeting while end users in project B2 were available immediately after the concept design. Their engagement allowed the team to test how well the client's requirements fulfil the needs of the end user (Jensen, 2011). With the Soft Landings Framework calling for regular reality checks, only project B1 adopted the process at this stage. Project A1 however, followed the principle and had regular meetings with the end users:

A11: (Architect) *'We did have a couple of workshops with pupils and we did have a couple of workshops with local residents. So, we did engage with most of the people on that list really.'*

A12: (Project Manager) 'For this project, the end users were very involved. Some of our projects we are not fortunate to speak to actual end users. The head teacher of the school was very involved, he had a clear vision on his expectations. We spoke to teachers, students, parent representative and every meeting helped us gain new perspectives into the project. As a Project Manager, I treated the end users as team members. Their input contributed to the success of the project.'

The words of the Project Manager showed that the team engaged the end users and treated them as part of the design team. This according to Altomonte, et al (2015) is a formula for successful sustainable construction. The inclusion of the end users during the design stage sets the scene for collaborative working. This inclusion mentally prepares the end users and gives them a sense of ownership with the finished design (Jenson, 2011). This was true of the project because the occupants gave the highest rating to the design during the building user survey.

Although both teams engaged the end users, project B1 had a soft Landings Champion which coordinated the feedback from the end users. Although project A1 had 12 recorded meetings with the end users, the feedback could have been streamlined to avoid wasting too much time on design issues. The lack of a dedicated Soft Landings Champion prevented the team from benefiting from a better system of meeting with the end users. The Engineer remembers a lot of unscheduled feedback from the end-users which can be a problem when assessing end user comments for use. A dedicated Soft Landings Champion would have been able to specifically work on the structure of consultations and make sure that feedback did not stray to topics not needed. Although there was a lot of feedback, the Project Manager admitted that the end users had little to do with any design changes.

Interviewer: ‘How were their input incorporated into the building?’

A12: (Project Manager) *‘Well, they had very little input in the building designs apart from telling us how the classrooms and playrooms were going to be used. They were particularly helpful when deciding the entrance of the site. We had our meetings and we noted every suggestion. During the design team meetings, we discussed the points and had to decide which ones we wanted to adopt...’*

The presence of a Soft Landings Champion would have afforded the team focus on more important aspects of the project target rather than having numerous meetings with the end users. Goldsmith and Flanagan (2017) discovered this situation as the norm with design teams actively seeking end user feedback but they are unable to convert this information into significant changes. This situation has opened an opportunity to developing a framework for user feedback, with researchers like Emmitt et al (2005) producing a framework for stakeholder participation and Strovang and Clarke (2014) producing a framework that structures the feedback from workshops by identifying the stakeholders, defining the social process and establishing the technical considerations for each issue.

This is in contrast to project B1 which had a Soft Landings Champion who played a supporting role during the design stage. The team took advantage of the champion to organise meetings with the appropriate people and coordinate the feedback to only include the most important issues. This worked to the advantage of the project because they were able to obtain valuable information without spend too much time having uncoordinated workshops. Although both projects got the timing of introducing the end users right, project A1 lost the opportunity to take advantage of the impact of their participation. This situation can be seen as the difference between a Soft Landings project and a conventional project. An extra person on the team (in project B1) improved the quality of the workshops and feedbacks.

Project A2 and B2 took a different approach because they were significantly larger projects with the clients looking to attract commercial customers and businesses. The designs needed to be flexible enough to accommodate different businesses. At the beginning of the project, the teams did not have actual end users to interact with therefore they took a different route to engaging with the end users. For project A2, following the client's brief, the building team targeted companies who wanted an innovative space to develop ideas to grow their businesses. They were also to provide state of the art meeting and conference rooms for groups looking to hire such places. When asked how the teams overcame the lack of end user participation:

A21: (Architect) *'We have been involved in the design of countless office buildings and spaces so we had that experience to bring to the project. Wet carried out a feasibility study on the type of companies that were likely to take up residence and we used some of requirements in the design… The client also provided us with companies they were in contact with about renting the office space. Some wanted informal meeting spaces, flexible office spaces and an environment where staff will feel comfortable and safe.*

We had a workshop with a group of customer representatives who were intending to rent office spaces in the building. The client was keen to invite top companies so we had 2 meetings to discuss their expectations of the space. Some wanted open plan offices but others were quite specific. They wanted specific floor finishes and lighting. I think this was before we finished the concept design.'

Although the design team in project B2 took over the design after the concept design stage, they had a similar approach to end user engagement.

B21: *'As the design had passed the concept stage when it arrived to us, we relied heavily on notes from the client's design team. There was consultation with some of the small and medium sized enterprises group and two companies which had signed up to rent offices in the building. The difficulty about these projects is not hearing directly from the end user. We must rely on the employer's requirement trusting that they had a done a thorough job of their feasibility studies on the expected tenants. Having said that, we did have a meeting with XXXXX whose team was one of the first to have offices in the building. Their requirements were in line with the client's. They wanted a modern space which was flexible and easy to maintain. They were also particular about the green credentials of the building asking to see the certification when completed. So, for the project the end users had been consulted before the employer's requirements were drawn up so I would say they were involved very early in the project.'*

Both these projects relied heavily on the client's requirement and the feasibility studies carried out. The Soft Landings Manager when asked about end user participation:

B22: (Soft Landings Champion) *'The design team had little contact with the end users on this project because the employer's requirement contained a section with an outline of the tenant's specifications. The design team used the notes from the client's design team to get a sense of the end users requirements. As with other professionals, the end users are now an important part of the design which is a double-edged blessing really.'*

Interviewer: 'Why is that?'

B22: (Soft Landings Champion) *'Well, on one hand, end users having a say in the design of the building allows both groups enjoy an interaction of taking each other seriously. Sometimes, this becomes a problem when some of their* *suggestions are not practical in terms of cost and know-how. Overall it is to the advantage of the design team to have an engaging end-user.'*

The Soft Landings Champion sees their interaction as 'a double-edged blessing' because if some suggestions are not used, the end users may not be satisfied. Some professionals seem to echo this sentiment making them reluctant to engage with the end user.

C05: (Architect) *'...I would say during these meetings, plans or other technical drawing are not shown to the end-user because this confuses them, as they do not have the expertise to interpret the drawings. I find it better to verbally communicate our ideas to them by listing the facilities that will be available and the position of certain offices.'*

From all four projects, workshops seem to be the most popular method of communication when engaging end users. The aim of the interaction between groups in workshops is to bring understanding to the participants (Sanoff, 2007). All the respondents agreed that the end user participation resulted in positives for the design.

A11: (Architect) '*We took feedback from the local residents and we fed it into the design. The access to the site rather than the buildings themselves. I remember there an …entrance side, the railway station side and a small fire escape on the other side of the fields. We had to change that slightly to reflect feedback but the buildings didn't really change. The buildings were very popular with everybody we spoke to we got really good feedback. Partly because of the curved shape of the classrooms and partly because of the barn. So, it was a very popular design, there was no problem.'*

A21: (Architect) '*...because flexibility was important to the companies and client, we included raise access floors in the building. We also had moveable partitions to allow each company to customize their space according to their requirement. Even though people worked in the same building, each floor had its own unique features.'*

B11: (Design Team Leader) *'I can definitely say that without the end user participation, that area would not have been brought to our attention so that worked to our advantage.'*

B21: (Architect) *'I will say that it affects the sustainability of the building a great deal because if the building is in conflict with the users, it cannot reach its full potential. Building systems that do not work well or not understood by the users will definitely affect the sustainability of the building. For this project, the first team (design) worked well with the limited resources and I believe they were spot on in their estimations and assessments.'*

With all respondents acknowledging the contributions of the end users, it surprising that design teams still have problems with the process of analysing and incorporating data. What teams must do is to be able to identify end user participation as a process and not a static enterprise. The client's brief is essentially a static document (Jensen, 2011) while end user participation should be dynamic adjusting to the events affecting the project. It should be seen as important as communication with other team members as suggested by A2. The teams should also be in continuous communication with end user representatives to update them on the progress of the design or changes to agreed elements. This important strategy is echoed by the Soft Landings Framework (2014) which encourages continuous interaction between teams.

Project A1 and B1 achieved this continuous flow of information with different results. Of course, for both of these projects, they had the advantage of the end users being close to the building site. Project B1 could keep the end users in the information loop by using messaging boards around the building updating them on any changes. This was reflected in their evaluation of the new space with an 89% score. Although project A1 also had their end users close by, the lack of a Soft Landings Champion may have prevented them from updating the information to the end users especially during the building of the additional classes. The Soft Landings Champion in project B1 recognised the need to keep the end users in the loop. This clearly shows the advantage of having a Soft Landings Champion.

This supports a call for an overhaul of end user participation process (Jensen, 2011; Christiansson et al, 2010). Who favour a collaborative working environment with the end users to produce more sustainable buildings. The design teams have to develop innovative ideas and ways to engage with the end users. With tools such as using virtual space and visualisation (Christiansson et al 2010) and client organisation mediating between the two groups (Jensen, 2011).

8.7 Summary

This chapter saw the analysis of the Soft Landings Core Principles with discussions on how the teams interpreted the principles. The analysis discovered the following:

- Procurement methods affected how the teams adopted the process with results varying from success in adopting the whole process and the fragmentation of adopting the process mid project.
- The role of the Soft Landings Champion remains one of the most distinct difference between a conventional project and a Soft Landings project. The role fits in the project to provide additional support and objectivity to all the teams.
- Analysing the impact of the collaboration between the design team and other team members shed light on the workings of each team. While they are signed up to work collaboratively, team members still seemed reluctant to share information which could have affected the projects negatively.
- Involving building managers and end users is important but the timing and feedback also has an effect on the success of the project.

Chapter nine goes further to analyse the flow of information between teams. The interesting question is how can the teams freely share information when some members have acknowledged withholding information from others.

Chapter Nine

Analysing the flow of Information and Communication

9.1 Introduction

A characteristic of successful sustainable construction is the level of communication and flow of information between teams (Gana et al, 2017; Otter and Emmitt, 2008; Emmitt and Grose, 2003). The increasing complexity of modern buildings along with the introduction of non-core design professionals raises new challenges in information exchange. Exchanging information relevant to the project needs to be directed to the correct team at the right time (Hjelseth, 2010). One of the key problems to this exchange is identifying what constitute information for team members. They can be in the form of tender documents, procurement documents, technical drawings, and minutes of meetings (discussed in section 9.2). Advancement in information technology has made emails, skype calls and different messaging services as easy as a phone call. With all these forms of communication, it is difficult to assess if the quality of the information has improved with the quantity (Hjelseth, 2010). Information serves to support decision making during design, construction, and handover. Therefore, communication between teams is essential for any construction project. With some respondents expressing reservations about the quality of information shared with other teams.

This chapter looks at the lines of communication between teams in the four cases, it looks at the timing and the quality of the information flow and the result of such communication. It also looks at the most common forms of communication within the teams to find out if they were effective. Finally, the chapter develops an information framework based on data and the Soft Landings principles to enhance the collaborative atmosphere in a Soft Landings design stage. The identification codes from the previous chapters remain the same.

9.2 Relationship between the quality of Information and Communication and Sustainability

The relationship between quality of information and achieving sustainability cannot be ignored (Emmitt and Gorse, 2003; Dainty et al, 2006; Gluch and Raisanen, 2009). Multiple professions, different strategies and supply chains make which trying to achieve the time, cost, and quality objectives increasingly difficult. A Project Manager or leader who oversees the different elements must be skilled in communicating the correct information at the right time (see chapter 4). Meyer (2014), found communication competency to be the most regarded skill for a project leader. This could be through interpersonal communication with coordination or integration (Sinclair, 2011) or face to face meetings and developing a network for communication relay (Gray and Hughes, 2001; Sinclair, 2011).

It is important to get the right definition of information; Bateson (2000) describes information as 'a difference which makes a difference' which Hjelseth (2010) interpreted as 'information is the relation between defined data and a defined purpose'. Meaning without a specified purpose or use, information is just data. Data must be targeted to a specific goal to be considered as information. The first step is to decide the most appropriate method to use then relate the information for specific use.

This shows that communication is a dynamic process (Gluch and Raisanen, 2009) it should therefore not be treated as a one-dimensional element in design. It needs to be efficient, to bring teams together and foster a collaborative environment for the project (Emmitt and Grose, 2007). The Project Management Institute (2008) outlines five crucial process which can achieve effective communication and information flow; stakeholder identification, communication planning, information distribution, stakeholder management and performance reporting. The four projects will be discussed using these five processes as a template for their communication.

C05: (Architect) *'I find that the best and most cost-effective method of holding these meetings is to separate them into two groups. My work partner and I usually review the project workings and drawings available and then have a meeting* *with the design and construction teams. A second meeting then includes the client, the design team and the SL champion'.*

This experienced Soft Landings consultant seems to follow the five processes by first identifying the right stakeholders for the meetings. Preparing and planning for the meetings by reviewing current drawings and other documents ensures that the information is relevant. We also see that the stakeholders are separated to manage the information, giving the reason for separating them:

C05: (Architect) '*The reason for splitting the meetings in two is to allow the design and construction teams to be able to speak freely about schedules, deadlines, specifications and cost given by the client. Some of the demands may be unreasonable and they need a third and neutral party to be able to analyse the drawings and arrive at a workable solution. During the technical design stage, I insist on coming to the site meetings in order to get a clear picture of the project'.*

Here, we see an experienced professional avoid conflict by identifying sensitive issues and solving the problem by separating the stakeholders. Being a Soft Landings consultant with 6years experience in Soft Landings has led to the development of tailor-made strategies for each project. There will be a high quality of information exchanged in these meetings because every member can speak freely and share information without fear of penalties. The design team in project A1 appear to follow a similar pattern when meeting with other stakeholders. The first meeting involved the teams already onboard the project.

A11: (Architect) '*…there were several people from the client's side, there was the head teacher, there was one or two people from XXXXX Borough Council, there was the Project Manager from our sister company (XXXXX), there was myself and other Architects from our company. As the project developed, more consultants got involved'.*

As the project progressed, the meetings were broken up into groups:

A11: (Architect) *'..., they were held in sub-groups. The clients would never meet the sub-contractors really. The client would meet initially, they would meet the consultants always the Project Manager and Architect, sometimes ....as well. Then when the contractor became involved, the main contractor once a month but these sub-contractors would meet the main contractor separately and sometimes the consultants would be part of that sometimes not depending on the situation'.*

The Architect highlights the previously discussed notion that shows information sharing as a dynamic process. As more people are introduced in the project, the ever-widening circle of information flow has to continue to evolve to be of benefit to the project. Once again, the meetings take place in sub-groups, it is unclear if the reasons why, are the same with the Soft Landings consultant (C05). The project Manager had a slightly different approach from the design team because the responsibility of the whole project fell to him.

A12: (Project Manager) *'Our meetings were organized in such a way that the activities which took longer were discussed first. So, in this case, I was in meetings with the design team a lot during the early stages. I will speak to XXXXX (name of Architect) on the phone several times a day. The meeting with the design team was once a week to check on the progress of work. Later those went to once a month or when we needed to discuss something important'.*

The nature of a Project Manager position ensured that he had to have a long-time plan of the project engaging in the immediate tasks and meetings especially the design team. For project A2, the first meeting:

A21: (Architect) **'***Well our first meeting had a large group but many people were not professionals, they were mainly interest groups. The client representatives were about four in number. I was present with three other colleagues from my team, the supervising team which would be the Project Managers, I remember a representative from the M&E being there as well. The discussions were not very* *formal at this point. It was just a chance for everyone to introduce themselves and state their roles in the project'.*

Once again, the first meeting is just to introduce the different stakeholders in the project and subsequently, the meetings were conducted in groups.

