CRANFIELD UNIVERSITY

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SUSTAINABILITY, AWARENESS AND THE BUILT ENVIRONMENT

CRANFIELD DEFENCE AND SECURITY

PhD
Academic Year: 2009 - 2018

Supervisor: DR JULIEANNA POWELL-TURNER
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ABSTRACT

Sustainability within the Built Environment (BE) has become increasingly important over the past decade. Drivers for this include company image, pecuniary advantage, and because it is an environmentally responsible choice. Anthropogenically-caused climate change is the biggest challenge to the world today; the BE is one of the world's largest producers of Green House Gas (GHG) emissions, a known cause of climate change. It became evident that this, and sustainability in general, was largely unknown to the researcher's peers. This apparent lack of awareness became the theory tested by the thesis. A simple point that could answer the research question, while the research aim provided a tool that could create awareness or enhance it. In addition to a literature review, a non-pure form positivistic methodology tested the awareness and understanding of sustainability with several of the BE's stakeholders all of who are involved in the BE and its lifecycle. The surveys revealed the occluding power of the barriers and the influential nature of the drivers, which influence sustainability within the BE. However, it was evident that a general lack of awareness and understanding could influence these barriers and drivers individually, and en masse.

Despite the formidable and proactive global framework that exists within the BE promoting a sustainable regime, the research demonstrated that true universal awareness of sustainability by the stakeholders was limited. The research aim became the development of the Sustainable Infrastructure Resource (SIR), a framework with the potential to promote sustainability awareness to every stakeholder in every context within the BE, everywhere.

A universal awareness of sustainability in the BE is arguably our best weapon to achieve its genuine implementation, with the ultimate ambition of reducing GHG emissions thus arresting, or perhaps reversing climate change.

Keywords: Anthropogenic climate change, Green House Gas emissions, construction, lack of understanding, Sustainable Infrastructure Resource.

ACKNOWLEDGEMENTS

It is hard to imagine any thesis being a completely solo project; in fact, I doubt it is possible.

This would not have been possible without the help of many individuals, but then perhaps that is what makes it worthwhile and important, the journey and not the destination. However, there must be a destination or perhaps an end to the beginning, which I hope will all live to see. None of this would have been possible without help and support. My Mother Monica Brown who came up to the wilds of North Sutherland to tend house and keep the peat fires burning. She never lived to read this final work, but her imprint in its message is clear, take care of yourself, the world you live in and leave it in a better state than you found it. She was the original inspiration and a firm believer in the principal topic of this thesis, sustainability, a genuine “war baby”. My stalwart PhD adviser Dr Julieanna Powell–Turner, who often went the extra seven hundred miles in coming up to said northern wilds on frequent occasion, lending an academic slant to the moving mountain adage, ceaselessly helping the researcher to progress through this endeavour especially and reminding me to weave in the golden thread. My employer Arch Henderson who never asked the questions of where I was or what I was up to, and never put the “screen test”, to the test. My colleagues who laboriously checked, proof read and formatted these chapters.

From South Africa, I would mention David Parry-Davies a dram loving environmentalist and his remarkable publication. Also, an unlikely champion of sustainability whose tiny artisan business effortlessly covers all of the pillars of sustainability, Davis Ndungu and his flip-flop animals. Last and not least Jess and Meg who edged their snouts around the study door to frequently remind me that there is a beach just over the brae and that they would very much like to be on it.

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LIST OF ABBREVIATIONS

AK	Auckland
B&CE	Building and Civil Engineering
BE	Built Environment
BRE	Building Research Establishment
BREEAM	BRE Environmental Assessment Method
BIFM	British Institute of Facilities Managers
BIM	Building Information Modelling
CAD	Computer-Aided Design
C2C	Cradle to Cradle
CO_2	Carbon Dioxide
C&D	Construction and Demolition
CIC	The Construction industry council
CFC	Chlorofluorocarbon
CIOB	Chartered Institute of Builders
CIRIA	Construction Industry Research and Information Association
CPD	Continued Professional Development
CSD	Commission on Sustainable Development
DEFRA	Department for Environment, Food and Rural Affairs
DETR	Department of the Environment, Transport and the Regions
DREAM	Defence Related Environmental Assessment Methodology
DQI	Design Quality Indicator
DTI	Department of Trade and Industry
EAM	Environmental Assessment Methodology
EP	Environmental Policy
EPR	Extended Producer Responsibility
FM	Facility Manager/ Management
GHG	Green House Gas
GRI	Global Reporting Initiative
GPS	Global Positioning System
HIP	Home Inspection Report
H&S	Health and Safety
ICE	Institute of Civil Engineers
LEED	Leadership in Energy and Environmental Design
M&E	Mechanical and Electrical
MoD	Ministry of Defence
NGO	Non-Governmental Organisation
OECD	The Organisation for Economic Co-operation and Development
SIR	Sustainable Infrastructure Resource.

MSIR	Macro Sustainable Infrastructure Resource
IAEA	International Atomic energy Authority
IEMA	Institute of Environmental Management and Assessment
IISD	International Institute of Sustainable Development
ISO	International Standards organisation
IT	Information Technology
FM	Facility Management
KG	Kilograms
m^2	Square Metre
m^3	Cubic metre
NCC	Natural Capital Coalition
ODS	Ozone Depleting Substances
RIBA	Royal Institution of British Architects
RICS	Royal Institute of Chartered Surveyors
SIR	Sustainable Infrastructure resource
SME's	Small Medium Enterprises
SP	Sustainability Policy
SQEP	Suitably qualified and experienced
TFM	Total Facilities Management
UNEP	United Nations Environmental Program
WBCSB	World Business Council for Sustainable development
WCED	World Commission on Environment and Development
WGBC	World Green Building Council
WHO	World Health Organisation
WRAP	Waste & Resources Action Programme
UK	United Kingdom
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNEP	United Nations Environment Program
UNESCO	The United Nations Educational, Scientific and Cultural Organisation
UKGBC	United Kingdom Green Building Council
UNGC	United Nations Global Compact
USGBC	United States Green Building Council

1 INTRODUCTION TO THE THESIS

1.1 Introduction

This research centres on the Built Environment[1] (BE) and its complex relationship with the planet on which we live. According to Goertemiller (2015), this relationship has significant adverse effects on the planet because of the finite materials used, energy expended and many systemic impacts. These contribute to or produce waste, water use, air and ground pollution, energy consumption and greenhouse gas emissions. Powell (2012) states that greenhouse gas emissions are a known cause of climate change.

The research will examine some of the direct causative factors which are driving these adverse environmental effects as well as the attitudes towards sustainability within the BE to determine the level of awareness[2] of its stakeholders. The research will consider sustainability within the BE, including legislation and policy initiatives, and, non-governmental organisations (NGOs) that help drive the sustainability agenda. Furthermore, it will appraise the recent history of the BE through the lens of sustainability, the barriers and drivers that govern development, and, ultimately develop an awareness support system (The Sustainable Infrastructure Resource, "SIR") to guide decision making around sustainability within the BE.

According to the Intergovernmental Panel on Climate Change (IPCC) global atmospheric concentrations of carbon dioxide (CO_2), methane and nitrous oxide have increased markedly because of human activities since 1750 which far exceed pre-industrial values. This is irrefutably evidenced by ice core examination (IPCC, 2007). The IPCC further cite that CO_2 is the most important anthropogenic greenhouse gas and that typical pre-industrial figures of 280 ppm

[1] The Built Environment (BE) refers to all structures people have built to live in, work in and their supporting infrastructure when considered as separate from the Natural environment.

[2] Awareness throughout the thesis refers to "Concern about and well-informed interest in a particular situation or development" (oxforddictionaries.com). This can be differentiated from the word "Knowledge", which may be treated as an awareness to garner greater knowledge. Once knowledge has been gained then an informed opinion and increased level of understanding can be reached. The researcher proposes that an effective mechanism to gain knowledge is to cultivate awareness in a person, which may evolve into curiosity, and in turn may develop into interest.

have risen significantly. According to Scripps (2017), the atmospheric concentration on July 26th 2018 was 407.96 ppm (see Figure 1.2). According to Scripps (2017), this far exceeds the pre-industrial CO_2 concentration figures over the past 800,000 years.

Cities are critical arenas for the pursuit of sustainable development, and achieving urban sustainability can have significant implications for mitigating climate change (Bulkeney and Betshill, 2003). Arguments for and against climate change are animated and global. Oreskes (2004) stated that in 928 scientific abstracts, human activity was implicated as exacerbating climate change. Vocal critics cited that Oreskes (2004) was guilty of “Statisticulation” (Stirling 2007). The denier arguments tend to centre on the premise that CO_2 is not the only “climate driver”. Others include solar and volcanic (Stirling 2007). The denier arguments such as Stirling’s (2007), focus on other heat-trapping gases (UCS, 2016). These denier arguments have in turn been examined igniting further and more comprehensive studies than Oreskes (2004). For example, a web-based search of peer-reviewed articles published between 1991 and 2012 yielded 13,950 articles with only 24 of these (0.17%) rejecting the notion of human activity being a causative factor (Powell, 2012). Interest pushed Powell (2012) to conduct further research between 2012 and 2014, reviewing a further 2258 articles written by a combined 9136 authors. Only one article rejected the theory of anthropogenically caused climate change (Powell, 2014).

Scientific literature since 1991 contains a mountain of evidence confirming human-made global warming as real and no convincing evidence that it is false. Powell (2014) states that Global warming denial is a house of cards. The researchers view is that climate change exists, as does the adverse way in which the human factor affects the planet in general. Climate change exists, and as outlined in Chapter 1 the BE is a causative factor of it.

One reason for this apparent surge in greenhouse gas emissions may have been a change in technology and construction materials that became popular during and after the industrial revolution (Sutton, 2014). Materials such as steel,

concrete and reinforced concrete were used because of advantages in strength, erection speed and cost savings. All pre-requisite qualities for buildings that required to be built quickly with large open spans, geared towards mass manufacture.

These materials were used in increasing quantities and had far higher embodied energy requirements than materials used before this period such as natural stone and wood (Circular Ecology, 2016). Using such materials produced increased greenhouse gas emissions for the BE sector during manufacture, use and disposal.

Dearing (2000) argues that signs of global environmental problems such as climate change either go unnoticed or trigger disagreement, about what the signs actually mean, and that action is taken when it is no longer possible to ignore the warnings or be in denial of them, however at that time it will be correspondingly harder to respond effectively.

Logic suggests, that if the BE is a major contributor to greenhouse gas emissions, then it can reverse that position. According to UNEP (2009), the building sector possesses the largest potential for the delivery of long-term significant and cost-effective greenhouse gas emission reductions.

1.2 Research Purpose

According to Shaika (2015), there are barriers to sustainable construction, and the most prominent was a lack of awareness.

The question of occluding barriers and influencing drivers is reflected in the following questions relating to sustainability within the BE: -

1. What are the pressing economic, environmental and social challenges for the construction industry (Adetunji, 2005)
2. How will the industry achieve these? (Adetunji, 2005)

According to Adetunji (2005), the “What” question is where most of the research is concentrated, and to be clear this thesis is no different, as it sets out to identify an all-inclusive barrier. One that can perhaps influence every other one.

Once done the research aim will offer a solution to perhaps a part of Adetunji's (2005) "How" question.

There appears to be no single all-encompassing answer to Adetunji's (2005) second question "how". It may be met by initiatives from thought leaders, entrepreneurs and forward-thinking organisations or by the examination of the drivers and barriers affecting sustainable construction. According to Shaika (2015), the most influential of these may be lack of awareness. Section 2.1 outlines the critical gaps that exist in environmental awareness and the impact on the BE (Herron et al., 2003).

In addition to Adetunji's (2005) questions, the research will also discuss:

"The link between the built environment (BE) and sustainability" and "Why it is essential that a comprehensively sustainable regime be achieved within the global BE and its associated industries."

1.3 Sustainable Development (SD) and Sustainability

Before the concept of sustainable development and sustainability are discussed it is important to outline the definition:

Arguably the best-known definition of Sustainable Development was that attributed to Gro Harlem Brundtland, the then Norwegian Prime Minister, who was the chairperson of the World Commission of Environment and Development (1987).

"Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987)

"Development" in this definition has two contexts. It must be universal and self-sustaining and intergenerational. The word "needs" may also have a more profound meaning. For many in developed countries, it can equate to the acquisition of material possessions to improve the quality of life. For those in the developing world, it simply means the elements required to survive.

The term “Sustainability” will be used throughout the thesis and refers to the spirit of the 1987 Brundtland definition but through the lens of the BE. This will focus on the reduction of greenhouse gas emissions and the linear industrial waste model.

According to a former UK Government advisor of the Sustainable Development Commission (SDC) which was disbanded in 2011, the concept of sustainable development could be interpreted in several ways. However, its core approach was to create a balance between competing needs, against awareness of the environmental social and economic limitations we face as a society (SDC, 2011). The SDC was disbanded with the aim of mainstreaming sustainable development through all UK government departments.

According to the International Institute of Sustainable Development (IISD) (2017), the Brundtland definition has two contexts:

1. the concept of needs, in particular, “essential needs” of the world's poor, to which overriding priority should be given; and
2. the idea of limitations imposed by the state of technology and social organisation on the environment's ability to meet present and future needs." (IISD, 2017)

The BE impacts directly on these two contexts. Firstly, an essential need of the world’s poor is for the provision of shelter, water and food. This can only effectively be achieved with the implementation of planned programmes and long terms strategies which may support, for example, a self-supporting and sustainable economy. This will demand new infrastructures in which the BE will play a part.

Secondly, the idea of limitations imposed by technology and social organisation, suggest materials may have increased durability and longevity which can be reused, remanufactured and recycled. Within these two contexts, any complex action demands some form of awareness and education. Therefore, if the BE is to adopt a sustainable approach, it may need to raise awareness and change behaviour.

The research will identify if this is required, sustainability will be discussed as having four pillars as illustrated in Figure 1.1, Economic, Environmental, Social and Cultural.

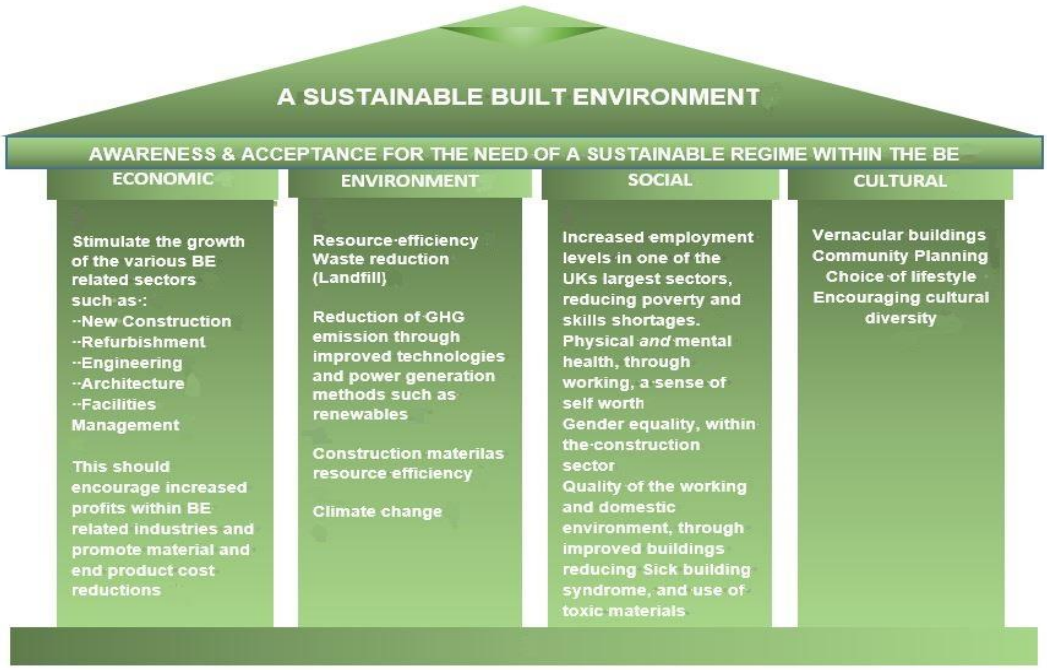

Figure 1.1 The four pillars of sustainability supporting a Sustainable Built Environment: Source Institute of Chartered Accountants in England and Wales (ICAEW) Adapted to incorporate the BE and the fourth pillar by Harrop (2017)