A21: (Architect) *'Our meetings were non-stop, well, at the beginning of the project there is a lot to get through before we could start the design. We had targets and benchmarks to review, energy strategies to develop so this meant there is a meeting with a team or another that the design team must be in almost every day'…*

This reply gives a little insight into the kind of issues that were discussed in the early meetings; sustainability targets and energy strategies are important aspects of achieving overall sustainability in buildings. These discussions with the design team show that early introduction of sustainability issues with all team members is needed for a project to achieve its objectives (SLF, 2014; Gana et al, 2017). That is not to say sharing the information with other teams is sufficient to achieve those aims but there is a greater chance of success. It is necessary that the information exchange must be as clear and transparent as possible to avoid struggling with the 'knowledge soup', consisting of vagueness, uncertainty, randomness and ignorance. (Sowa, 2000). Therefore, sharing must be concise and direct so that all the stakeholders understand the meaning of the information.

In project B1, the design leader about their first meeting:

B11: (Design Team Leader) *'We had a large group of people, all the major parties were available for the meeting. Those who were construction professionals were the team of designers, the Project Manager, the building owners, (XXXXXXXxXXx) I remember the building managers* (facilities Manager*) being there, the sustainability team, some sub-contractors were invited because the tenders are usually a closed affair so there was a select few of them, the client representative* (Project sponsor) *and different representatives of groups using the building'.*

Once again, show a group of diverse teams at the initial meeting for introductions which is the norm in many modern projects. Commenting about subsequent meetings:

B11: (Design Team Leader) *'My team met every day to discuss any new developments and to check on the progress of the design. We met other team members once every week usually to check that we were on the same wavelength. My team carried on with the design drawings while we met with other teams. The meetings reduced when construction started but we still had the important meetings monthly'.*

This Soft Landings project showed its collaborative working by sharing information constantly to 'check that they were on the same wavelength' meaning that they shared any new information with other teams to allow them to make appropriate decisions on issues.

For project B2 about the first meeting:

B21: (Architect) *'…we were a large group with quite a lot of people around. We had the client, and representatives, we were still getting the team ready. There were several representatives from different sub-contractors, the client's design team were also available to brief the group on the concept and the progress they had made'.*

It is clear that each team loosely followed the Project Management Institute (PIM, 2008) tools for communication in one form or another by carrying out the following:

- Stakeholder identification analysis to collect qualitative and quantitative data which enabled them to identify whose interest to take account during the project (Senaratne and Ruwanpura, 2016).

A11: (Architect) '…*once we had agreed a preference with the client, we brought in the rest to the design. I mean strategic preference'...*

- Having done that some teams went further to find expert judgement (as in the case of projects A2, B1 and B2). As confirmed by C05 when asked about the introduction of other professionals into the design.

C05: (Architect) *'It tends to be as the need arises, with the concept design started the team realises the need to add a specialist or professional who is then invited to join the design team. I remember working on a project that had a warehouse were commissioned to work on. Because proper analysis was not carried out, it was until we were in the detailed design stage that we discovered that a special type of ancient plastering technique was used. We had to put things on hold to search for the specialist plasterer before we could continue'.*

When specialised sub-contractors are identified early, they can be included in the into the design and start the process of information exchange. This can save valuable time later in the project as shown in the comment above. It should be noted that once again the two-step procurement method in project B2 delayed the introduction of such expertise.

Having identified the relevant stakeholders for different areas of the project, the next step is the communication planning stage, where the teams need to determine the following as discussed by the Soft Landings consultants and the design team:

- Communication requirement analysis: to determine the information needs of the identified stakeholders.

- Communication technology: this is the method information will be transferred between stakeholders.

C03: (Project Manager) *'Every team is usually represented in the meetings with minutes of the meetings distributed usually by email. There can be exceptions where a team representative may not be available but will be updated on all discussions'.*

- Communication models and methods: where the team creates a system of information exchange (lines of communication; these can be either interactive, push or pull forms). A Soft Landings consultant of how to deal with the lines of communication.

C01: (Energy Consultant) *'If I was involved in a project supporting a project, I would be laying out some details of learning and communicating with them. They will be copying me with information like design updates and specifications, changes things like that so it would just be normal communication channels'.*

C03: (Project Manager) *'Most site meetings take place at least once a month but can be more if there are pressing issues to deal with. There can be informal meetings on site as well, these are not usually planned but may come about because of situations that may popped up during construction'.*

C05: (Architect) *'The lines of communication are usually opened to me; I am privy to most of the emails of the project team. If any of the team has a problem or concerns that they want reviewed, I am contacted by email and we arrange a meeting to work with them to resolve the problem'.*

- When it comes to the distribution of information, many teams get the process wrong because they have not clearly identified the right stakeholders and the correct communication model (Senaratne and Ruwanpura, 2016). Information can be distributed using tools such as emails. With technology giving teams a wide choice of methods to distribute information. The most common method is using emails for communication either to a specific recipient (push communication):

A11: (Architect) *'We keep in regular contact with the client, we had a monthly meeting and were probably sending a couple of emails every 2 weeks to the client'.*

Or between two or more recipients (interactive communication) which can create a multi-directional chain of information exchange:

A21: (Architect) '*We had details of every project member including the project email address and phone numbers. Most written correspondence is available on the* *project forum, everyone with access to the forum can have access to the messages'…*

Or even general emails that must be sent to all members of the project team (pull communication):

A22: (Construction Manager) *'Yes, we always have a central messaging centre which is quick and easy. We use emails to reach teams and individuals'…*

Sophisticated technology has made communication easier for the teams with the all of them using central messaging forums.

B11: (Dear Team Leader) *'We had several lines of communication, I was in constant communication with the client, the sub-contractors from Italy, the other sub-contractors, the Project Manager. The software allows you to send messages to other team members so we used it constantly. We also used our emails to communicate, we spoke on the phone to others. There was a lot of communication going on especially during the design stage'.*

B21: (Architect) *'I think our communications were pretty straight forward really. We had the management software which we all signed up to according to the teams. There was a central messaging board which was updated weekly, we had personal chats and phone conversations with all team members really. Emails, skype calls'.*

- Managing stakeholder expectation is the next step for communication management; it needs both interpersonal and management skills to be successful. Both these skills are necessary for a Project Manager and a Soft Landings Champion (see chapter four).

Interpersonal skills such as active listening, building trust and overcoming resistance to change can all help teams to communicate better. Management skills have to do with directing and coordinating groups of people for a project. They include presentation, writing and negotiation skills. Dialogue between the parties allows the exchange of views where new ideas can develop and decisions can be reached amicably (Gregory et al, 2003). Skills used in resolving conflict and building trust were discussed by the respondents for specific cases.

A12: (Project Manager) *'I felt the working drawings took too long for us. I understand the design team wanted to get everything right but there were times I felt some of their consultations dragged on a bit. We were all working to the schedule timetable which I remember they (the design team) missed two times. I expressed this in one of our meetings, which I got some explanation for. Once we were on site work went according to schedule.'*

A21: (Architect) *'Well while we are deciding the best approach to the design we listen to suggestions from all the team both from the company and those invited and sometimes there will be differences in opinion but we have always been able to come to an amicable agreement with everyone in the team'.*

A22: (Construction Manager) *'…we attended some meetings with discussions on different aspects which we (construction team) thought will present some challenges. These meetings usually ended with a compromise either on their part or on mine. I believe that they (design team) took our opinions (construction team). There was a major redesign of the boiler room because of our discussions'.*

B11: (Design Team Leader) *'We had an environment where we were open to suggestions and criticisms. We met with different teams asking them how they would like the space to function. We got a wide range of requests and suggestions…'*

B22: (Soft Landings Champion) *'There was some tension between the client's design team and the final design team about changing some elements specified earlier but communication is the key in any negotiation and in the end the drawings were signed off with no objections...'*

All these are examples of using interpersonal and managerial skills to communicate with team members. There seemed to be a disconnection in communication between the building and design team. The architect recalled that the scheduling for the design stage was too short and raised it during a meeting. The Project Manager did not speak

of any extension of the timetable and gave the impression that the design team undertook some unnecessary consultations. The issue of poor communication has plagued the industry for years (Senaratne and Ruwanpura, 2016). They explained that there is a link between the quality of communication and the success rate of a project. This is clearly demonstrated in this case (project A1) where the Project manager felt the design process was dragging while the design team thought that their request for more time had been approved. Such breaks in communication can lead to serious problems.
The Project Manager in project A1 felt the design team was not keeping to the schedule but using face to face meetings, they were able to resolve the issue. The design team were able to explain reasons for not meeting the deadline. This helped to manage the Project Manager's expectation of the design team. In all the instances discussed, the individual members made the effort to either communicate clearly or listen actively to others. All these helped the respective projects achieve their aim of collaborative working while producing sustainable buildings.

- Finally, for the information to come full circle, a performance report is necessary to consider the aspects that the teams got right and where improvements can be made. Using reporting systems which provides standard tools such as spreadsheet analysis and table reporting to understand the flow of information. Variance analysis can provide an 'after the fact' look of what happened in the project.

A23: (Environmental Engineer) *'We welcome collaborations, as sub-contractors we are sometimes left in the dark, we are not given sufficient information and we are expected to start work in the middle of important procedures. Early meetings and workshops with us will definitely have a positive effect on any sustainability target or objective'*

B23: (Service Engineer) *'Every piece of information that helps with the design is like a puzzle piece. The designers focus on certain aspects of the brief dealing with aesthetics and positioning of certain elements, it is our responsibility as sub-contractors and specialists to focus on aspects of the design that will not be apparent but have a big influence on the success of the building and project. I* *believe that we contributed positively to the project our meetings were always informative and they were very keen to take our suggestions'.*

B22: (Soft Landings Champion) *'For every project, there is a learning curve, there are many things looking back that the team could have done differently…Translating some of the employer's requirements were lost during the contracting and sub-contracting stage. Having a Soft Landings Champion earlier in the project could have made a difference'.*

All the respondents acknowledged there were elements during the project that could have been done differently. The sub-contractors expressing their views about their inclusion during the design. For project, A1 and A2, which did not fully embrace the Soft Landings process during the design stage, there is a marked difference on the way communication between the design team and others in the project. The post occupancy evaluations of project A1 noticed several issues including overheating in the additional classes. This affected the heating and cooling targets; it was suggested that these were because of decisions during the design which could have been from miscommunication between the teams. Additional funds were released from the client and this prompted calls for extra classrooms. This resulted in $56m^2$ of extra space for classrooms. At this stage, all the energy modelling for the building had been done and was not updated to include this new increase in floor area and energy demand. This therefore increased the energy consumption in the new part of the building and influenced the Energy Performance Certificate. The new section of the building had to play catch up which resulted in the M&E design being rushed and underfloor heating manifolds being specified and installed in that section. This resulted in overheating and the classrooms being uncomfortable.

A Soft Landings based Design Management would have identified the variation order at this stage and would have taken steps to make sure that the subsequent design is included in all energy modelling and target revision. Value engineering could have been used to adjust the specification of the new space in term of the Solar Thermal installations and the Natural Ventilation cowls. A Soft Landings Champion would have seen the change in design and asked for a review of the design targets and review the usability and manageability of the new space.

Project B1 and B2 were able to utilize the Soft Landings Champion to manage most of the communication and information sharing of their groups. The Soft Landings Champions provided support for the teams; this had a positive effect on the whole project.

9.3 Framework for Integrative Information Flow between design team and other teams

Having studied the information patterns of the four case studies, several issues are highlighted for improvement. During crucial end stages of the project lifecycle, there seemed to be a lag in information sharing. Figure 9.1shows the stages in the project where information sharing slows down. This maybe because the teams feel that they have shared information during the distinct phases therefore, they do not need the same intensity during the changeover. Or it could be because the teams suffer from fatigue at the point these stage because of the pressure to meet deadlines. Whatever the reasons this is happening, the information structures have to be fortified at these points so that all stakeholders are still kept in the information loop. This is paramount for the design team because of the unique position they occupy in the project. A Soft Landings project is supposed to overcome this lag in information sharing by recommending reviews at crucial points in the project but from the case studies, it appears that the teams reverted to conventional procedures.

The solution to this break in information sharing may rest on the Soft Landings Champion, whose primary role is to provide support for the project objectives. This means that the role has to evolve from simply supporting to taking a more prominent position during these crucial stages. From the inception of the project where roles and responsibilities are being defined, it will be important that a Soft Landings Champion is briefed on the responsibility of information sharing. Actively involved in setting environmental evaluation programme so that during the handover of the brief they are available to communicate with the relevant stakeholders. When the project enters its design stage, the Champion should be actively involved in meetings with specialist sub-contractors and end users to help coordinated the information sharing process (see figure 9.2). After the input stages of design (briefing and concept design stage), the Soft Landings Champion should continue to keep the relevant stakeholders (end users, sub-contractors, clients) in the information loop. Obviously certain procurement processes can make this difficult (see Chapter seven) that is why clients are encouraged to adopt the Soft Landings process early. Appointing a Soft landings champion early will free up teams to fully engage in the project while sharing information with other team members.

Figure 9.1 shows an information sharing framework between the design team and other stakeholders using the Soft Landings Champion as a main information conduit. The thickness of the arrows shows the importance of the information flow with the arrow going between the design team and the Soft Landings Champion given equal importance as the arrow going between the design team and Project Manager. The important point to note is the information sharing between stakeholders during the change in stages. While the Project Manager is busy during these crucial stages, the Soft Landings Champion is available to relay and share information about any new developments and reviews quickly. Time is also essential during these stages so it would be an advantage to know that any team needing information can go to the Soft Landings Champion and be updated on any issue.