1.4 The Core Issue

Arguably anthropogenic climate change[3] is a key catalyst driving the pursuit of a global sustainable agenda. If the global temperature increases by 4°C, which is envisaged by 2100, (Carrington, 2013) adverse effects are likely to occur and could have catastrophic consequences (Hansen, Makiko, Hearty, Ruedy, Kelley Masson-Delmotte, Russell, Tselioudis, Cao, Rignot,Velicogna, Tormey, Donovan ,Kandiano, Von Schuckmann, Kharecha, Legrande, Bauer M and Kwok-Wai o (2016). This includes an exponential loss of ice which will increase sea level by several metres in as little as 50 years' time. Hansen et al. (2016) argue that ice sheets in contact with open ocean are vulnerable to accelerating disintegration, a point perhaps evidenced in July 2017 when a 5,800sq km trillion tonne iceberg broke off the Larsen C ice shelf (Davis, 2017). Furthermore, as areas covered in ice melt, the reflective surface will dissipate, and the methane-rich permafrost will release methane gas as it warms. Global warming will increase at an accelerated rate as methane is 70 times more efficient a "greenhouse gas" than CO_2 (Andrei, 2012). Also, it is likely that greenhouse gas emissions will increase further with the growth of the BE. The BE is responsible for a high percentage of anthropogenic greenhouse gas emissions (UNEP, 2009), a point that most published scientists agree is a causative factor to global warming (Powell, 2012). It is therefore important that the BE adopt a sustainable approach to everyday operations as a large contributor.

Evidence of increasing greenhouse gas concentrations in the atmosphere have been routinely recorded at the Mauna Loa Observatory by the North American federal agency the National Oceanic and Atmospheric Administration (NOAA) and plotted on a graph known as the Keeling Curve. Charles Keeling (1928-2005) was an American scientist who started measuring atmospheric carbon

[3] Anthropogenic climate change refers to human influences, which are large enough to exceed the bounds of natural variability (Karl, Trenberth, 2003). According to Karl and Trenberth (2003) the main source of this is human induced changes in atmospheric composition which include energy use and urbanisation. Anthropogenic climate change within this context refers to the production of greenhouse gases emitted by human activity.

dioxide concentrations in 1958 at the Mauna Loa Observatory in Hawaii. Readings before this were ascertained by analysis of ice cores.

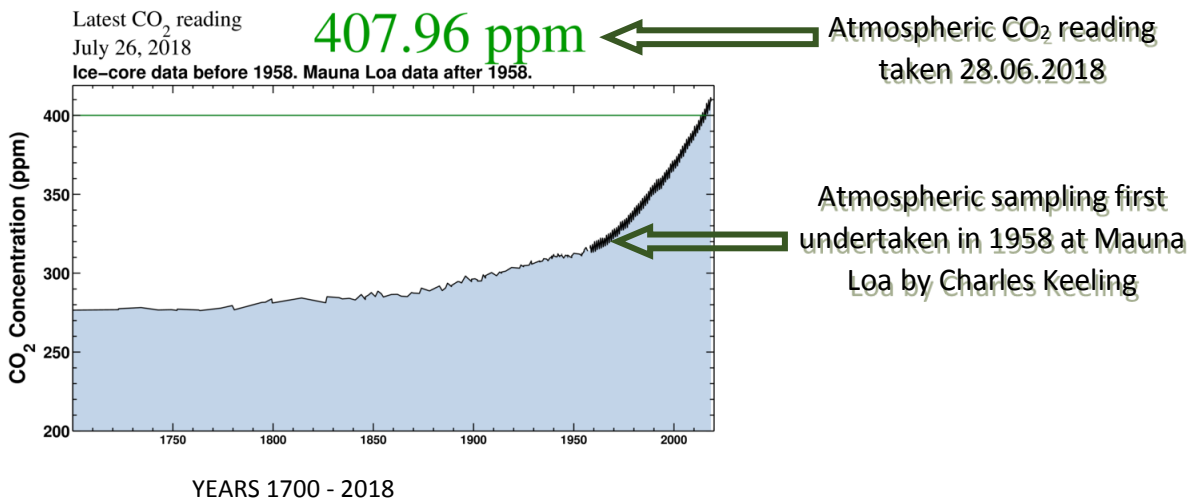

Figure 1.2 Keeling Curve 1700 – present day, showing atmospheric CO_2 reading taken on 26th July 2018, adapted by Harrop (2018) Source Scripps institution of Oceanography (2018)

1.5 The BE and Global Warming

The BE produces approximately 50% of the UK's CO_2 emissions from the use of fossil fuels in the construction and operation of buildings, and 30% of global CO_2 emissions (Stubbs, 2008). This includes materials such as timber where global construction uses 55% (Roodman et al., 2008). It could, therefore, be argued that unless timber is sourced responsibly, the BE is a significant cause of deforestation and displacement. According to UNEP (2009), 40% of global energy consumption is attributed to the BE and particularly relevant to global warming, where it produces 30% of anthropogenically caused greenhouse gas emissions.

The researcher would argue that if the above figures were reduced, the overall environmental impact of the BE would significantly decrease offering positive impacts including reduced greenhouse gas emissions, reduced waste and a greater mindset geared towards a sustainable regime within the BE.

Figure 1.1 illustrates that sustainability has four pillars and illustrates the complex interrelationship between them and the BE. This is because many variables are required to work in harmony creating a genuinely sustainable regime.

The researcher would argue that this is critical because the global population is expected to rise to 9.6 billion by 2050 (UNDP, 2013).

An increasing population will equate to a higher demand on resources and more waste in addition to an ever-expanding global urbanisation program. This the researcher believes will require a proportionate response regarding the BE. Maintaining a sustainable equation between human activity and the earth's ecosystem while reducing environmental impacts will be a challenge. This research will not provide solutions to these issues but will identify barriers that may impede sustainability in the BE and develop a tool the Sustainable Infrastructure Resource (SIR) to counter what the researcher believes to be the most significant barrier. To develop the SIR the following aim and objectives will be examined.

1.6 Research Question

Can an effective intergenerational sustainable regime become a reality within the Built Environment?

1.7 Research Aim

The aim is to develop a Sustainable Infrastructure Resource (SIR). A framework with a principal aims to promote a genuine intergenerational sustainable regime within the BE. This would be achieved through the stimulation of greater awareness amongst its many stakeholders. The design, scope and format of the SIR will be wholly dependent on the research.

1.8 Objectives

1.8.1 An evaluation of sustainability within the BE from 1900 to the present day

This is intended to provide a working knowledge of how and why sustainability has become integrated within the processes of the BE from a historical and current perspective. This will include an overview of the BE's evolution movements since the industrial revolution and any thought leaders and organisations who have promoted sustainability.

1.8.2 Evaluate the current level of understanding of Sustainability within the context of the BE.

Although there is certainly much activity in promoting sustainability within the BE, there are barriers including limited appreciation and a lack of awareness (Shaikha, 2015). This will be further explored in Chapter 2.

This objective is critical to the research. Without the consensus of participants, i.e. a lack of knowledge, awareness or appreciation, a fully sustainable regime cannot be achieved.

1.8.3 An evaluation of the existing and future regulatory framework that impacts on the Built Environment

Compliance with legislation is a core requirement impacting on every aspect and all life cycle stages of the BE. Its importance is hard to dispute. No area of the BE seems free of legislative drivers and barriers. This is relevant as the BE needs to ensure its users are aware of all associated risks and liabilities. Legislation impacts on the BE at every stage where breaches may lead to significant fines and imprisonment, and loss of reputation or brand. Legislation that impacts on the BE's sustainability agenda will be targeted and outlined.

1.8.4 An analysis of the drivers and barriers impacting on sustainability within the Built Environment

It is questionable that any system, initiative or concept could be utilised or made manifest without a thorough examination of the barriers and drivers that either

prevent or permit something from happening. It is therefore likely that the barriers and drivers will be complex. Understanding the nature of a barrier that for example prevents an action is the first step in understanding how to overcome it, once done that action can be completed. Similarly identifying a driver that facilitates an action, fully understanding it and why it is a driver and advantageously manipulating it is perhaps the best way of facilitating it to best effect.

1.9 Introduction to the Chapters

1.9.1 Chapter 1 Introduction to the Thesis

This chapter will introduce the research and each chapter that forms this thesis. It will include an introduction to the thesis, providing the reader with direction and justification including the aim and objectives.

1.9.2 Chapter 2 Literature Review Sustainability and the Built Environment

This chapter provides a critical analysis of sustainability through the lens of the Built Environment (BE) and from a broader perspective. It explores the history of sustainability from the Industrial Revolution to the present day. It assesses the great environmental movements of the 1960s, some of the thought leaders, initiatives and causative issues that brought the concept of Sustainable Development to a wider audience. This chapter also examines the regulatory framework including sustainability within the BE where comment will be provided on the effectiveness applied to the research question

1.9.3 Chapter 3 Barriers and Drivers influencing Sustainability within the Built Environment.

The design of the Sustainable Infrastructure Resource, (SIR) is strongly influenced by the barriers and drivers affecting sustainability within the BE. The barriers and drivers distilled from the literature review and research are identified, and their relevance to the BE and sustainability discussed. The SIR would need to support the drivers and accommodate the barriers.

1.9.4 Chapter 4 Methodology

This chapter outlines the methodology employed to investigate the research question and develop the research aim and objectives. Research paradigms and stakeholder selection are discussed and justified. Furthermore, question bias, question type, survey and interview design is outlined, and the rationale for this methodology provided.

1.9.5 Chapter 5 The Main Survey & Semi-Structured Interview Results

The results from the main surveys and interviews will be discussed with the intention of answering the research question and providing the information and data required to develop the research aim and sustainable Infrastructure Resource (SIR).

1.9.6 Chapter 6 SIR, the Sustainable Infrastructure Resource

This chapter outlines the data gathered from the preceding chapter and describes how it defines the form and function of the SIR. The SIRS's form and function are then discussed providing an insight as to the proposed macro and micro functions of the SIR and how it can arrest the barriers that impede the promotion of sustainability within the Built Environment.

1.9.7 Chapter 7 Conclusions

This chapter outlines the conclusions of the thesis, how they impact on answering the Research Question, and where the researcher proposes to take the research on sustainability within the BE forward.

2 SUSTAINABILITY AND THE BUILT ENVIRONMENT

2.1 Introduction

This research centres on the Built Environment (BE) with its massive 30% contribution to global carbon emissions (Ürge-Vorsatz et al., 2007), a known anthropogenically generated cause of climate change. The aim is to develop a tool (The Sustainable Infrastructure Resource (SIR)) which will raise awareness and promote sustainability among the BE's many stakeholders, with the outcome of reducing greenhouse gases.

This chapter will explore chronologically, sustainability both within the BE and at times beyond its boundaries. It will outline micro and macro initiatives, perspectives, events, disasters and the existing legislative framework that influences the promotion of sustainability in the BE. It will seek to illustrate that a lack of universal awareness of sustainability exists in the BE which will be tested through the methodology. Many terms, entities, systems and environmental methodologies will be outlined and discussed; these are included for a number of reasons other than being relevant to the theme of the research question, they impact strongly because they can become the tools for achieving a sustainable regime at the grassroots level. Examples of these tools include the triple bottom line accounting method and the principle of natural capitalism. Also, many of these terms tend to repeatedly appear when researching sustainability within the BE. These terms entities and environmental methodologies will frequently be referenced, including within the methodology to ascertain levels of awareness on the main survey.

Associated legislation and initiatives that affect sustainability within the BE will be outlined chronologically as far as possible throughout this chapter, however, to introduce that element it seems prudent to briefly outline the different legislative elements that will be woven throughout the progressive timeline. Although this thesis was written during the process of BREXIT, it assumes that all EU legislation remains in place. At the time of writing, much remains

uncertain as to how this change will impact environmental legislation after the BREXIT process has been completed.

International Legislation: The United Nations (UN) was established after the Second World War in 1945. It has six organs; The General Assembly, The Security Council, The Economic, The Social Council, The Trusteeship Council and The International Court of Justice (Birnie and Boyle, 2002), The UN has had a significant influence on the promotion of sustainability within the BE.

Laws made by the United Nations might be defined as “hard” and “soft”. Signatory countries to the United Nations agree formally to abide by protocols, conventions or treaties and are therefore legally bound by them. The International Court of Justice enforces any breach of international law. In the UK, however, this can only take place if it has already been accepted and passed by the UK’s legislative framework.

Soft law, by contrast, is not legally enforceable and is found in the form of charters and recommendations such as the United Nations Framework Convention on Climate Change (1992), and the Kyoto Protocol, which was adopted in 1998 and came into force in 2005. Agenda 21 was born from the RIO 92 conference, Chapter 7 of Agenda 21 “Promoting Sustainable Human Settlement Development” and has arguably influenced sustainability within the BE. The human settlement objective had an overarching objective to improve the social, environmental and economic quality of human settlements, and, the living and working environments (UNEP, 2016). In particular in the impoverished urban and rural contexts.

International organisation for standardisation (ISO) and CEN standards: There are some national and international standards related to sustainability within the BE. These include standards produced by ISO Technical Committees specialising in this area; particular examples being the ISO/TC 59 Building Construction, ISO/TC 163 Thermal performance and energy use in the BE, ISO/TC 205 Building design and ISO/TC 207 Environmental Management. Although this thesis will not explore the effectiveness of this legislation in the

real world questions relating to the awareness of it will be asked to the relevant stakeholders as part of the methodology/methods.

European Union (EU) Legislation: All member states are bound by EU legislation, which is enforceable by law. EU law can be influential as it can override national level laws within the same context.

EU Directives have to be ratified by the UK; then they become either Acts or Statutory Instruments. Environmental Law tends to enter the UK framework as a directive, primary or secondary legislation. For example, the Waste Framework Directive (WFD 08/09) (2008/2009EC) (revised in England and Wales in 2011) became relevant in 2008. Article 40 of this directive required EU states to enforce legislation and administrative provisions necessary to comply with this directive by 2010. The directive provides the overarching framework for the collection, recovery, treatment and disposal of waste which is a large sector with the BE, i.e. construction and demolition.

UK Legislation: It might be argued that sustainability-related UK legislation within the BE predominantly impacts on, waste regulations and environmental regulations. According to Tolson (2007), there have been a number of directives, statutes, guidance and policies that have permeated the UK BE sector, which may have been internationally or locally driven. These include primary legislation which relates to sustainability in the BE, and which Tolson (2007) argues not only have been oblique concerning sustainability within the BE, but also the broader goal of sustainable development, as they are rooted in environmental concerns. At this time, there exists little overarching, bespoke legislation dedicated solely to the pursuit of sustainability within the BE, focussing on the four pillars. However, there are many related policies and strategies including the UK National Policy Planning Framework (2012),

As outlined above, legislation that influences the research question will be interspersed throughout this thesis chronologically; the above serves only to outline the differences and relevance of the different legislative elements.

2.2 Pre - Industrial Revolution

The roots of sustainable construction can be found in vernacular architecture (Lewcock, 2006). The earliest examples of vernacular architecture were 4.00 m deep vertical caves with roofs of Mammoth bones found in Russia (ibid).

This example illustrates that sustainable construction is not a new concept. All early indigenous vernacular forms of construction further illustrate this; however, few of these examples would be conducive for convenient modern living. Perhaps the ultimate expression of sustainable construction is the Igloo. It is made from only one construction material, water, a readily available completely sustainable building material. The Igloo probably dates back tens of thousands of years (Eskimolod, 2016), and was constructed to keep its occupants safe from the elements, and warm. The Inuits like other ancient cultures practised sustainable construction although arguably their principle driver was survival (Schmid, 1999), probably not a consideration for modern sustainable architecture.