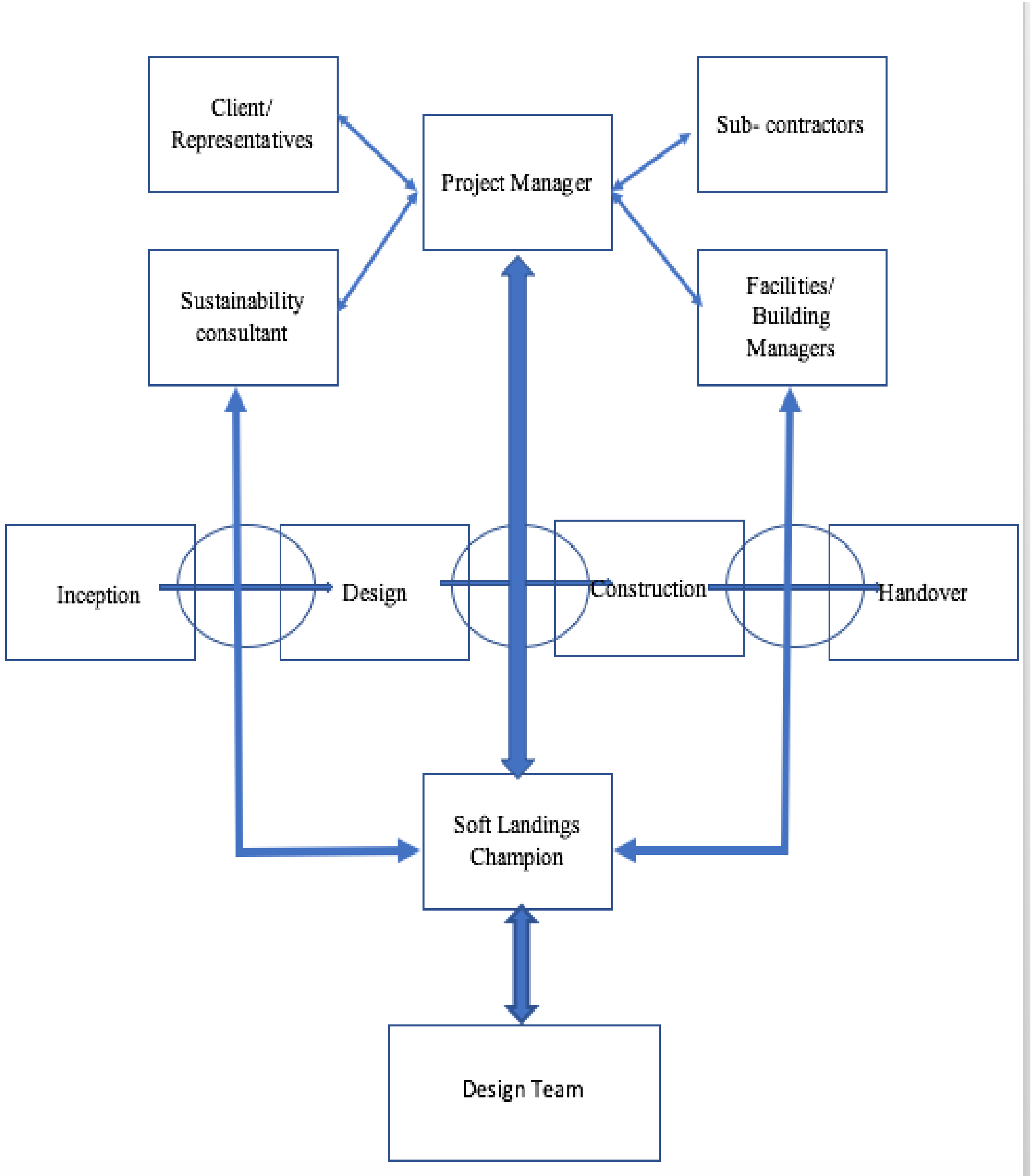


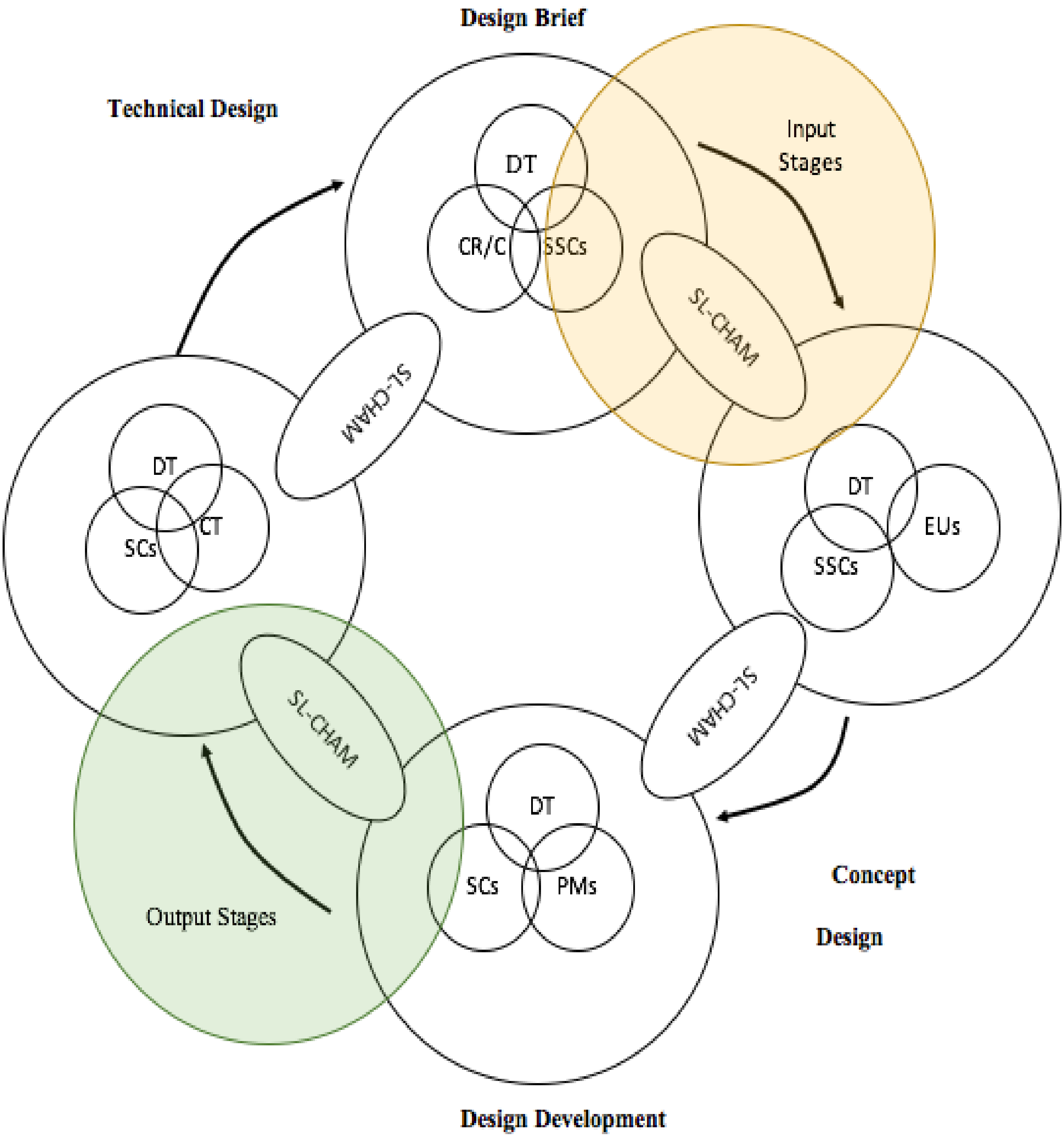
Figure 9. 1: Information flow between stages using a Soft Landings Champion.

Although figure 9.1 shows where breaks in information sharing occur during the stages of a project and how the role of a Soft Landings Champion can be central to information flow, this research is concerned with the design stage of the project. To understand a building design, a definition from the 1990's is used because it encompasses all the important aspects of the stage.

> *'A process which maps an explicit set of client and end-user requirements to produce, based on knowledge and experience, a set of documents that describe and justify a project which would satisfy these requirements plus other statutory and implicit requirements imposed by the domain and/or the environment'*
>
> *(Hassan, 1996).*

This includes the design brief, concept design, design development and technical design stages. These stages are grouped into the input and output stages where the input stages are the first two stages of design. At these stages, information is collected from the client's brief, review of past experiences, specialist sub-contractors, end users and other consultants. The design team is focused on collecting data to assist in making the decisions regarding the design. The output stages are the design development and technical stages where information gathered will translate to the design of the building. The above definition recognises the pre-requisite inputs and outputs of design. At this stage, the team no longer collects new information but makes informed decisions from the information collected from the input stage. Recognising these distinct stages allows the team work with relevant stakeholders and the right time (Gana et al, 2017).

Identifying the right stakeholders and whether they belong in the input or output side of the design is important for the flow of information. Figure 9.2 shows the stages during the design with relevant stakeholders. This allows every team to take part in the design process with the support of the Soft Landings champion. Although the stakeholders vary during the four stages, the Soft Landings Champion is a constant presence who can inform or update other team members. In an ideal situation, the stages will follow each other in sequence but many factors can lead to several stages going on at the same time as was the case of project B2. The Soft Landings Champion will be able monitor the stages and keep the flow of information going even when the stakeholders change.



KEY

DT- Design Team

CR/ C- Client's Representative/ Consultants

SL- CHAM- Soft Landings Champion

EUs- End users

SSCs- Specialist Sub-contractors

SCs- Sub-contractors

CT- Construction Team

PMs- Project Managers

Figure 9. 2: Framework showing key stakeholders during distinct stages of design.

9.4 Developing a framework for quality of communication for a Soft Landings project at the design stage

About 58% of time during the design stage is used in managing information (Flager et al, 2009), it is therefore important that the quality of communication and information flow must be at the highest level. High quality information exchange can free the design team to dedicate more time to core design activities by eliminating repetitions and only sending target-focused information to the correct stakeholder. All this lead to a well-informed decision-making process which will add value to the over design.
There are several factors that affect the quality of communication in a conventional project. they include: Taking decisions based on assumed information, directing information to the wrong stakeholder, withholding information from other team members, correctly predicting the impact of changes to the design, assessing the impact of missing information. Understanding these factors and taking steps to mitigate their impact will improve the quality of information in any project.

To resolve the issues mentioned above, the research proposes a framework for quality communication (Figure 9.3); And a communication matrix with stakeholder responsibilities regarding communication for project objectives (Table 9.1). The first step is identifying the project objectives with respect to the design. This will include identification of interdependent design objectives (tasks), revise the objectives in order of importance, and identify objectives that can be resolved using a common solution.

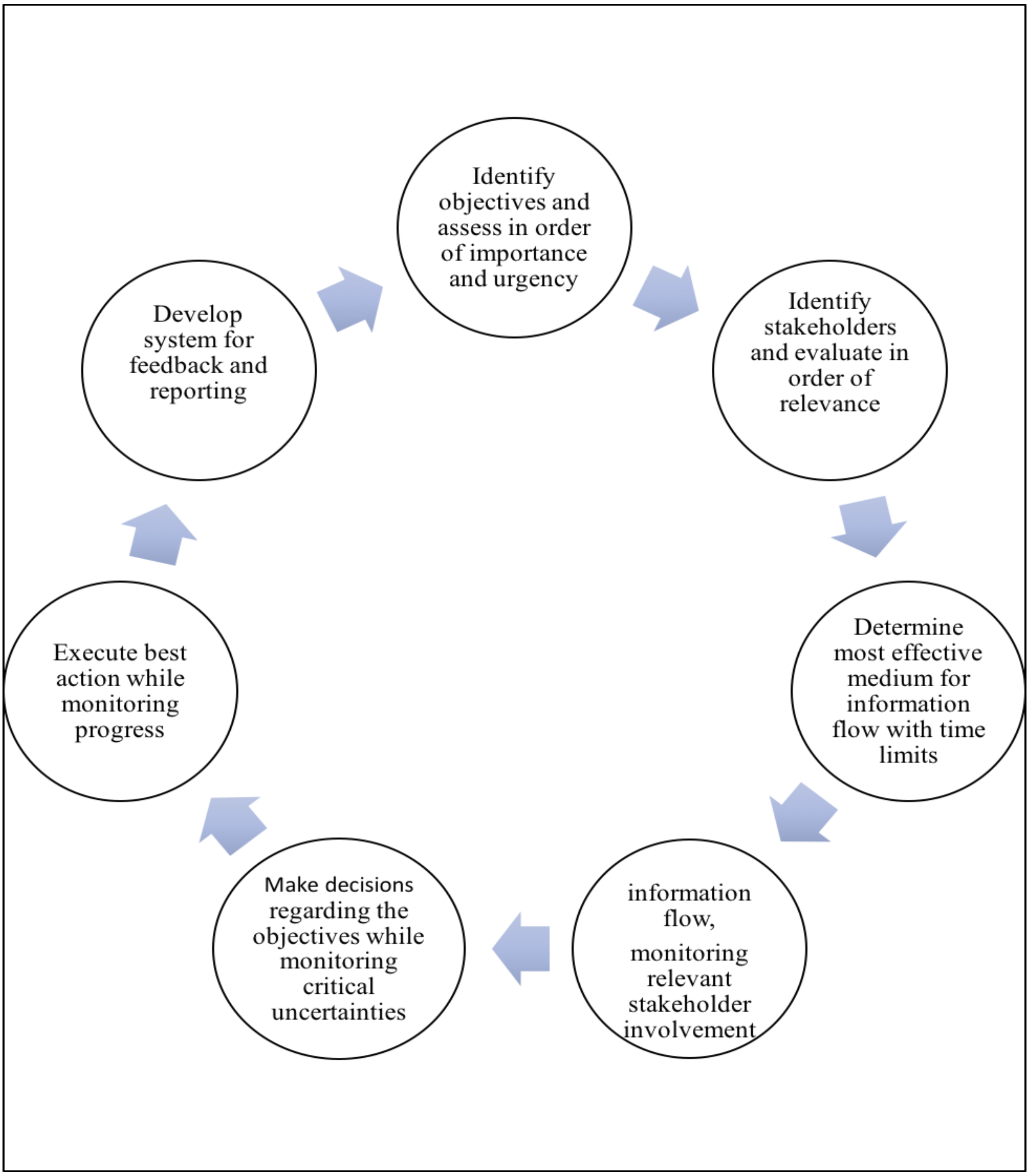


Figure 9. 3: Framework for quality communication during a Soft Landings design process.

The next step is to identify the relevant stakeholders and the roles which they will play in achieving the objectives. They will be evaluated in order of their importance to the objective. For example, from Table 9.1, the Architect is responsible for ‘design and functionality of space’, while the Sustainability Consultant is consulted on issues regarding sustainability targets on the design and functionality of space and the Soft Landings Champion played a supporting role during the design. This communication matrix gives each stakeholder a structure of the hierarchy and the chain of command during the project. Identifying the stakeholders allows the design team to focus their efforts on the right team to interact with. The next step is to determine the most effective way to communicate. This was seen in project B1 where the sub-contractor was based in another country but still had to be available for the meetings. It was decided that the first meeting should be face to face while subsequent meetings were conducted over Skype and the telephone (see Chapter seven). Finding the appropriate medium saves time and effort for all the teams.

Table 9. 1: Communication matrix showing responsibilities for project objectives

Stakeholders	Project Objectives							
	Sustainability objectives	Energy and environmental performance	Design and functionality of space	Construction Stage	Training of facilities management staff	Engagement with end user	Handover	Post occupancy evaluation
Client/ Representative	△	▲	△	▲	▲	●	▲	▲
Design Manager/ Architect	△	△	○	◎	▲	◎	△	▲
End users	▲	▲	△	△	▲	△	▲	△
Facilities/Building Team	△	△	△	△	○	●	◎	●
Project Manager	◎	●	◎	○	◎	○	○	△
Soft landings Champion	●	●	●	●	●	●	●	○
Sub-contractors	△	△	△	◎	●	△	△	△
Sustainability Consultant	○	○	△	●	△	△	△	△

Legend

△	**Consulted**	▲	**Informed**	○	**Responsible/ Team leader**		**Accountable**	●	**Supporting role**

The framework suggests a time limit for the flow of information; this is to help keep the project on schedule. Compromising the time in exchange for more information may not necessarily yield the desired results as seen in project A1 where although there was a lot of end user participation, some classrooms experienced problems with overheating during the summer months.

It is important to note that step one to three involved collecting data and making decisions for the next step. It was therefore difficult to move to the next step without the correct information. These steps will eliminate the problem of teams making decisions based on assumptions. The actual information flow begins at step four, the quality of data collect in the three previous steps will determine the success of the objective. The design team starts to share information at step four having made decisions on the right stakeholders and the medium. Step five sees the interaction between the teams; collaborating to solve the design objectives. The framework acknowledges that there will be uncertainties and unknown elements at step five but recommends monitoring the uncertainties. Actions based on the information flow will begin at stage six, this is after the teams have worked together sharing information and exchanging ideas. The final stage suggests developing a system for feedback where the team can look back at the process and find areas where they could have proceeded differently. Figure 9.4 provides a reporting template where the teams can easily summarise the actions and results of such actions.