Vernacular construction methods have positive impacts on sustainable construction and several advantages. According to Fernandes et al., (2014), environmental advantages of vernacular architecture include reduced transportation requirements, lower embodied energy and carbon dioxide (CO_2) emissions. They can also be constructed of biodegradable organic materials, which in turn can generate social and economic advantages, such as local employment, local and sustainable supply chains, and using materials of low toxicity potential (Berge, 2009). From an economic perspective according to Goodman (1968), an industry based on vernacular principles, i.e. ecological construction has to have its production unit near the place of consumption, using local renewable materials. According to Fernandes et al. (2014), sustainable architecture should seek to achieve the integration of the traditional and contemporary. Although the researcher certainly agrees with Fernandes (2014), the point should be made that an architect and indeed the client will need drivers to promote this, have an awareness of the importance of a green corporate image, and the company's triple bottom line, which often drives

sustainable considerations. From a social perspective, Kazimee (2008) argues that vernacular architecture could be the answer to housing shortages. That is properties built using self-help schemes, local materials and reintroducing or reinforcing the concept of community, all points that integrate the BE with the full concept of sustainability. The researcher might argue that with the benefits of developing and promoting awareness of sustainability within the BE self-help schemes of this nature should be encouraged by both carrot and stick measures.

The concept of environmental conservation was practised by the South Pacific islanders thousands of years ago. Their understanding of the environment led them to realise it could be abused, overfished and deforested (Diamond, 1995). Populations and environments could become imbalanced leading to the dissolution of societies, such as what occurred on Easter Island before the Europeans first arrived. Deforestation on Easter Island was caused by over harvesting the island's palm trees. The deforestation had several adverse effects including the proliferation of rats that ate seeds; the shortage of raw materials for building canoes leading to a decline in fishing capability. A reduced fish stock meant land birds were eaten and so today, only one of the original 22 avian species survives (Diamond, 1995). Firewood became scarce which had a dramatic effect on the supply of construction materials; streams dried up and soil erosion meant crops could not grow. All of which threatened starvation and led to civil unrest. In précis, what had been a great civilisation illustrated by the remarkable iconic statues, was little more than a collection of angry gangs when the first Europeans arrived in the Islands in 1722 (Diamond, 1995). Arguably all of this was because of a lack of awareness of the importance of a sustainable regime, particularly in such an isolated locale.

It may seem odd that the Easter Island situation developed at all, because a few thousand kilometres across the Pacific, both the Polynesians and the Maoris understood the importance of sustainability, even in its modern context. They adhered to the concept of "Rahui". Rahui was a restriction that set aside an area and banned the harvesting of resources. For example, a lake or forest that

was temporarily off limits, allowing for the growth in biodiversity such as fish, birds and plants (Miller et al., 2004). So the question has to be asked why this happened to the Easter Island population, when other parts of the Pacific, understood the concept of sustainability. Perhaps it was the fact Easter Island was isolated. Perhaps they had no benchmark for sustainable living and sustainable planning. Perhaps the Easter Islanders simply were not aware, as suggested by Pakandam (2009) of how delicate the island's ecosystem was, and this lack of awareness was enough of a barrier to all but destroy their way of life.

2.2.1 Embodied Carbon in the Built Environment

The concept of embodied carbon and embodied energy will be referred to frequently during this thesis. Embodied carbon refers to carbon dioxide emitted during the manufacture, transportation and construction of building materials, through to "end of life" (Wynn D, 2012)

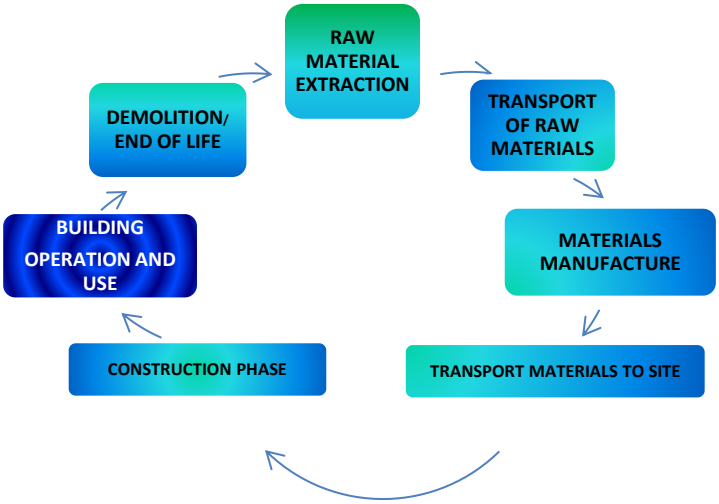

Figure 2.1 Illustrating embodied carbon throughout the construction cycle. Source: Wynn (2012) adapted by Harrop (2017) for ease of reference

Wynn (2012) states that there are two types of CO_2 emission from the BE: the operational and the embodied: The operational phase as shown in Figure 2.1 is the CO_2 emitted during the lifetime of the facility, from sources such as heating, lighting and electricity use / Embodied carbon refers to the element of the cycle

illustrated in Figure 2.1. According to Wynn (2012), this can be as high as 65% of the entire emissions figure (operational + embodied). According to Wynn (2012), zero carbon legislation tends to concentrate more on the operational cycle and not the embodied carbon, which as previously illustrated has the greater significance.

2.3 The Industrial Revolution

Although the research will not focus on this period in detail, it is important to mention the contribution it made to anthropogenic climate change. If the industrial revolution had not occurred and humankind had remained to this day a contented albeit technologically backward agrarian race, then perhaps if we were still experiencing climate change, it would not arguably have been anthropogenically caused.

The Industrial Revolution occurred first in Great Britain and then the United States and was driven by cheap and plentiful sources of fossil fuels including coal, oil and its associated products such as petroleum. In 1858, a Scottish chemist James Young (1811-1863) pioneered a method of distilling kerosene from coal and oil shale. Also, at this time, Ignacy Lukasiewicz (1822-1882), built the world's first oil refinery in 1856 and it is considered that he pioneered the petroleum industry, with the resulting technology that would power a "second" industrial revolution. Wilde (2014), argues that a second industrial revolution was driven by the internal combustion engine, electricity, and the revolutionary new material steel, which was used not only in transportation technology but also extensively within the BE at a seemingly ever-increasing rate.

The combustion of refined oil petroleum has been continuous to this day, and it is argued, along with compelling evidence (UCS, 2016), that this has had a dramatically adverse effect on the planet's biosphere. The BE's seemingly exponential expansion was an inevitable phenomenon driven by population shifts. The great industrial centres of the Midlands were created, comprising of vast factories and equally vast supporting infrastructures. Immense quantities of raw materials would have been used to fabricate and then construct the complex infrastructures to support supply lines and the transport routes to

domestic and international markets. These included railways and canal networks (Wilde, 2014).

The start date of the Industrial Revolution is open to debate. However, the most cited dates fall between 1760 - 1840. (Wilde, 2014)

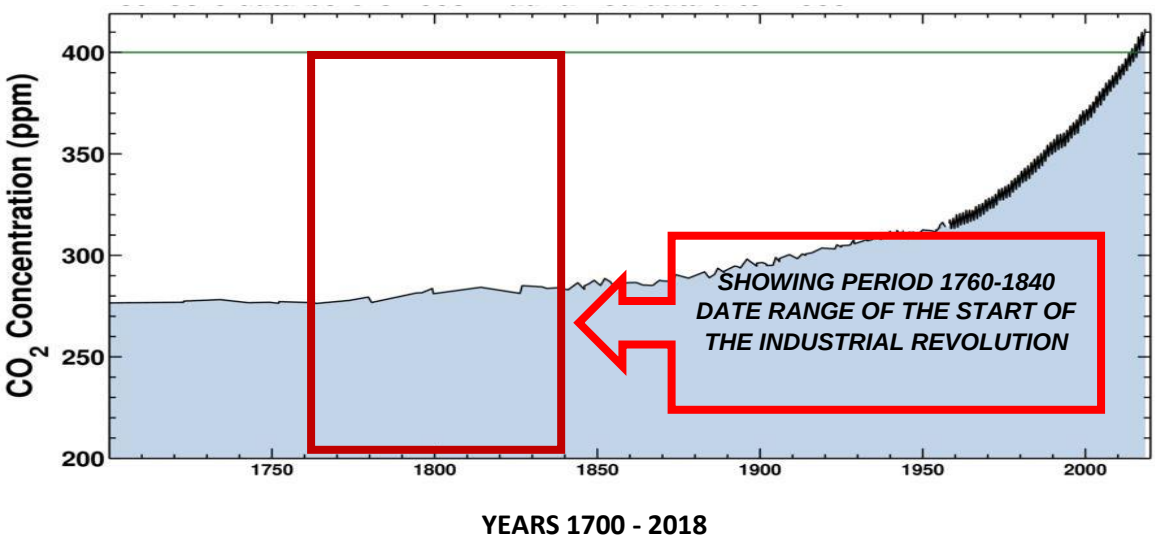

Figure 2.2 Illustrating the apparent rise in atmospheric CO2 between 1760 – 1840 Source: Scripps (2018) adapted by Harrop (2018) to illustrate the apparent effects on atmospheric CO2 levels at the start of the industrial revolution using the Keeling curve for reference. https://scripps.ucsd.edu/programs/keelingcurve/wp-content/plugins/sio-bluemoon/graphs/co2_800k_zoom.png.