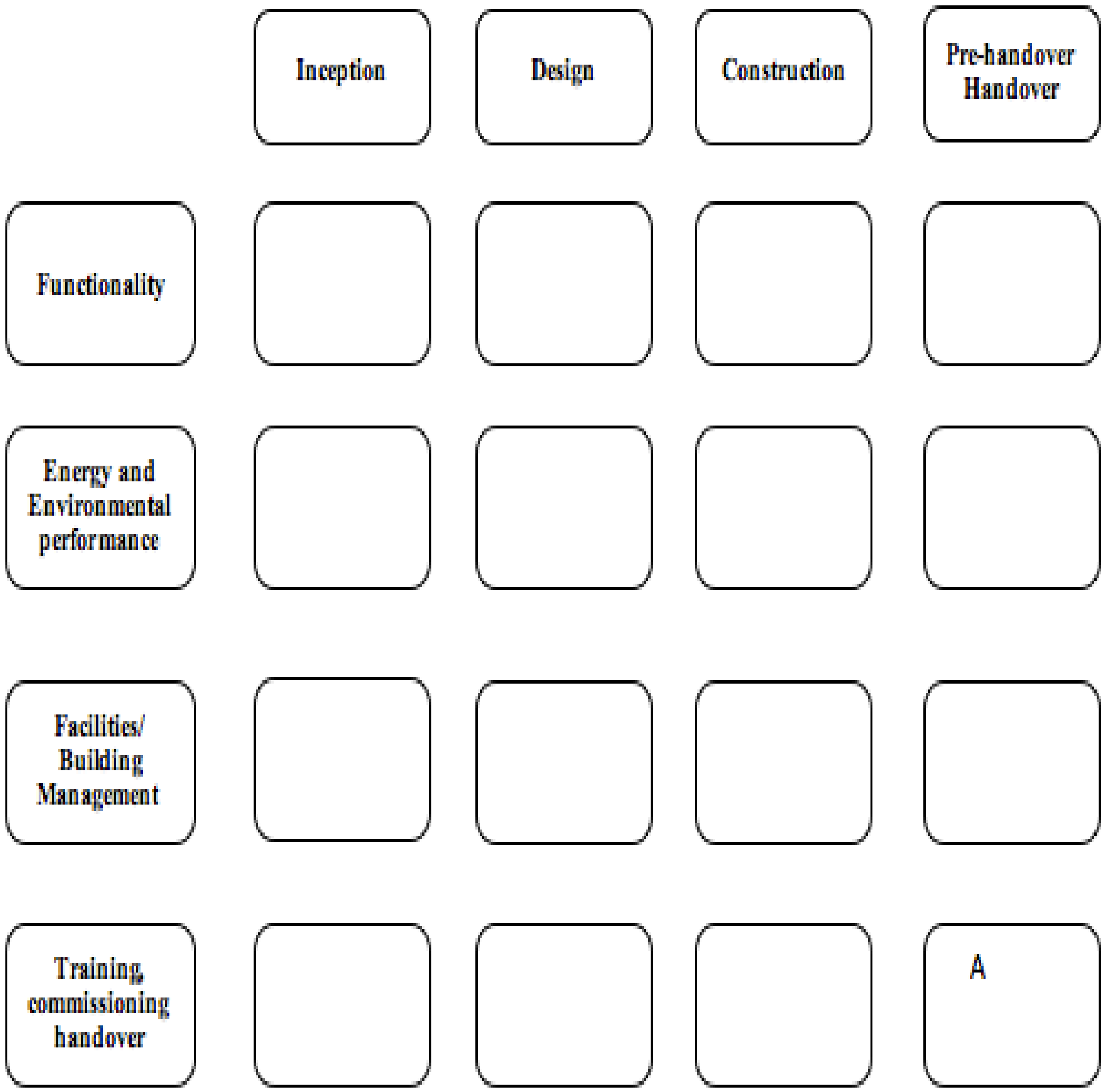


Figure 9. 4: Template for reporting process in a Soft Landings Project

9.5 Summary

This chapter highlighted the fragile relationships between information flow, communication, and sustainability in buildings. The following was discovered:

- Getting the right balance of all three elements can be difficult. This is because it has been established that information flow cannot be static or move only in one direction.
- Information flow between teams needs to be dynamic enough to adapt to new situations quickly but robust enough to follow a framework or process to succeed.
- The framework for the flow of information shows that weak points at the interchange of the project stages needs attention. Rather than the teams relaxing at these stages, they need to continue the high-level multi-dimensional information exchange.
- Design teams are the first to handover to the next group of professionals so they must be ready to keep information flowing before, during, and after the technical drawings are being produced.
- The quality of information is also as important as the flow with information based on assumptions and rough estimates having a damaging effect on the design and the project.

The frameworks addressed both the flow of information and the quality of the information. This will help design teams adopting Soft Landings quickly identify the process by which they can collaborate effectively and efficiently with other teams. The conclusion chapter will discuss in depth the implication of this research on design teams and the adoption of Soft Landings for projects.

Chapter 10

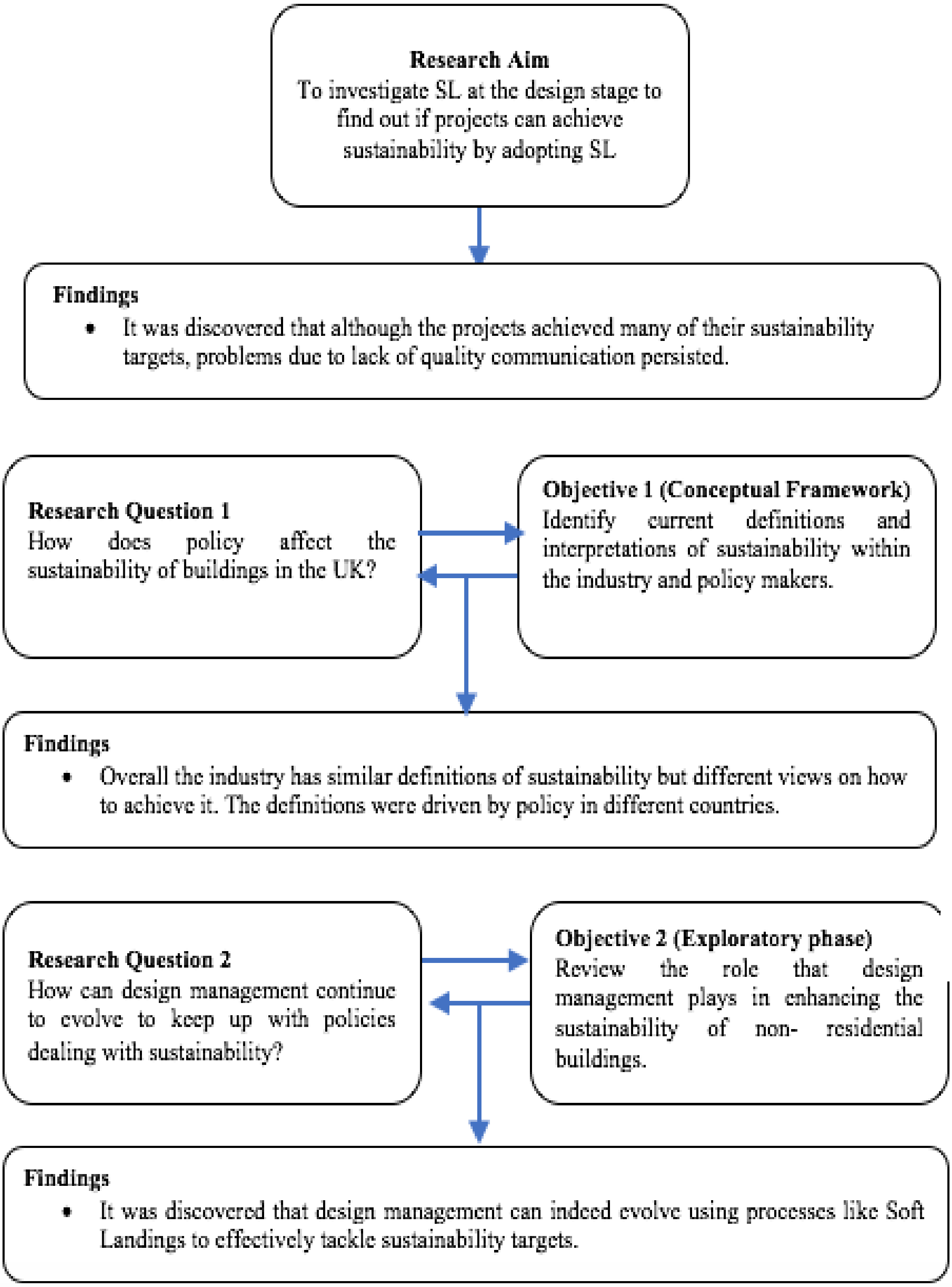
Conclusions

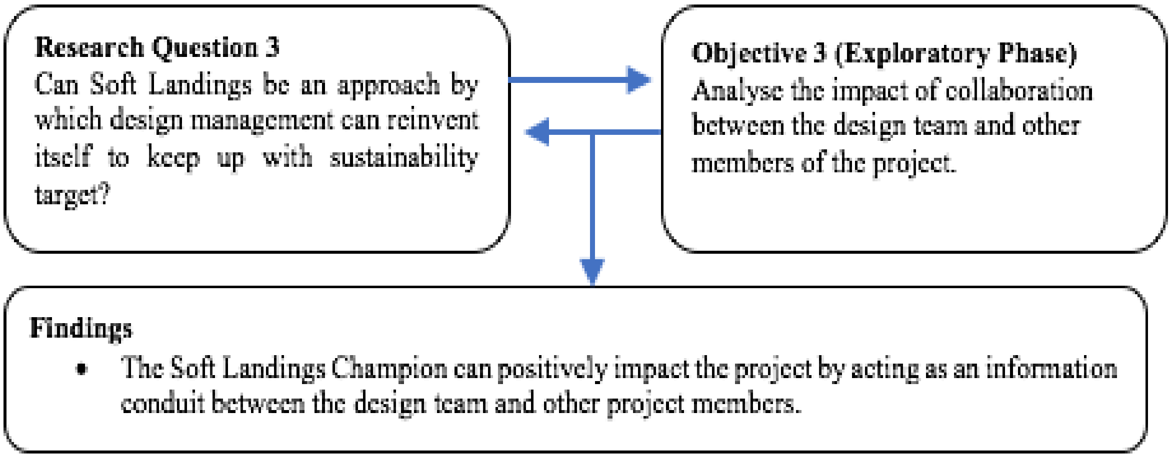
10.1 Introduction

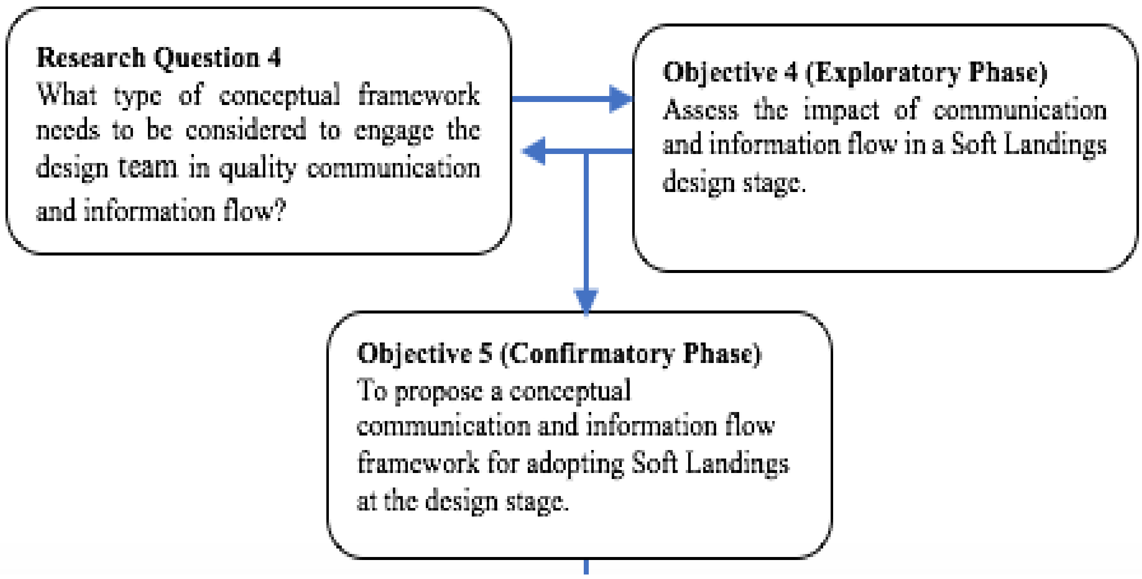
The aim of this research was to investigate Soft Landings at the design stage, to find out if projects can achieve sustainability by adopting the principles of Soft Landings. To achieve the research aim, the researcher concluded that some questions had to be answered in respect to sustainability (see Chapter one). To answer the questions, the research design and methodology used a system of investigation, starting with a comprehensive literature review (see Chapter four), before collecting data using case studies and interviews (see Chapter five). The researcher analysed the collected data using inductive coding and cross comparison analysis (Chapter five). The findings were discussed and further analysed in chapters seven and eight. Finally, chapter nine presents the total of the research data after collection and analysis resulting in conceptual frameworks for information flow and the quality of communication between the design team and other team members in a Soft Landings project. The research reached conclusions that answered the research questions while achieving the objectives of the project. This chapter summaries the research (Section 10.2) with its contribution to both practice and research (10.3); the limitations of the research (10.4) and directions for future research (Section 10.5).

10.2 Research Summary

This research wanted to consider the whole process of Soft Landings but it became clear that it was going to take longer than the time available. The research therefore, concentrated on the design stage. The research aim of investigating if design management working with the principles of Soft Landings can achieve sustainability in buildings has been summarised into a research framework (Figure 10.1).


Research Aim
To investigate SL at the design stage to find out if projects can achieve sustainability by adopting SL
Findings
It was discovered that although the projects achieved many of their sustainability targets, problems due to lack of quality communication persisted.
Research Question 1
How does policy affect the sustainability of buildings in the UK?
Objective 1 (Conceptual Framework)
Identify current definitions and interpretations of sustainability within the industry and policy makers.
Findings
Overall the industry has similar definitions of sustainability but different views on how to achieve it. The definitions were driven by policy in different countries.
Research Question 2
How can design management continue to evolve to keep up with policies dealing with sustainability?
Objective 2 (Exploratory phase)
Review the role that design management plays in enhancing the sustainability of non- residential buildings.
Findings
It was discovered that design management can indeed evolve using processes like Soft Landings to effectively tackle sustainability targets.


Research Question 3
Can Soft Landings be an approach by which design management can reinvent itself to keep up with sustainability target?
Objective 3 (Exploratory Phase)
Analyse the impact of collaboration between the design team and other members of the project.
Findings
• The Soft Landings Champion can positively impact the project by acting as an information conduit between the design team and other project members.


Research Question 4
What type of conceptual framework needs to be considered to engage the design team in quality communication and information flow?
Objective 4 (Exploratory Phase)
Assess the impact of communication and information flow in a Soft Landings design stage.
Objective 5 (Confirmatory Phase)
To propose a conceptual communication and information flow framework for adopting Soft Landings at the design stage.

Findings

- The framework identified the areas where inadequate communication can cause inefficiencies in buildings.
- The framework indicated the areas where the Soft Landings Champion can bridge the communication gap between the design team and other project teams.
- A second framework outlined how quality communication can be identified and used effectively during a Soft Landings design stage.

Additional Findings

- Procurement methods have a big impact in adopting Soft Landings during design.
- The industry is yet to fully embrace the Implementation of the Government Soft Landings.
- There is confusion on the role of the Soft Landings Champion.

Figure 10. 1: Summary of Research Framework

The first research question was ‘how does policy affect the sustainability of buildings in the UK?’ The research discovered that there has been a shift towards sustainable buildings since the 1970’s. With different international and national organisations working to make sustainable buildings the norm. Recently, the focus of the international community has been on carbon reduction resulting in the Paris Agreement. The Climate Change Act helped shape the housing policy in the UK with new regulations on new buildings and retrofits. New buildings using BREEAM assessment method have become more sustainable, not only in their supply chains but also their energy efficiency.