It is difficult to accurately quantify the BE's contribution to the upturn in the Keeling curve, as illustrated in Figure 2.2. However, it seems inevitable that the contribution of atmospheric CO_2 would have been significant, for reasons such as the accelerated use of fossil fuels. Additionally, the use of building materials with far higher embodied carbon and energy figures such as iron and steel were used extensively during this period replacing masonry and wood as primary construction materials, which also would have exacerbated carbon emissions.

The benefits of these new construction materials were numerous, such as the factories that could be larger, with bigger spans and wider bays, higher ceilings, more skylights, greater ventilation, and, were no longer were cramped (Sutton,2014) Manufacturing processes shifted to methods that needed high-

energy input, specifically the energy that was found in coal and oil. Before the Industrial Revolution, the BE used comparatively little steel or iron in its structures. Although large span buildings were built before the Industrial Revolution such as St Paul's Cathedral, this method of construction was enormously expensive and uneconomical. As argued by Sutton (2014), the biggest impact on the BE was the use of mass-produced iron and steel, for construction materials.

The embodied energy figures for the materials most used to service the massive rise in infrastructure included steel, concrete and reinforced concrete, as well as a combination of both. The greater the energy required to produce these materials, the greater the potential to produce greenhouse gases. Combine this with an exponentially increased production output of these materials, and it is perhaps simpler to imagine the roots of anthropogenically caused climate change.

MATERIAL	EMBODIED ENERGY (MJ eq/m2)	GLOBAL WARMING POTENTIAL (kg CO_2 eq/m3)
VERNACULAR MATERIALS (TYPICAL PRE-INDUSTRIAL REVOLUTION)		
Granite*	1300	26
Timber (1)	1058.88	57.7
Rammed Earth*	942.5	37.7
Straw*	65	0.65
CONVENTIONAL INDUSTRIAL AND POST INDUSTRIAL REVOLUTION BUILDING MATERIALS		
Concrete	1449.63	264
Steel (Sections)	182286	2,035,800
Ceramic Tiles	22185	1167
Polystyrene	3271.13	341.25

*Table 2.1 Illustrating embodied energy and global warming potential figures for some vernacular and conventional Building Materials with relevance to pre and post-industrial revolution construction materials. Adapted by Harrop (2015) to illustrate a comparison Notes: (1) Sawn timber, air-dried, including planning processes Source: Bragança & Mateus (2011) and *Berge (2009).*

The link between the BE and anthropogenic greenhouse gas (GHG) emissions would seem to be established. Aside from GHG emissions generated by energy use during the BE's lifecycle, there are other perhaps less well-known sources. Such as the oxidation of carbonates in cement production which according to

Olivier, Janssens-Maenhout, Muntean and Peters. (2016) amounted to 4.1% of global GHG emissions in 2014. Although the researcher was unable to quantify accurate global emission figures produced by the BE, it is suggested by Olivier et al. (2016), that emissions generated from this element alone along with fossil fuel combustion are key to GHG mitigation. A point certainly that the researcher was initially unaware of and intends to investigate if this is well known among his peers, during the surveys.

Cement and steel production are indicators of national construction activity according to Olivier et al. (2016). China produced 58.5% of the world's capacity in 2014, which can be compared to the United States figure of 2%. (ibid). This is further demonstrated in Figures 2.4 and 2.5, which illustrate the rate of urbanisation in a selection of developed countries and developing countries between 1980 and 2012.

Work in these areas of industrial expansion encouraged mass migrations within the UK with people from rural areas looking for work (Manolopoulou, 2008). This drove the domestic housing expansion, urbanisation, and the construction of new towns and their associated infrastructures in the BE. Raw material extraction rates to support this expansion increased, as did the pollution to air and water.

It may be questioned whether this was an era where an awareness existed of the adverse effects that industrial activity had on the planet. According to Segger and Khalfan (2004), 18th-century scholarly debates recognised the existence of essential links between the environment and development, and that those environmental constraints would affect economic development. According to Kellogg (1987), there were two "remarkable" studies at the turn of the twentieth century that advanced the appreciation of the effects of carbon dioxide on the changes in the climate. It was perhaps for the first time that it was realised that atmospheric carbon dioxide was increasing because humankind was taking carbon from the earth in the form of coal and petroleum and burning the materials. So although there may have been a limited appreciation from a scientific perspective that human activity had adverse links

with the environment, there was no apparent wide-scale awareness of the issues or the potential damage. The researcher cannot offer concrete reasons for this other than perhaps the scientific community of the day had less influence in macro governmental policy than they do today.

Perhaps the scientific community could not foresee the macro environmental consequences because they lacked the depth of scientific knowledge needed to gain a clear analytical perspective, and of course, the mass media was not capable of disseminating information as efficiently as they do today. The stakeholders of the BE were represented at this time although the scale of their influence is open to debate.

The Chartered Institute of Builders (CIOB) was formed in 1834, in the midst of the Industrial Revolution. The Royal Institute of British Architects (RIBA) was also founded in this year, and the Royal Institute of Chartered Surveyors was formed in 1868, it seems likely that the increase in BE related construction may have influenced the creation of these institutions that are major players in the BE to this day, each with thousands of members. The researcher could find no evidence to indicate that any of these organisations were aware of the adverse environmental effects that their member's activities were having. However, it is arguable that the fact that they were so well established by the time that the environmental conscience was starting to develop, may have meant that when they did speak up, their voices would be listened to. This can be illustrated by initiatives such as the RIBA Plan of Work which since 2013 has considered sustainability through all of its stages, In addition to which the proactive pro-sustainability stances of the CIOB and the RICS, would have lent considerable weight to the arguments of creating a sustainable regime within the BE and promoting awareness of it.

However, further to Segger and Khalfan’s (2004) citation above it was not until the early 1960s that greater recognition for a sustainable agenda became apparent with the UN passing a resolution in 1962 for Governments to take natural resource preservation measures at the earliest stages of economic development (Segger and Khalfan, 2004).

2.4 The Population Dynamic

As articulated by Thomas Malthus (1766–1834) human populations grow exponentially (Malthus, 1798). A point well illustrated in figure 2.3, during the researcher's lifetime the world population has effectively doubled to 7.64 billion as of August 2018. It stands to reason therefore that the BE has had to grow accordingly.

According to Taipale (2012) within the next few decades, there will be more construction on the planet than has been undertaken before. The growth in global construction will outpace the world gross domestic product over the next ten years, and the value will grow by 70% from the US $7.2 trillion in 2010 to US$12 trillion by 2020 (WC, 2011) in October 2016 the population exceeded 7.45 billion people.