There are however, critics of government policies (see Chapter four) who say that definitions of sustainability are ambiguous and do not address some parts of carbon reduction. Some complained about the different assessment methods calling for more inclusive solutions rather than a checklist of regulations and arbitrary targets. Others pointed out that older buildings are the main problem and resources should be focused on retrofitting old buildings to raise them to the current standards. Overall, the research discovered that government policy has had a positive effect on the sustainability of buildings with more new buildings achieving BREEAM ‘excellent’ ratings. The government must keep the momentum in offering incentives to the construction industry and educate end users on the advantages of embracing such policies. Objective one which was ‘identifying current definitions and interpretations of sustainability within the industry and policy makers’ answers question one (see Figure 10.1). By finding the latest and widely used definitions, the research could proceed to outlining the criteria for the professionals who are acquainted with these definitions.

The second question was ‘how can Design Management continue to evolve to keep up with policies dealing with sustainability’? The topic of Design Management continues to reveal layers that were not available 10 years ago. Elements like value management, change control and communication control are now widespread during projects (See Chapter two). What the research discovered was Design Management (which by comparison, is a relatively new discipline) is yet to find its niche within the industry, with many misunderstanding the role (see Chapter four). Whilst focusing on the research question, the research discovered that often Design Management struggles to keep up with policies dictated by government legislation. Researchers have tried to overcome this drawback by setting up frameworks on the role of a Design Manager, the collaboration and communication between teams (see Chapter four). This shows that Design Management is evolving with the trends in the industry focusing on collaboration and communication.

The common understanding is that Design Management is positioned in the industry to help achieve sustainability in buildings. Objective two which is ‘Review the role that design management plays in enhancing the sustainability of non- residential buildings’ answers question two (see figure 10.1). This enabled the research to proceed in the knowledge that Design Management is able to keep up with government policies as long as it embraced new processes such as Soft Landings.

The third question was ‘Can Soft Landings be an approach by which Design Management can reinvent itself to keep up with sustainability targets’? This question which is a follow-up from question two, is looking for ways which Design Management can evolve to keep up with sustainability targets. Soft Landings was introduced in chapter two, outlining the 12 core principles with an approach to addressing many of the problems that plague the industry (see chapter one). The research discovered that although Soft Landings aimed for energy efficiency and by extension sustainability, the emphasis was on the handover stage. Trying to build-up collaborative working from inception, the design stages described in the Soft Landings framework were flexible enough for companies to adopt without losing their corporate identity. While this was an inclusive way to work, it allowed the companies to revert to status quo during the design stage (see chapter seven). The research discovered that Soft Landings did indeed provide an opportunity for Design Management to evolve by establishing tasks, responsibilities and review procedures (see chapter four). By adding new elements during the design stage, sustainability targets can be closely monitored with regular reality checks, fine tuning, and feedbacks. Communication and information flow plays a major role in the elements introduced at this stage. Objective four which is ‘Assess the impact of communication and information flow in a Soft Landings design stage’ answers question three. Discovering from the context of the research (see chapter one) that communication and information sharing are some of the main problems of the industry. Soft Landings offers Design Management an available solution that can evolve with the policies and regulations.

The fourth question was ‘What type of conceptual framework needs to be considered to engage the design team in quality communication and information flow’? Having researched the problems in the construction industry along with policies on sustainability targets, it was discovered that if the issue of the quality of communication and information flow can be effectively addressed, then collaborative working and partnerships can produce more sustainable buildings.

Logically, the next step was to propose a conceptual communication framework. A framework that will be incorporated into a Soft Landings design stage which can be easily adapted by the design team. A framework that will give design teams the flexibility to work but a structure that will not allow them to revert to ‘type’ after adapting Soft Landings. The research discovered that the quality of communication was one of the most important aspect in interaction between teams. That sustainability depends not only on the flow of information but also in the quality. Meetings and workshops must be conducted in a way that all teams will receive the right information at the right time. Objectives three and five answer the question by analysing the interaction of the design team with other teams in the case studies. The discovery that despite the collaborative atmosphere that Soft Landings encourages, some team members were still reluctant to share certain information underlined how difficult it is to change the culture of the industry.

The proposed conceptual framework for the quality of communication ensures that teams cannot easily withhold information for other teams. The Soft Landings Champion who will be available for most of the meetings will ensure that no relevant stakeholder is left out of the information loop (see chapter nine). The proposed concept for the flow of information also ensures that delays are minimized by involving the Soft Landings Champion in all stakeholder meetings. The Soft Landings Champion will be an important partner during the stages when the teams feel they no longer need to keep the information flow.

10.3 Conclusion on Findings

The research aim of discovering if buildings can achieve sustainability by using Soft Landings during the design stage followed the path dictated by the literature review. From all four case studies, it is evident that the buildings achieved high ratings in their BREEAM design and construction scores (See Chapter seven). The occupants also gave all the buildings high ratings for design and use of technology. This of course, is not enough to say it was solely as a result of the use of Soft Landings. Many other factors contributed to the success of the projects. Factors such as early engagement of the end users, close collaborative working between teams and the involvement of building/facilities managers. What is clear is that these factors are fundamental to the Soft Landings Framework. By adopting the framework from design, project B1 and B2 took maximum advantage of the process. Engaging the Soft Landings Champion, shifted the paradigm of traditional projects to allow for new directions in collaboration to be taken by the teams. This can be seen in project B1, where although many of the professionals had never used Soft Landings before, they were able to follow the principles to achieve their sustainability targets. It can therefore be said that Soft Landings does benefit projects and helps to achieve their sustainability targets; providing all the professionals are equally committed to the process.

The Soft Landings Champion is one of the influences that separate a Soft Landings project from a traditional one. The introduction of this dynamic role fulfils many of the responsibilities that often get overlooked during a project. The role is established to add a new layer of commitment and information transfer between team members. The projects which had a Soft Landings Champion (B1 and B2) benefitted from the interactions of the Soft Landings Champion. It can be said that the Champion provided value to the project. There will be arguments that will say the Soft Landings Champion is another Project Manager but as discovered in Section 4.6, the role of the Soft Landings Champion goes further to create a collaborative atmosphere.

10.4 Contribution to knowledge and practice

This research contributed both academically and to the construction industry by filling the research gap for academic research into a Soft Landings design team. Although the industry has encouraged case studies on buildings using Soft Landings as mention earlier, their focus has been the handover stages and post occupancy evaluations. Some companies produced the case studies themselves which presents a problem with bias towards the projects. This research will be counted as one of the first independent researches into the Soft Landings design stage. Subsequent researches can build on the foundations laid by this research.

10.4.1 Theoretical Contribution

Currently, the most common theoretical framework for investigating sustainability in buildings is a positivist approach. This approach advocates for the analysis of quantitative data usually collected using monitoring and questionnaires. This research takes a different approach to investigating sustainability taking a social constructivists view. As explained earlier (see chapter three), design is a social process which cannot be adequately investigated with monitoring building spaces. There is a need to dig deeper into the reasons why certain decisions are taken during design.

By using social constructivist as a theoretical framework to underpin this research, the respondents were able to spend more time discussing individual elements during the interview. This cannot be explored using questionnaires. The social construct of the case studies was highlighted in the interaction between teams and end users. As some researchers have argued, sustainable buildings must come from the conscious effort of both professionals and end users. This research has contributed to the body of work available for researchers of sustainable design. Showing that research into sustainable buildings is possible using other approaches that are not absolute in their results. Developing a conceptual framework from this research also shows that the theoretical framework is robust enough to support a wide range of investigations.

10.4.2 Implications for design teams

The conceptual communication framework from this research will have far reaching implications beyond the design teams. As is evident from research, communication and information flow holds the key to more homogenised teams in construction. The individual project goals may be different but they usually follow time, cost and quality factors. Teams will need Information flow to achieve these goals. The design teams have acknowledged that they cannot work in isolation as is clear in all the case studies. But it is not enough to want more teams involved at the design stage. A systematic coordination of information flow must be available to succeed within this fast-paced industry.

Soft Landings needs more exposure before it can be fully embraced by an industry that is notoriously resistant to change. Knowing that equal importance is given to all the stages of the project will go a long way to helping its acceptance. Design teams looking to adopt Soft Landings can adopt this communication frameworks to make communication easier between teams. It can be easily adopted within other existing frameworks and help to make sustainable projects successful.

10.5 Limitations of Research

As with any research it is important to acknowledge its limitations and drawbacks. The research is located in the UK because Soft Landings process originated from partnerships in the UK. The government also adopted the Government Soft Landings (GSL) in the UK, so it was appropriate that the research should originate from the UK. For this reason, the analysis may only apply to a small number of companies. Although generalisation from this research may prove difficult, that is not to say it is impossible to apply to other countries. From this research, it is already established that some foreign companies partnered with other UK companies on Soft Landings projects so some companies already have experience with the process. The research also had a limited pool of professionals who have experience with Soft Landings at the design stage. Many projects adopted Soft Landings but mostly for the advantage of the post occupancy evaluations it provided. Therefore, it was challenging to find a sufficient number of professionals who could discuss their experiences on the process from the design stage.

The lack of academic research on the topic also proved challenging; many Soft Landings case studies are purely qualitative. Most researchers carried out monitoring activities measuring actual readings against estimated targets. Their theoretical framework was from a positivist approach. This approach could not be used when researching the design stage of a Soft Landings project. A social constructivist approach had to be adopted to uncover the experiences of the respondents. This was overcome by using data from the post occupancy evaluations of the case studies to corroborate the data collected from the respondents.

The research was also limited because the respondents were asked to remember incidents on projects that ended years ago. They were asked specific questions about certain elements and some of the respondents had trouble remembering what happened. There were phases like…'if I can remember correctly' and 'I cannot remember everyone there'. This was circumvented by interviewing more than one person in the project and using supporting documents like minutes of meetings and contract documents. Overall the researcher tried to address all the limitations of the thesis.

10.6 Directions for Further Research

This research could be usefully extended to several researches. The first would be to investigate the whole process of Soft Landings from start to finish. This would be almost impossible within the current timeframe. Research into the communication during the construction stage will highlight the interactions between teams during construction. To be able to investigate interactions between sub-contractors and the main contractors of a Soft Landings project will whole process of Soft Landings. The role of the Soft Landings Champion also needs more research to benefit the industry.

References

Abdellatif M., A., Othman A., A. E. (2006). Improving the sustainability of low-income housing projects: the case of residential buildings in Musaffah Commercial City in Abu Dhabi. Emirates *Journal for Engineering Research*. Vol 11(2), Pp 47 58.

Abowitz, D. and Toole, T. (2010) Mixed method research: fundamental issues of design, validity, and reliability in construction research. *Journal of Construction Engineering and Management*, Vol 136(1), 108–16.

Adetunji, I., Price, A., Fleming, P. and Kemp, P., 2003, 'Sustainability and the UK construction industry – a review', in Proceedings of the Institution of Civil Engineers: *Engineering Sustainability*. Vol 156(1), Pp 185–199.

Aguwa, C.C., Monplaisir, L., Turgut, O. (2012). Voice of the customer: Customer satisfaction ratio based analysis. Expert Systems with Applications.39:10112 10119.

Agyekum-Mensah, G. Knight, A. Coffey, C. (2012) "4Es and 4 Poles model of sustainability: Redefining sustainability in the built environment", *Structural Survey*. Vol. 30 (5). Pp 426 – 442.

Ahm, Y. H. and Kim, K. T. (2014) Sustainability in modular design and construction: a case study of 'The Stack'. *International Journal of Sustainable Building Technology and Urban Development*. Vol 5 (4). 250-259, DOI: 10.1080/2093761X.2014985758.

Ahmad, T. Thaheem, M. and Anwar, A (2016). Developing a green building design approach by selective use of systems and techniques. *Architectural engineering and Design Management*. Vol 12 (1). Pp 29-50. Doi.org/10.1080/17452007.2015.1095709.

Ahsan, K., Ho, M. and Khan, S. (2013), Recruiting Project Managers: A Comparative Analysis of Competencies and Recruitment Signals from Job

Advertisements. *Project Management Journal.* Vol 44: Pp 36–54. Doi: 10.1002/pmj.21366

Altomonte, S., Rutherford, P., and Wilson, R. (2015). Human factors in the design of sustainable built environments, *Intelligent Buildings International*, 7:4, 224-241, DOI: 10.1080/17508975.2014.970121.

Ares, E. (2016). Zero Carbon Homes. Briefing Paper, Number 6678, 27 April 2016. House of Commons Library. Available at www.researchbriefing.files.parliament.uk/documents/SN06678.pdf. Accessed on 12 January 2017

Asif, M., Muneer, T. and Kelley, R. (2007) Life cycle assessment: a case study of a dwelling home in Scotland. *Building and Environment.* Vol 42 (3). Pp1391–4.

Atkinson, P. (1999). Making sense of Qualitative Data: Complementary Research Strategies. Thousand Oaks, California, Sage.

Auchterlounie T, Hinks J. (2001). The measurement of customer satisfaction in the private house building sector. In: Kelly J, Hunter K, editors. Proceedings of the RICS Construction and Building Research Conference (COBRA 2001); Glasgow Caledonian University, Glasgow; 2001 Sept 3 5; 2:35 646.

Bal, M (2014). Stakeholder Engagement and Sustainability-Related Project Performance in Construction. Doctoral Thesis submitted at Liverpool John Moores University.

Barrett, P., and Sutrisna, M. (2009) Methodological strategies to gain insights into informality and emergence in construction project case studies. *Construction Management and Economics.* Vol 27(10). Pp 935-948, DOI: 10.1080/01446190903273943.

Basit, T (2003). Manual or electronic? The role of coding in qualitative data analysis, *Educational Research*. Vol 45(2). Pp. 143-154. DOI: 10.1080/0013188032000133548.

Bateson, G, (2000). *Steps to an Ecology of Mind*. Chicago, University of Chicago Press. Pp 457-459

BHKR (Burt Hill Kosar Rittelmann Associates), 2003, Achieving Architectural and Engineering Collaboration in Building Design, White Paper, Butler, PA.

Bibby, L., Austin, S. and Bouchlaghem, D., (2003), 'Design management in practice: Testing a training initiative to deliver tools and learning'. *Construction Innovation,* London. Vol 3(4). Pp 217–229.

Blutstein, H.; Rodger, A. (2001). The sustainable tall building of the third millennium, in Proc. of the CTBUH 6th World Congress, 26 February-2 March 2001, Melbourne, Australia, 131-142.

Bordass, B. (2003). Learning more from our buildings- or just forgetting less? *Building Research and Information*. Vol 31 (5). Pp 406-411.

Bordass, B., Leaman, A. (2005a). Making feedback and post occupancy evaluation routine 1: A portfolio of feedback techniques. *Building Research and Information*. Vol 33 (4), Pp 347-352.

Bordass, B. and Leaman, A (2005b). Making feedback and post-occupancy evaluation routine 3: Case studies of the use of techniques in the feedback portfolio. Building *Research and Information.* Vol 33 (4), 361- 375.

Bordass, B., Leaman, A (2015). Building performance assessment and evaluation. Paper presented at PART 1. 2, Building Performance Sessions, 12 May 2015 at the Centre for Alternative Technology (CAT). Available at www.usablebuildings.co.uk. Accessed on 12 January 2017.

Bouchlaghem, D., Shang, H., Anumba, C., Cen, M., Miles, J. and Taylor, M. (2005). ICT-enabled collaborative working environment for concurrent conceptual design. *Architectural Engineering and Design management.* Vol 1(4). Pp 261-280. Doi: 10.1080/17452007.2005.9684597

Bowen, P.A. and Edwards, P.J. (1998). Building cost planning and cost information management in South Africa. *Journal of Construction Procurement*. Vol 4(1). Pp 16–25.

Braithwaite, P., (2007). Improving company performance through sustainability assessment, in Proceedings of the Institution of Civil Engineers: *Engineering Sustainability*. Vol 160(2). Pp 95–103.

Bresnen, M. and Marshall, N. (2000). Building partnerships: client-contractor collaboration in the UK construction industry. *Construction Management and Economics.* Vol 8 (7). Pp 819-832.

British Standards Institution (2000) *Guide to Project Management.* BS 6079. BSI, UK.

Britten N. (1999). Qualitative interviews in healthcare. *In* Pope C, Mays N (eds) *Qualitative research in health care*. 2nd ed. pp 11–19. London: BMJ Books.

Brown, N. Wright, A., J., Shukla, A., Stuart, G. (2010). Longitudinal analysis of energy metering data from non-domestic buildings. *Building Research and Information.* Vol 38 (1). Pp 80-91

Bryde D., J., (2007). Is construction different? A comparison of perceptions of project management performance and practices by business sector and project type, *Construction Management and Economics*. Vol. 26 (3). Pp. 315–327.

Bryman, A. (2001) *Social research Methods.* Oxford, Oxford University Press.

Bryman, A., and Bell, E., (2007), Business Research Methods, 2nd Edition. Oxford: Oxford University Press.

Bunn. R, (2013). How to procure Soft Landings. Specifications and supporting guidance for clients, consultants and contractors. Available at www.softlandings.org.uk. Accessed on 16 November 2016.

Burnett, J. (2007). Sustainability and sustainable buildings. *International Journal of Hong Kong Institution of Engineers Transactions.* Vol 14 (3). Pp 1-9.

Carbon Trust (2012). Closing the Gap: Lessons Learned on Realising the Potential of Low Carbon Building Design.

Carson, D., Gilmore, A., Perry, C. and Gronhaug, K., (2001), *Qualitative Marketing Research*, Sage Publications, London.

Chan, A., Scott, D. and Lam, E. (2002) Framework of success criteria for design/build projects. *Journal of Management in Engineering*. Vol 18(3). Pp 120–128.

Chan, A.P.C., Scott, D. and Chan, A.P.L. (2004) Factors affecting the success of a construction project. *Journal of Construction Engineering and Management*. Vol 130(1). Pp 153–155.

Chappells, H and Shove, E. (2005). Debating the future of comfort: environmental sustainability, energy consumption and the indoor environment. *Building Research and Information.* Vol 33 (1), Pg 32-40.

Cheung, S., Ng, T., Wong, S.-P. & Suen, H. (2003) 'Behavioural Aspects in Construction Partnering'. *International Journal of Project Management.* Vol 21 (5). Pp 333-343.

Chiocchio, F., Forgues, D., Paradis, D. and Lordanova, I. (2011). Teamwork in integrated design projects: understanding the effects of trust, conflict and collaboration on performance. Project Management Journal. Vol 42 (6). Pp 78-91

Christiansson, P., Svidt, K., Pedersen, K. B., Dybro, U. (2011). User participation in the building process. *Journal of Information Technology in Construction.* Vol 16, Pp 309 -335

CIBSE (2012). Guide F: Energy Efficiency in Buildings (3rd edition). The Chartered Institution of Building Services Engineers, London.

Cicmil, S. and Hodgson, D. (2006). "Making projects critical: an introduction". In *Making Projects Critical*, Edited by: Hodgson, D. and Cicmil, S. 1–28. New York: Palgrave Macmillan.

CIOB (2002), Code of Practice for Project Management for Construction and Development. 3rd Edition. Blackwell Publishing, Oxford.

Clark, J. 2001. Energy Simulation in Building Design, UK: Butterworth Heinemann.

Climate Change Act (2008), available at: www.legislation.gov.uk/ukpga/2008/27/pdfs/ukpga_20080027_en.pdf Accessed on 2 December 2014.

Cohen, L. and Manion, L. (1989). *Research Methods in Education*, Third edn. London: Routledge.

Committee on Climate Change (2014). Meeting Carbon Budgets- 2014 progress report to parliament. Available at www.theccc.org.uk. Accessed on 12 January 2016.

Committee on Climate Change (2016). Meeting Carbon Budgets- 2016 progress report to parliament. Available at www.theccc.org.uk. Accessed on 30 January 2017.

Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Energy Efficiency Plan (2011) – COM/2011/0109 final.

Cooper, R. and Press, M., 1995, The Design Agenda; A Guide to Successful Design Management, Chichester, John Wiley & Sons.

Crawley, D. B., Hand, J. W., Kummert, W., and Griffith, B. T. (2008). Contrasting the capabilities of building energy performance simulation programs. *Building and Environment.* Vol 43(4). Pp 661-673.

Creswell, J.W. (2007). Qualitative inquiry and research design: Choosing among five approaches. Thousand Oaks, CA: Sage.

Creswell, J. W. (2013). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. 4th Edition, Sage Publications.

Crocker, L., & Algina, J. (1986). *Introduction to classical and modern test theory*. Toronto: Holt, RineHart, and Winston, Inc.

Crook, D. (1997) Empirical enquiry or metaphysics? Respecifying the methodological debate. *Journal of Construction Procurement.* Vol 3 (2), Pp 56-71.

Dainty, A., Moore, D., & Murray, M. (2006). *Communication in construction – Theory and practice* (1st ed.). London: Taylor and Francis.

Dainty, A. R., Green, S. and Bagilhole, B. (2007) *People and culture in construction: contexts and challenges*. In: A.R.J Dainty, S. Green and B. Bagilhole (eds). People and Culture in Construction. Abingdon, Taylor and Francis.

Damodaran, L., and Shelbourn, M. (2006). Collaborative working- The elusive vision. Architectural Engineering and Design Management. Vol 2 (4). Pp 227-243.

David, M. and Sutton, C. (2004). S*ocial Research, the basics*. Sage Publication: London.

Davies, D., Halliday, M., Mayes, M. and Pocock, R. (1997). Attitudes to cycling: A Qualitative Study and Conceptual Framework. Transport Research Laboratory, Wokingham, Berks.

Davies, M. and Oreszczyn, T. (2012). The unintended consequences of decarbonising the built environment: A UK case study. *Energy and Buildings*. Vol 46 Pp 80-85.

De Mozota, B., B. and Kim, B., Y. (2009). Managing design as a core competency: Lessons from Korea. *Design Management Review*. Vol 20 (2). Pp 67-76.

Den Otter, A., and Emmitt, S. (2008). Design team communication and design task complexity – The preference for dialogues. *Architectural Engineering and Design Management*. Vol 4, Pp 121–129.

Den Otter, A.F., & Emmitt, S. (2009). Architectural design management – A practical reflection on the development of a domain. In C.-T. Tzeng, S. Emmitt, & M. Prins (Eds.). International Symposium on Future Trends in Architectural Management (pp. 245–256). Tainan, Taiwan: National Cheng Kung University.

De Vaus, D.A. (1993), *Surveys in Social Research* (3rd edn.), London: UCL Press.

De Vaus, D.A. (2001) Research design in social research, London, Sage.

Denzin, N. K., & Lincoln, Y. S. Eds.). (1998). *The landscape of qualitative research: Theories and issues.* Thousand Oaks: Sage Publications.

Department of Communities and Local Government, (2006). *Building a Greener Future: Towards Zero Carbon Development-* Consultation. Rotherham, Communities and Local Government Publications.

Department of Energy and Climate Change (2015). A historic new global climate at the United Nations Conference on Climate Change in Paris. Available at www.gov.uk/climatechange/announcements . Accessed on 5 September 2016.

Department of Energy and Climate Change (2015). 2010 to 2015 government policy: greenhouse gas emissions. Available at www.gov.uk/decc/government/policies/reducing-the-impact-of-climate-change-in-developing-countries. Accessed on 21 January 2016.

Ding, G. and Forsythe, P. J. (2013). Sustainable construction: life cycle energy analysis of construction on sloping sites for residential buildings. *Construction Management and Economics*. Vol 31 (3). Pp 254-265 DOI: 10.1080/01446193.2012.761716

Dixon, T., Colantonio, A., Shiers, D., Reed, R., Wilkinson, S., & Gallimore, P. (2008). A green profession? A global survey of RICS members and their engagement with the sustainability agenda. *Journal of Property Investment and Finance.* Vol 26(6), Pp460 – 481.

Dixon, T., Ennis-Reynolds, G., Roberts, C., and Sims, S. (2009). Is there demand for sustainable offices? An analysis of UK business occupier moves (2006-2008). *Journal of Property Research.* Vol 26 (1). Pp 61-85

Du Plessis, C. (2007). A strategic framework for sustainable construction in developing countries. *Construction Management and Economics*, Vol 25, Pp 67-76.

Easterby-Smith, M., Thorpe, R. and Jackson, P. (2012), Management Research, 4th Edition, London: Sage Publications Ltd.

Egan, J. (1998). *Rethinking Construction: Report of the Construction Task Force*. Report to the Deputy Prime Minister, John Prescott, on the scope for improving the quality and efficiency of UK construction. The Department of Trade and Industry (dti). Available at: www.dti.gov.uk/construction/rethink/report/index.htm. Accessed on 21 January 2016.

Eguchi, T., Robert, S. and Dainty, A. (2010), "The role of the design practice as an arena for innovation", *Proceedings of the Association of Researchers in Construction Management ARCOM, Leeds*, 6-8 September, pp. 491-500.

Ekins, P., Anandarajah, G. & Strachan, N. (2011). Towards a low-carbon economy: scenarios and policies for the UK. *Climate Policies*. Vol 11 (2). Pp 865-882.

Elforgani, M. S., and Rahmat, I., B. (2012). The influence of design team attributes on green design performance of building projects. Environmental Management and Sustainable Development. Vol 1 (1). Pp 10-30.

Ellison, L., Sayce, S. and Smith, J. 2007. Socially responsible property investment: Quantifying the relationship between sustainability and investment property worth. *Journal of Property Research*. Vol 24(3). Pp 191–219.

Elmualim, A., Czwakiel, A., Valle, R., Ludlow, G., and Shah, S. (2009). The Practice of Sustainable Facilities Management: Design Sentiments and the Knowledge Chasm. *Architectural Engineering and Design Management*. Vol 5. Pp 91-102.

Elmualim, A. and Gilder, J. (2014). BIM: innovation in design management, influence and challenges of implementation. *Architectural Engineering and Design Management.* Vol 10 (3-4) Pp183-199.

Emmitt, S., Sander, D., and Christoffersen, A. (2005). The value universe: Defining a value based approach to lean construction. Proceedings, 13th annual conference of the International Group for Lean Construction. Sydney, Australia.

Emmitt, S., & Gorse, C. A. (2007). *Communication in construction teams*. London: Taylor and Francis.

Emmitt, S. (2009). Design Management for sustainability. *Architectural Engineering and Design Management*, Vol 5(1), 3–4.

Emmitt, S. (2010). Managing interdisciplinary project: A Primer for Architecture, Engineering and Construction, Spon Press, Abingdon.

Enhassi, A., Kochendoerfer, B. and Al Ghoul (2016). Factors affecting sustainable performance of construction projects during Project Life Cycle phases. *International Journal of Sustainable Construction Engineering and Technology*. Vol 7 (2).

Eriksson, P.E. and Westerberg, M. (2011). Effects of cooperative procurement procedures on construction project performance: a conceptual framework. *International Journal of Project Management*. Vol 29 (2). Pp197–208.

Erol, H., Dikmen, I. and Birgonul, M (2016). Measuring the impact of lean construction practices on project duration and variability: a simulation-based study on residential buildings. *Journal of Civil engineering and Managemen*t. DOI: 10.3846/13923730.2015.1068846.

European Commission (2010). Directive 2010/31/EU of the European Parliament and of the Council on the Energy Performance of Buildings. European Commission, Brussels.

European Investment Bank (2000). The European Investment Bank and Public Private Partnerships. *Newsletter of the International Project Finance Association*. Vol 1Pp 3–4.

Farmer, G (2013). Re-contextualising design: three ways to practicing sustainable architecture. *Architectural Research Quarterly*. 17 (2) pp 106-119. Doi: 10.1017/S1359135513000468.

Fellows, R. and Liu, A., (2003). Research Methods for Construction, 2nd edn, Oxford, Blackwell.

Feng, P. and Feenberg, A. (2008). 'Thinking about design: Critical Theory of Technology and the Design Process', Philosophy and Design: from Engineering to Architecture, by P.E

Fernández-Solís, J.L. (2008). The systemic nature of the construction industry, *Architectural Engineering and Design Management*. Vol 4 (1). Pp 31-46.

Fewings, P. (2005). Construction Project Management: An Integrated Approach. Taylor and Francis, Oxon.

Finch, E., Zhang, X. (2013). Facilities management. Design and Management of Sustainable Built Environments, Springer, London. Pp 305-326.

Flager, F., Welle, B., Bansal, P., Soremekun, G., & Haymaker, J. (2009). Multidisciplinary process integration & design optimization of a classroom building. *Journal of Information Technology in Construction (ITcon)*, *14*, 595–612.

Flyvbjerg, B. (2001). Making social science matter: Why social inquiry fails and how it can succeed again (S. Sampson, Trans.). Cambridge, UK: Cambridge University Press.

Flyvbjerg, B. (2006). Five misunderstandings about Case-Study Research. *Qualitative Inquiry.* Vol 12 (2), 219-245 doi:10.1177/1077800405284363**.**

Fortune, C. (2006). Process standardisation and the impact of professional judgment on the formulation of building project price advice. *Construction Management and Economics*. Vol 24. Pp1091–8.

Fuerst, F. and Van der Wetering, J. (2015). How does environmental efficiency impact on the rents of commercial offices in the UK? *Journal of Property Research.* Vol 32 (3). Pp 193-216

Galvin, R. (2014). Making the 'rebound effect' more useful for performance evaluation of thermal retrofits of existing homes: Defining the 'energy savings deficit' and the 'energy performance gap'. *Energy and Buildings*. Vol 69, Pp 515–524.

Gana, V., Giridharan, R., and Watkins, R., (2017). Application of Soft Landings in the design management process of a non-residential building. *Architectural Engineering and Design Management.* Vol. Pp 1-16

Gana, V., Giridharan, R. (2017). Soft Landings driven Design process: Achieving Sustainability in school building in the UK. Conference paper presented at the *Passive Low Energy Architecture (PLEA Conference),* Edinburgh, 4th to 6th July 2017. Pp 441-448.

Georg, S. and Tryggestad, K (2009). On the emergence of roles in construction: the qualculative role of project management. *Construction Management and Economics.* Vol 27 (10). Pp 969-981.

Ghobadi, S., and D'Ambra, J. (2012). Knowledge sharing in cross-functional teams: A coopetitive model. *Journal of Knowledge Management*, *16*(2), 285–301. Doi: 10.1108/13673271211218889

Gillham, B. (2001). Case Study Research Methods. London, New York: Continuum.

Glaser, B., and Strauss, A. (1967). The Discovery of Grounded Theory: Strategies for Qualitative Research. New York, Aldine De Gruyter.

Glass, J. and Dainty, A (2011). The sustainable construction business: A missing ingredient in creating a sustainable built environment? *International Journal of Construction Management.* Vol 11 (2). Pp 1-18

Gluch, P. and Raisanen, C. (2009). Interactional perspective on environmental communication in construction projects. *Building Research and Information*. Vol 37 (2). Pp 164-175.

Golafshani, N (2003). Understanding Reliability and Validity in Qualitative research. *The Qualitative Report.* Vol 8, (4). Pp 597-612.