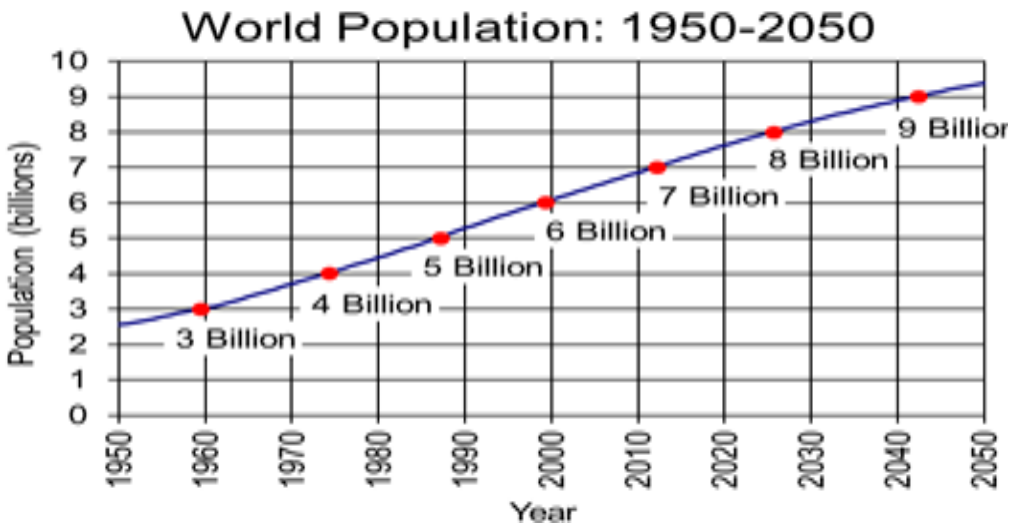

Figure 2.3 Illustrating World population projection graph: Source US Census Bureau (2012)

2.5 Urbanisation

According to Girardet (1999), in response to a growing population, the global construction industry grew. Girardet (1999) articulates that there will be no sustainable world without sustainable cities. However, urbanisation is spreading at an alarming rate where individuals/families are moving from rural communities to cities in the pursuit of jobs and a better standard of living. According to WHO (2014), the Chinese are leaving rural areas and are being encouraged to migrate to cities where people are required to fulfil an ever-increasing job market as the country continues to expand and export services and goods.

It seems very unlikely that the planet can accommodate urbanised humanity, which casually uses resources for building, and uses ever-decreasing amounts of agricultural land and the biosphere. Girardet (1999) calculated that although cities accounted for only 2% of the world's land surface, they used 75% of the world's resources discharging equal amounts of waste.

A century ago, 20% of the world's population lived in urban areas. In 2014 this percentage had risen to 50%, (1914, population c1.8 billion. 2018, 7.64 billion). By 2050, it is expected to rise to 70% (WHO, 2014). Arguably nowhere will be more affected by this than China. In 2011, the Chinese National Bureau of Statistics confirmed that for the first time in China's history a larger percentage of the population lived in urban rather than rural areas (Buchanon and Batcup 2015). It is expected that China will have the largest urban population in the world by 2050; approximately 1 billion people, all of whom will be consuming resources for shelter and food as well as contributing to increasing amounts of localised pollution. Aspinal et al. (2012), stated that developed land in the UK would rise to 12%, which is higher than most other countries in the world. However, according to Caraballo (2016), the six leading nations in the Association of Southeast Asian Nations (ASEAN) will require $2.1 trillion in infrastructure spending by 2030 to cater for the growing trend in urbanisation. This "megatrend" of urbanisation seems inevitable, which further heightens the

requirement for the BE to be more sustainably aware in the way materials are procured, used and recycled.

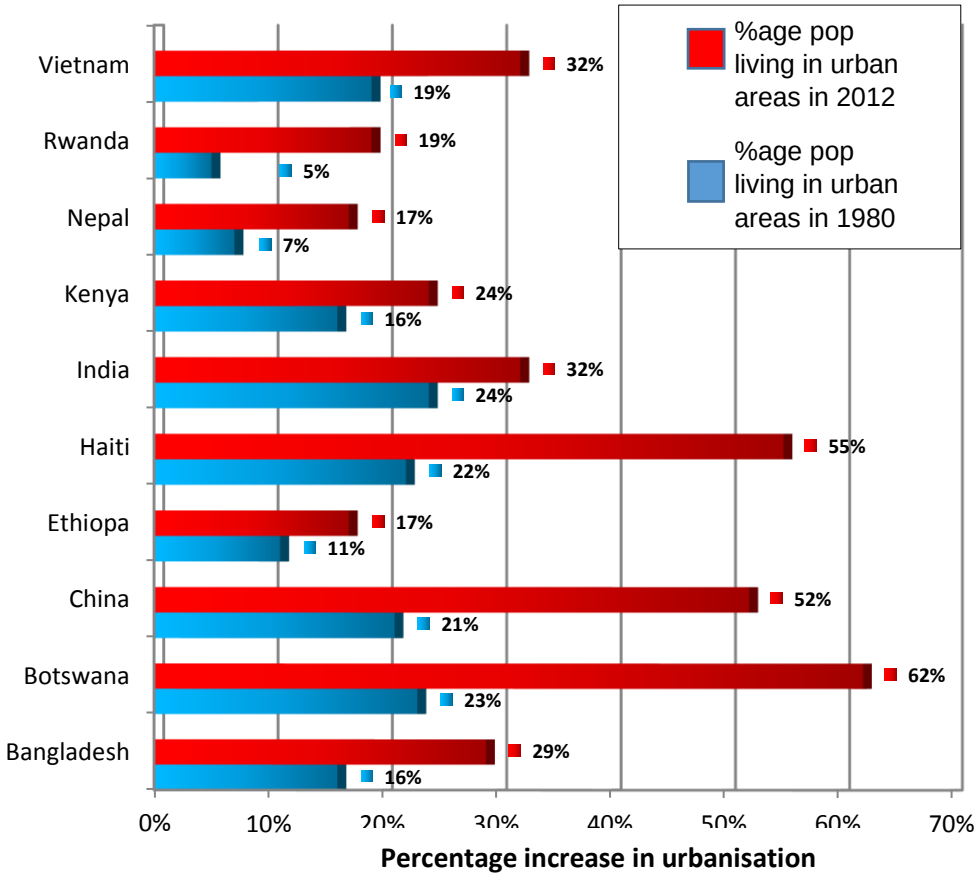

Figure 2.4 Bar chart illustrating percentage increases in urbanisation for Developing Countries from 1980 – 2012. Source: (WHO 2014) Adapted by Harrop (2015) to demonstrate cross-country comparison