Goldsmith, W. Flanagan, T. (2017). Value methodology- case studies with climate resilience and sustainability policy application. *Architectural Engineering and Design Management*. Vol 13 (1), Pp 3-21.

Gray, C. and Hughes, W., (2001). *Building Design Management,* Oxford, Butterworth-Heinemann. Linacre House, Jordan Hill, Oxford.

Gregory, R., Fischhoff, B., Thorne, S. and Butte, G., (2003). A multi-channel stakeholder consultation process for transmission deregulation. *Energy Policy*. Vol 31. Pp1291-1299

Guba, E. and Lincoln, Y. (1998). Competing paradigms in social research.

Gummesson, E. (2000). Qualitative methods in management research (2nd ed.). Thousand Oaks, CA: Sage.

H¨akkinen, T., and Belloni, K. (2011). Barriers and drivers for sustainable building. *Building Research & Information.* Vol, 39(3). Pp 239–255.

Halliday, S. (2007). *Sustainable Construction*. Routledge, London.

Hansen, G. and Olsson, N. (2011). Layer project-layered process: Lean thinking and flexible solutions. *Architectural Engineering and Design Management*. Vol 7(2). Pp 70-84.

Harvey, F. (2014). UK on track to miss carbon targets, climate change advisers warn. Guardian newspaper. Available at www.theguardian.com. Accessed on 4 January 2017.

Harvey, L. (2009). Reducing energy use in the buildings sector: measures, costs and examples. *Energy Efficiency*. Vol 2 (2). Pp 139-163.

Healy, M., and Perry, C. (2000). Comprehensive criteria to judge validity and reliability of qualitative research within the realism paradigm. *Qualitative Market Research*, *3*(3), 118- 126.

Heiskanen, E., Matschoss, K., and Kuusi, H. (2013). Report on specific features of public and social acceptance and perception of nearly zero-energy buildings and renewable heating and cooling in Europe with a specific focus on the target countries D2.6. of WP2 of the Entranze. Available at www.entanze.eu. Accessed on 16 April 2014.

Hellmund AIA, A. J., Van Den Wymelenberg, K. G., and Baker, K. (2008). Facing the Challenges of Integrated Design and Project Delivery, *Strategic Planning for Energy and the Environment*, 28:1, 69-80.

Hill, R. C. and Bowen, P. A (1997) Sustainable Construction: principles and a framework for attainment. *Construction Management and Economics*, Vol 15 (3). Pp 223-239.

Hjelseth, E. (2010) Exchange of Relevant Information in BIM Objects Defined by the Role- and Life-Cycle Information Model. *Architectural Engineering and Design Management.* Vol 6 (4). Pp 279-287.

HM Government (2016). Government response to the Committee on Climate Change: Progress on meeting carbon targets. Available at www.gov.uk. Accessed on 4 January 2017.

HM Government. (2008) Strategy for Sustainable Construction. Available at http://bit.ly/1WX69ti. Accessed on 4 January 2017.

HM Treasury (2015). Fixing the foundations: Creating a more prosperous nation. Available at www.gov.uk/government/publications. Accessed on 15 June 2016.

Hoffman, A.J. and Henn, R.L. (2008) Overcoming the social and psychological barriers to green building. *Organization and Environmen*t. Vol 21(4). Pp 390-419.

Hopwood, B., Mellor, M. & O'Brien, G. (2005) Sustainable development: mapping different approaches. *Sustainable Development*, 13**,** 38-52.

Horman, M.J., Riley, D.R., Pulaski, M.H., Magent, C., Dahl, P., Lapinski, A.R., & Harding, N.G. (2006). Delivering green buildings: Process improvements for sustainable construction. *Journal of Green Building*. Vol 1(1). Pp 123-140.

House of Commons Library (2015). Construction Industry: Statistics and Policy. Available at: www.parliament.uk/briefing-papers/sn01432.pdf. Accessed on 4 April 2016.

Innovate UK (2013). Building Performance Evaluation, Non-Domestic Buildings *Stevenage Bioscience Catalyst.* Phase 1, Final Report. Available at www.buildingdataexchange.org.uk/wp/content/uploads/2015/11/450046-stevenage-bioscience-catalyst.pdf . Accessed on 15 January 2015.

Innovate UK (2014). Building Performance Evaluation, Non-Domestic Buildings. Castle Hill Primary School. Phase 1, Final Report. Available at: www.buildingdataexchange.org.uk/wp/content/uploads/2015/11/450035-Castle-Hill-Primary-School.pdf. Accessed on 26 January 2015.

Innovate UK (2015). Building Performance Evaluation, Non-Domestic buildings. Pool Innovation Centre and Tremough Innovation Centre. Phase 2: Buildings in use, Final Report. Available at: www.buildingdataexchange.org.uk/wp/content/uploads/2015/11/450043-Pool-Innovation-Centre-and-Tremough-Innovation-Centre.pdf. Accessed on 10 February 2015.

Intergovernmental Panel on Climate Change. (2007). Climate change 2007: The physical science basis, Geneva: Available at IPCC. www.ipcc.ch . Accessed on 3 February 2015.

Intergovernmental Panel on Climate Change. (2014) Climate Change 2014: Synthesis Report, Contribution of working groups i, ii and iii to the fifth assessment report of the inter- governmental panel on climate change.

Intergovernmental Panel on Climate Change. (2014). Climate Change 2014: Impacts, Adaptation and Vulnerability. Available at www.ipcc.ch. Accessed on 3 February 2015

Janda, K. B. (2011). “Buildings Don’t Use Energy: People Do.” *Architectural Science Review*. Vol 54 (1), Pp 15–22.

Jensen, P.A. (2006). ‘Continuous briefing and user participation in building projects’, in Proceedings of the Joint CIB, Tensinet, IASS International Conference on Adaptability in Design and Construction, Netherlands, Eindhoven University of Technology.

Jensen, P., A. (2009). Design integration of Facilities Management: A challenge of Knowledge Transfer. Architectural Engineering and Design Management. Vol 5 (3). Pp 124-135

Jensen, P. A. (2011). Inclusive briefing and user involvement: Case study of a media centre in Denmark. *Architectural Engineering and Design Management*, 7(1), 38–49. doi:10.3763/aedm.2010.0124.

Johnson, B. R. (1997). Examining the validity structure of qualitative research. *Education*, *118*(3), 282-292.

Johansson, R. (2003) Case study Methodology. Royal Institute of Technology Infrastructure. Built Environment analysis.

Johnston, D., Farmer, D., Brooke-Peat, M., & Miles-Shenton, D. (2016) Bridging the domestic building fabric performance gap, *Building Research & Information*. Vol 44(2), Pp 147-159, DOI: 10.1080/09613218.2014.979093.

Johnston, L. (2006). Software and Method: reflections on teaching and using QSR NVivo in Doctoral Research. *International Journal of Social Research Methodology.* Vol 9 (5). Pp 379-391.

Joppe, M. (2000). *The Research Process.* From http://www.ryerson.ca/~mjoppe/rp.htm Kothari, C.R., (2008), Research methodology: methods and techniques.2nd Ed. New Age International.

Judson, E. P., and Maller, C. (2014). Housing renovations and energy efficiency: Insights from homeowners' practices. *Building Research and Information*, 42(4), 501 – 511. doi:10.1080/09613218.2014.894808.

Kajikawa, Y., Inoue, T., and Goh, T. N (2011). Analysis of building environment assessment frameworks and their implication for sustainability indicators. *Sustainability Science*. Vol 6 (2). Pp 233-246.

Kamara, J.M., Anumba, C.J. and Evboumwan, N.F.O., (2002). Capturing Client Requirements in Construction Projects, London, Thomas Telford.

Keeping, M. (2000). 'What about demand? Do investors want sustainable buildings?' London. The RICS Research Foundation.

Kent, D. & Becerik-Gerber, B. (2010). Understanding construction industry expectations and attitudes toward integrated project delivery. *Journal of Construction Engineering and Management.* Vol136(8), Pp 815–825.

Kibert, C. (1994). The next generation of sustainable construction, in Kibert, C. J. (ed.), Proceeding of the first International Conference of Sustainable Construction, 6-9 November, Tampa, FL

Kibert, C. (2007). The next generation of sustainable construction. *Building Research and Information.* Vol 36 (6). Pp 595-601.

Kinley, R., (2017). Climate change after Paris: from turning point to transformation. Climate Policy. Vol 17 (1). Pp 9-15.

Koskela, L. (1992) Application of the New Production Philosophy to Construction, Stanford University (Technical Report No. 72, Center for Integrated Facility Engineering, Department of Civil Engineering), Stanford, CA.

Koskela, L. (2000). An Exploration Towards a Production Theory and its Application to Construction, VTT Technical Research Center of Finland, Espoo

Koskela, L., Huovila, P., and Leinonen, J. (2002). Design management in building construction: From theory to practice. *Journal of Construction Research*, 3(1), Pp 1–16.

Kpamma, Z. E., Adjei-Kumi, T., Ayarkwa, J. and Adinyira, E. (2016) An exploration of the choosing by advantages decision system as a user engagement tool in participatory design, *Architectural Engineering and Design Management*. Vol 12 (1). Pp 51-66, DOI: 10.1080/17452007.2015.1095710

Kratzenbach, J. and Smith, J., (2003). The Wisdom of Teams, New York, HarperCollins Publishers.

Lapinski, A., Horman, M. and Riley, D., 2006, 'Lean processes for sustainable project delivery'. *ASCE Journal of Construction Engineering and Management.* Vol 132(10), 1083–1091.

Latham, M. (1994). *Constructing the Team,* London: HMSO. ISBN 978-0-11-752994-6.

Leaman, A. (2011). Coping with the age of consequences. Build, (125), August/September, pp 50. Building Research Association of New Zealand (BRANZ). Wellington, New Zealand.

Lewis, M., (2004). Integrated design for sustainable buildings. *ASHRAE Journal*. Vol 46(9), S22–S29.

Levy, D. (2006). Qualitative Methodology and Grounded Theory in Property Research. Pacific Rim Property Research Journal, Vol 12 (4), Pp 369-388. DOI: 10.1080/14445921.2006.11104216.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Beverly Hills, CA: Sage.

Lincoln, Y. S., Lynham, S. A and Guba, E. G. (2011). *Paradigmatic controversies, contradictions and emerging confluences*. The Sage Handbook of Qualitative Research 4th Edition. Thousand Oaks, CA Sage.

Lombardi, P. and Trossero, E. (2013) Beyond energy efficiency in evaluating sustainable development in planning and the built environment. *International Journal of Sustainable Building Technology and Urban Development.* Vol4 (4), Pp 274-282, DOI: 10.1080/2093761X.2013.817360.

Loosemore, M. (1999). A grounded theory of construction crisis management, *Construction Management and Economics*. Vol 17 (1) Pp 9-19. DOI: 10.1080/014461999371781.

Love, P., Skitmore, M. and Earl, G. 1998. Selecting a suitable procurement method for a building project. *Construction Management and Economics*. Vol 16(2). Pp 221–233.

Luzkendorf, T. and Lorenz, D. (2007). Integrating sustainability into property risk assessments for market transformation. *Building Research and Information*. Vol 35(6). Pp 644–661.

Lützkendorf, T., Foliente, G., Balouktsi, M. and Wiberg, A. H. (2015) Net-zero buildings: incorporating embodied impacts. *Building Research and Information,* 43(1) 62-81, DOI: 10.1080/09613218.2014.935575.

Magent, C., (2005). A Process and Competency-based Approach to High Performance Building Design, PhD thesis, Department of Architectural Engineering, Penn State University, PA.

Magent, C. S., Korkmaz, S., Klotz, L. E., & Riley, D. R. (2009). A design process evaluation method for sustainable buildings. *Architectural Engineering and Design Management*, 5(1–2), 62–74.

Mao, X.; Zhang, X. (2008). Construction process reengineering by integrating lean principles and computer simulation techniques. *Journal of Construction Engineering and Management* 134(5): 371–381.

Martensen A, Gronholdt L, Kristensen K. (2000). The drivers of customer satisfaction and loyalty: cross-industry findings from Denmark. *Total Quality Management*. Vol 11(4 6). Pp 544- 553.

McCracken, G. (1988). *The Long Interview.* Sage University Paper Series on Qualitative Research Methods, No. 13. Newbury Park, Calif.: Sage.

McLeod, R. S., Hopfe, C. J., & Rezgui, Y. (2012). An investigation into recent proposals for a revised definition of zero carbon homes in the UK. *Energy Policy.* Vol 46, Pp 25–35.

Meredith, J., R., & Mantel, S., J., (2006). *Project management: A managerial approach*. Hoboken, NJ: John Wiley.

Merschbrock, C., Gudnason, G. and Scherer, R. (2012). Ework and Ebusiness in Architecture. Engineering and Construction. Pp 793- 799. CRC Press Leiden.

Mertens, D., M. (2010). Research and evaluation in education and psychology: Integrating diversity with quantitative, qualitative, and mixed methods. (3rd ed.) Thousand Oaks, CA: Sage.

Meyer, A., M. (2014). What are the competencies of a successful project leader? International Journal of Management Cases. Vol 16(1). Pp 29-36.

Middlebrooks, B. (2008). Integrated project delivery in practice. Structural Engineering. Vol 9(12), Pp 28-30.

Miles, M.B and Huberman, A.M. (1994). *Qualitative Data Analysis*. 2nd edition, Sage, Thousand Oaks, CA.

Mills, F. and Glass, J. (2009). The construction design manager's role in delivering sustainable buildings. *Architectural Engineering and Design Management*. Vol 5(1) pp 75-90.

Min, Z., Morgenstern, P. & Marjanovic-Halburd, L. (2016). Facilities management value in closing the energy performance gap. *International journal of Sustainable Built Environment*. Vol 5 (2). Pp 197-209.

Murtagh, N., Roberts, A. and Hind R. (2016). The relationship between motivations of architectural designers and environmentally sustainable construction design. *Construction Management and Economics*. Vol 34 (1). Pp 61-75.

National Audit Office, (2010). Sustainable development briefing for the House of Commons Environmental Audit Committee, July 2010. Available at www.nao.org.uk . Accessed on 15 January 2016.

Nayar, S. (2012) Grounded Theory: A Research Methodology for Occupational Science, *Journal of Occupational Science*. Vol 19(1). Pp. 76-82. DOI: 10.1080/14427591.2011.581626.

NHBC Foundation. (2012). Today's attitudes to low and zero carbon homes Views of occupiers, house builders and housing associations. Milton Keynes, UK: NHBC Foundation.

Nicholls, C. (2014). Energy use in non-domestic buildings: the UK government's new evidence base. *Building Research and Information*. Vol 42 (1). Pp 109-117.

Nielsen, Y., & Erdogan, B. (2007). Level of visualization support for project communication in the Turkish construction industry: A quality function deployment approach. *Canadian Journal of Civil Engineering.* Vol 34, 19–36. doi:10.1139/l06-147.

Ogunbiyi, O., Oladapo, A. and Goulding, J. (2013). A review of lean concept and its application to sustainable construction in the UK. *International Journal of Sustainable Construction Engineering and Technology*. Vol 4 (2). Pp 82-92.

Othman, A.A., Hassan, T.M., and Pasquire, C.L. (2004). Drivers for dynamic brief development in construction. *Engineering, Construction and Architectural Management*. Vol 11(4) Pp 248- 258.

Othman, A. A. (2015) An international index for customer satisfaction in the construction industry, *International Journal of Construction Management*, 15:1, 33-58, DOI: 10.1080/15623599.2015.1012140.

Pala, M., and Bouchlaghem, N. M. (2012, August 15–17). *How could ICT benefit design managers for assessing sustainability of their project?* Proceedings of the 7th International Conference on Innovation in AEC, São Paulo, Brazil.

Pam, W. (2013). Zero carbon buildings: Contexts, challenges and strategies. Public Facilities A special supplement of *Building journal*. June 2013 Pp 76-78. Reprinted from *Building Journal*, January 2013, Pp71–73.

Parfitt, M. and Sanvido, V. (1993) Checklist of critical success factors for building projects. *Journal of Management in Engineering*. Vol **9**(3). Pp 243–249.

Park, J. Y. (2012). Design process exclude users: the co-creation activities between user and designer. *Digital Creativity*. Vol 23 (1). Pp 79-92.

Parker, S., K. and Skitmore, M. (2005). Project Management turnover: Causes and effects on project performance. International Journal of Project Management. Vol 23. Pp 205-214.

Payne, S. R. Mackrill, J. Cain, R. Strelizt, J. Gate, L. (2105). Developing interior design briefs for health-care and well-being centres through public participation. *Architectural Engineering and Design Management*. Vol 11 (4), Pp 264-279, DOI: 10.1080/17452007.2014.923288.

Pearce, A. R., Ahn, Y. H. and HanmiGlobal, (2012). Sustainable Buildings and Infrastructure: Paths to the Future, Earth- scan, Washington, DC.

Pink, S., Tutt, D., Dainty, A., and Gibb, A (2010). Ethnographic methodologies for construction research: knowing, practice and interventions. *Building Research and Information*. Vol 38 (6), Pp 647-659.

Plumer, B., Chavar, A., and Archer, S. (2017). New York Times. *U.S to Leave Paris Climate Accord. What Happens Now?* Available at www.nytimes.com/climate.

Poirier, E. Forgues, D. and Staub-French, S (2016). Collaboration through innovation: implications for expertise in the AEC sector. Construction Management and Economics. Vol 34 (11) Pp 769-789.

Prasad, D and M Hall. (2004). Construction challenge: sustainability in developing countries. London: RICS Leading Edge Series.

Project Management Institute. (2008). A guide to the project management body of knowledge (PMBOK® guide)—Fourth edition. Newtown Square, PA: Author.

Pryke, S., D. (2004). Analysing construction project coalitions: exploring the application of social network analysis. Construction Management and Economics. Vol 22 (8). Pp 787-797.

Puddicombe, M. S., Johnson, B. (2011). Research and Theory Building in Construction Management. International Journal of Construction Education and Research. Vol 7 (2), Pp 126-142.

Qiao, L, Wang, S., Q, Tiong, R., L., K and Chan, T., S. (2001). Framework for critical success factors of BOT projects in China. *Journal of Project Finance*. Vol 7(1). Pp 53–61.

Qu, S., Q. and Dumay, J., (2011), The qualitative research interview, Faculty of Economics and Business, Qualitative Research in Accounting & Management, University of Sydney, Sydney, Australia, Vol. 8, No. 3, pp. 238-264.

Reed, W. and Gordon, E. (2000). Integrated design and building process: what research and methodologies are needed? *Building Research & Information*. Vol 28(5-6). Pp. 325-337, DOI: 10.1080/096132100418483.

Reed, W. and Eisenberg, D., (2003). 'Regenerative design: Toward the re-integration of human systems with nature'. *A Contribution to the Mayor's Green Building Task Force.* Boston, MA, www.bostonre developmentauthority.org/gbtf/documents/RegenerativeDesign-Reed03- 12-18.PDF

Reed, T., Clouston, P., Hoque, S., & Fisette, P. (2010). An Analysis of LEED and BREEAM assessment methods for educational institutions. *Journal of Green Building*. Vol 5(1). Pp132–154.

Rekola, M., Mäkeläinen, T., & Häkkinen, T. (2012). The role of design management in the sustainable building process. *Architectural Engineering and Design Management.* Vol 8(2). Pp 78–89. DOI: 10.1080/17452007.2012.659503.

Research for energy Optimized Building, (2013). International projects on carbon neutral buildings: map of zero energy buildings. Res. Energy Optim. Build.

Rice, L. (2011). "Black-Boxing Sustainability." *Journal of Sustainable Development* 4 (4). Pp 32–37.

Richards, L. and Morse, J. (2007). Users guides for qualitative methods, 2nd Edition. Thousand Oaks, CA: Sage.

Rigby, E., McCoy, A. and Garvin, M. (2012). Toward Aligning Academic and Industry Understanding of Innovation in the Construction Industry. *International Journal of Construction Education and Research*. Vol 8 (4). Pp 243-259. DOI: 10.1080/15578771.2012.663861

Robichaud, L.B., and Anantatmula, V. S. (2010). Greening project management practices for sustainable construction. *Journal of Management in Engineering*. Vol 27(1). Pp 48-57.

Rohracher, H. (2001). Managing the technological transition to sustainable construction of buildings: A socio-technical perspective. *Technology Analysis & Strategic Management.* Vol 13(1), Pp 137–150.

Rooke, J., Seymour, D. and Crook, D. (1997) preserving methodological consistency: a reply to Raftery, McGeorge and Walters. *Construction Management and Economics,* Vol **15**(5), Pp 491–494.

Ruddin, L., P. (2006). You can generalise Stupid! Social Scientists, Bent Flyvbjerg and Case Study Methodology. Qualitative Inquiry. Vol 12 (4), Pp 797-812.

Russell-Smith, S., V., Lepech, M., D., Fruchter, R., and Littman, A. (2015). Impact of progressive sustainable target value assessment on building design decisions. *Building and Environment.* Vol 85. Pp 52-60

Rydin, Y. (2008). Reassessing the role of planning in delivering sustainable development. SDRN/RICS lecture: Sustainability and the built environment (6pp.). UK: RICS Research.

Sanoff, H. (2007). Editorial, Special issue on participatory design. *Design Studies.* Vol 28 (3). Pp 213-215

Scheurich, J., J. (1995). A postmodernist critique of research interviewing. International *journal of Qualitative Studies in Education*. Vol 8 (3). Pp 239-252.

Schweber, L. and Harty, C. (2010). Actors and objects: A socio-technical networks approach to technology uptake in the construction sector. *Construction Management and Economics.* Vol 26 (6). Pp 657-674

Schweber, L. (2013). The effects of BREEAM on clients and construction professionals. *Building Research and Information*. Vol 41(2). Pp 129-145.

Schweber, L. and Haroglu, H. (2014). Comparing the fit between BREEAM assessment and design process. *Building Research and Information.* Vol 42 (3). Pp 300-317.

Sebastian, R. (2003). Multi-architect design collaboration on integrated urban complex development in the Netherlands. *Journal of Design Research*. Vol 3(1).

Sebastian, R. (2004). Critical Appraisal of Design Management in Architecture. *Journal of Construction research.* Vol 5, Pp 255-266.

Senaratne, S., and Ruwapura, M. (2016). Communication in construction: a management perspective through case studies in Sri Lanka. *Architectural Engineering and Design Management.* Vol 12(1). Pp 3-18.

Shi, Q., Zuo, J., and Zillante, G. (2012). Exploring the management of sustainable construction at the programme level: A Chinese case study. *Construction Management and Economics*. Vol 30 (6). Pp 425-440.

Siew, R. Y. J. (2014). A review of sustainability reporting tools (SRTs) for Communities. *International journal of Sustainable Construction Engineering and Technology*. 5 (2), 39-52.

Sinclair, D. (2011). Leading the team an architect's guide to design management. London; RIBA.

Slattery, D., K. and Summer, M., R. (2011). Leadership characteristics of raising stars in Construction Project Management. *International Journal of Construction Education and Research.* Vol 7 (3). Pp 159-174

Smyth, H. and Pryke, S (2008). Collaborative relationships in construction: developing frameworks and networks. Blackwell Publishing Ltd, Oxford.

Sowa, J.F., (2000). Knowledge representation: Logical, Philosophical and Computational Foundations, London, Thomson Learning. Pp 348–356.

Spence, R. and Mulligan, H. (1995). Sustainable development and the construction industry. *Habitat International,* Vol 19 (3), Pp 279-292.

Stevenson, F., and Rijal, H. (2010). Developing post occupancy feedback from a prototype to improve housing production. *Building Research and information.* Vol 38(5). Pp 257-272.

Storvang, P., and Clarke, A. (2014). How to create a space for stakeholders' involvement in construction. *Construction Management and Economics*. Vol 32 (12). Pp 1166-1182

Strauss, A., and Corbin, J. (1990). Basics of qualitative research: Grounded theory procedures and techniques. Newbury Park, CA: Sage.

Taheriattar, R. and Farzanehrafat, M. (2014). Construction Managers' Perception of the Factors Affecting Sustainability in Construction Projects. *International journal of Sustainable Construction Engineering and Technology.* 5 (1), 22-32.

Taylor, J. and Bernstein, P. (2009). Paradigm trajectories of building information modelling practice in project networks. *Journal of Management in Engineering*. Vol 25 (2). Pp 69-76

Teijlingen van, E., Rennie, A.M., Hundley, V., Graham, W. (2001), The importance of conducting and reporting pilot studies: the example of the Scottish Births Survey, *Journal of Advanced Nursing* 34: 289-295.

Tribelsky, E., and Sacks, R. (2011). An empirical study of information flows in multidisciplinary civil engineering design teams using lean measures. *Architectural Engineering and Design Management*. Vol 7 (2). Pp 85–101.

Tzortzopoulos-Fazenda, P., & Cooper, R. (2007). Design management from a contractor's perspective: The need for clarity. *Architectural Engineering and Design Management,* 3(1), 17–28.

UKGBC, D. A (2009). Definition of Zero Carbon Task Group. Available at www.ukgbc.org/content/definition-zero-carbon-task-group. Accessed on 12 June 2015

UKGBC (2014). Key Statistics: Construction industry and carbon emissions. Available at www.ukgbc.org/key/statistics/construction-industry-and-carbon-emission. Accessed on 12 September 2017.

Usable Building Trust and BSRIA. (2014), The Soft Landings Framework: For better briefing, design, handover and building performance in use. BSRIA BG 54/2014. Building Services Research and Information Association, Bracknell.

Usable Building Trust and BSRIA. (2014), The Soft Landings Core Principles. BSRIA BG 38. Building Services Research and Information Association, Bracknell.

Van der Ryn, S. and Cowan, S (1996). *Ecological Design.* Island Press, Washington.

Van der Voordt, T.J.M. and van Wegen, H.B.R., (2005). Architecture in Use – An Introduction to the Programming, Design and Evaluation of Buildings, Oxford, Architectural Press/Elsevier.

Van Hemel, C. and Cramer, J. (2002). Barriers and stimuli for eco-design in SMEs. *Journal of Cleaner Production.* Vol 10. (5). Pp 439-453.

Van Hoof, J., Rutten, P. G. S, Struck, C., Huisman, E. R. C., and Kort, H. S. M. (2014). The integrated and evidence-based design of healthcare environments. *Architectural Engineering and Design Management*. Pp 1-21. DOI:10.1080/17452007.2014.892471

Vakili-Ardebili, A. and Boussabaine, A.H., (2007). 'Creating value through sustainable building design', *Architectural Engineering and Design Management*, 3(2), 83–92.

Vinuales, E., Depledge, J., Reiner, D., & Lees, E., (2017). Climate policy after the Paris 2015 climate conference. *Climate Policy.* Vol 17 (1). Pp 1-8

Viscidi, L. (2017). 'Trump's Withdrawal from the Paris Agreement Challenges Latin America', *New York Times*. 23rd June. Available at www.nytimes.com. Accessed on 26th September 2017

Wallhagen, M., Malmqvist, T., and Eriksson O., (2017). Professionals' knowledge and use of environmental assessment in an architectural competition. *Building Research and Information.* Vol 45 (4). Pp 426-442.

Wang, N. and Adeli, H. (2014). Sustainable building design. *Journal of Civil engineering and Management*. Vol 20 (1). Pp 1-10

Ward, B. (2016). How will Brexit affect climate change policy? *Grantham Research Institute on Climate Change and the Environment*. Available at www.lse.ac.uk

Watson, T.J., (1997). Theorizing managerial work: a pragmatic pluralist approach to interdisciplinary research, British Journal of Management, Vol. 8, No. 1, pp. 3-8.

Watson, C. (2003). *Reviewing of building quality using post occupancy evaluation*. PEB Exchange Programme on Educational Building (No 2003/03). Paris OECD Publishing.

Watson, C. and Thomson, K. (2005). Bring post occupancy evaluations to school in Scotland. Available at www.oecd.org/unitedkingdom/37905347.pdf. Accessed on 21 January 2016.

Way, M and Bordass, B. (2005) Making feedback and post- occupancy evaluation routine 2: Soft landings – involving design and building teams in improving performance, *Building Research & Information*, 33:4, 353-360, DOI: 10.1080/09613210500162008

Wedawatta, G., Ingirige, B. and Amaratunga, D. (2012). Case study as a research strategy: investigating extreme weather resilience of construction SMEs in the UK

Wei Pan & Yan Ning (2015) A socio-technical framework of zero-carbon building policies, *Building Research & Information*, 43:1, 94-110, DOI: 10.1080/09613218.2015.955759.

Welsh, E. (2002). Dealing with data: using Nvivo in the qualitative data analysis process. *Qualitative Social Research*. Vol 3 (2).

Wheeler, A. and Malekzadeh, M. (2015). Exploring the use of new school buildings through post occupancy evaluation and participatory action research. *Architectural Engineering and Design Management.* Vol 11(6). Pp 440-456. Doi: 10.1080/17452007.2015.1021292.

Wilkinson, P., (2005). *Construction Collaboration Technologies*, Routledge, London.

Wild, A., (2002) 'The unmanageability of construction and the theoretical psycho-social dynamics of projects', *Engineering, Construction and Architectural Management*, 9(4), 345–351.

Williams, K. and Dair, C., 2006, 'What is stopping sustainable building in England: Barriers experienced by stakeholders in delivering sustainable developments', *Sustainable Development*, 15(2), 135–147.

Winch, G. and Courtney, R. (2001). Re-engineering construction: the role of research and implementation. *Building Research and Information*. 31 (2), pp 172-178.

Xue, X., Shen, Q. and Ren, Z. (2010). Critical review of collaborative working in construction projects: business environment and human behaviors. *Journal of Management in Engineering.* Vol 26 (4). Pp 196-208

Ye, G., Jin, Z., Xia, B., and Skitmore, M. (2014). Analyzing causes for reworks in construction projects in China. *Journal of Management Engineering*. doi:10.1061/(ASCE)ME.1943-5479.0000347,04014097.

Yin, R. (1994). Case study research: Design and Methods. Thousand Oaks, London, New Delhi: Sage

Yin, R. (2003). Case study research: Design and Methods, 3rd edition, London, SAGE Publications.

Zanni, M., Soetanto, R., and Ruikar, K. (2017). Towards a BIM-enabled sustainable building design process: roles, responsibilities and requirements. *Architectural Engineering and Design Management*. Vol 13 (2). Pp 101-129

Zapata-Lancaster, G. (2014) "Low carbon non-domestic building design process. An ethnographic comparison of design in Wales and England", *Structural Survey*, Vol. 32 (2), pp.140 – 157

Zapata-Lancaster, G., and Tweed, C. (2014). Designers' enactment of the policy intentions. An ethnographic study of the adoption of energy regulations in England and Wales. *Energy Policy*. doi: 10.1016/j.enpol.2014.04.033i.

Zero Carbon Hub (2010), "Closing the gap between designed and built performance", available at: www.zerocarbonhub.org/resourcefiles/topic4_pink_5august.pdf Accessed 01 September 2014.

Zero Carbon Hub. (2014). Closing the gap between design and as-built performance: Evidence review report, March 2014. [Internet] London, Zero Carbon Hub. Available at http://www.zerocarbonhub.org/current-projects/ performance-gap Accessed 07 September 2015.