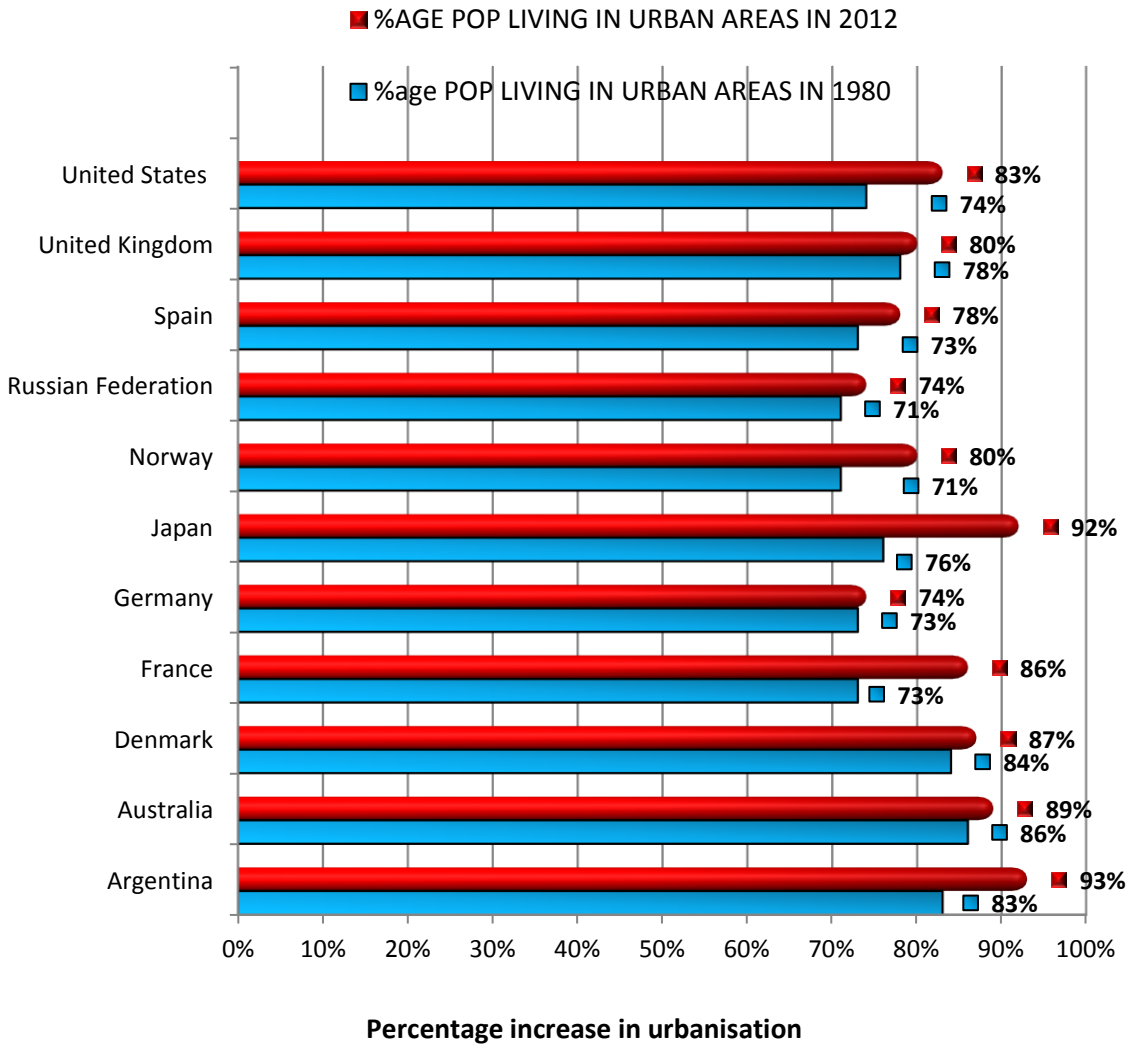

Figure 2.5 Bar chart illustrating percentage increases in urbanisation for Developed Countries from 1980 – 2013. Source: WHO (2014) Adapted by Harrop (2015) to demonstrate a direct cross-country comparison

The mean figures taken from Figures 2.4 and 2.5 indicate that the urbanisation rate is far higher in developing countries. This inevitably has had and will continue to impose enormous pressures on the BE sectors in those countries, including the adverse environmental issues that are associated with the increased raw material resource demand, waste, and carbon emissions from energy and the production of cement.

The researcher would argue that there has never been a more important time for the stakeholders of the BE to be aware of and understand their responsibilities to ensure that a genuinely sustainable regime exists within the BE. That said, awareness of the adverse environmental issues does exist, because the issues are not new and with today's mass media potential we can see the images and hear the stories of them in real time, such as microplastic pollution in the oceans. As mentioned these issues are not new, or rather humanity's adverse effect on the environment is not new, and as a species, we have been slowly learning this for some time now.

2.6 The Growth of Environmental Awareness

According to Ullah, Hasan and Uddin (2013), education is the most effective method for raising public awareness and garnering a custodial attitude to the environment. Ullah et al. (2013) state that if people's perception, knowledge, awareness and attitude towards environmental issues are high, then the environmental literacy rate is also high, in which case this will lead to a positive change in behaviour. Pillai's (2012), definition of the "Environment", includes the BE. The salient point from this is that environmental awareness in the BE can originate from the stakeholder's own experience and knowledge. Arguably that is the case for the proactive curious mind where Ullah et al (2013), state; "environmental education is the most efficient way of improving environmental literacy". Increasing environmental literacy can make people more conscious of the environment, which leads to positive change. There is a practical truth in this statement, demonstrated for example, in the way that almost all householders recycle domestic waste. To illustrate this point, in a poll of 2,426 people for recycling campaign "Recycle Now", it was found that 82% of people thought recycling does make a difference. Linda Crichton (Head of "Recycle Now") stated "We know that understanding the recycling process motivates people to recycle" (Telegraph Reporters, 2017).

Education is achieved through many mediums, the spoken word, the written word, the internet and by raw life experience. This section will explore the decades that followed the industrial revolution and the Second World War considering whether the notable environmental issues increased awareness towards sustainability, particularly within the BE.

2.7 The Growth of Environmental Awareness, 1949 - 1969

Birnie and Boyle (2002), argue that before 1972 there was a limited approach to environmental legislation. At this time environmental based legislation was also not strong within the BE, and a lack of awareness of the adverse environmental impacts created by the BE was possibly more prevalent than it is today. The same could be argued for architecture. Famous names such as the American Frank Lloyd Wright (1867-1959), the French Architect Le Corbusier (1887-1965), had an immense influence on the modernist movement. They also may have had a notable lack of awareness towards sustainability-related issues within their area of expertise such as health and safety, and, the environment. To say that modernist architecture conformed to the four pillars of sustainability is debatable, as it employed materials antithetical to eco-friendly environmental design, such as polymers, and asphalt both made from hydrocarbons. Paints and adhesives were other examples of popular materials which contained ozone-depleting properties and toxic ingredients. These materials included asbestos where its well-documented carcinogenic risk was freely used (Rifkind, 2014). Whether this demonstrated a lack of awareness of the issues in using hydrocarbons and toxic materials such as asbestos is debatable, particularly in light of the fact that the adverse effects of asbestos on human physiology was known by Pliny the Elder (23-79 AD), and as early as 1908 insurance companies began decreasing policies and benefits for asbestos workers. Metropolitan Life, for example, increased the premiums for asbestos workers. (Barbalace, 2004). Rifkind (2014) also argues that the adverse effects of exposure to asbestos were known during this era, and therefore it seems surprising that these leading figures in the BE could have been unaware of these facts. However, one example that might contradict that assertion was

Frank Lloyd Wright who with his young family lived in Oak Park Illinois from 1889 to 1911. This development is currently listed on the Mesothelioma Cancer Alliance website (Oak Park, 2015), due to the quantities of asbestos used in construction. Frank Lloyd Wright (1867–1959) designed many of these properties; it seems reasonable to assume that he would neither expose himself or his family to these risks had he been fully aware of the risk that the material can pose. It may therefore be easy to be unaware of a thing even when there is a great deal of information about it.

It should be noted that earlier generations of architects before Frank Lloyd Wright had deeper-rooted ideologies with an environmental bias. According to Lam (2009), Antoni Gaudi (1852-1926), had a deep affinity with the natural world and recognised that nature could answer many design queries. A philosophy that might in contemporary terms be called biomimicry.

This recognition went beyond the aesthetic comparison with nature, Gaudi's designs, for example, were congruent with current thinking in the design and inclusion of large open green areas. According to Lam (2009), Gaudi understood that the need for open areas and green space was essential to the human psyche. Natural daylight was something that Gaudi took seriously and according to Lam (2009) took every opportunity to ensure that natural daylight permeated through the buildings he designed, by installing skylights. It may be noted that in today's design this could qualify for credit awards in the Leadership of Energy and Environmental Assessment Methodology (LEED).

The aftermath of the Second World War saw UK construction materials in very short supply, so the principle driver behind material reuse and prefabrication was at that time due to material scarcity (Gajanan M, 2011), as opposed to environmental preservation.

Not surprisingly, material scarcity was a global issue, and in 1949, The United Nations Educational, Scientific and Cultural Organisation (UNESCO) held a conference on the conservation and utilisation of resources in the United States. Harry S Truman proposed the conference in 1946 (Jundt, 2014). Its scope considered the regions that had suffered from economic underdevelopment and

had been affected by exhausted natural resources. According to UNESCO (2017), the conference also wanted to consider the use of by-products and to increase the proportion of materials used in “closed cycles”.

The 1948 conference according to Melvern (1985), was the world’s first environmental conference. It hosted over 700 experts from 48 countries who discussed the “improvident use of the world’s natural resources” (Melvern, 1985). Although the researcher was unable to confirm that the BE was on the conference agenda, it seems reasonable to assume that it was, particularly as according to UNESCO (2017), engineers were invited to attend, and based on the conference’s core interests namely resource depletion, these engineers likely would have included civil engineers. As outlined above material scarcity was a concern at the time for several reasons, not least being, that much of the UK and Europe’s BE and supporting infrastructure had been destroyed or damaged during the Second World War. According to Walker (2015), post-war demands placed increasing complexity on the construction industry including an increase in building, and rebuilding homes, all of which required the manufacture of building materials such as steel, which contained high-embodied energy loadings.

In 1968, UNESCO facilitated the Paris Biosphere conference. These discussions were at an intergovernmental level with the main objective of finding a balance between economic development and environmental preservation, the combination of which developed into the concept of Sustainable Development. From this, the International Co-ordinating Council was formed and later became the governing body of the Man and Biosphere Programme (MAB). In response to growing environmental awareness Friends of the Earth was established in 1969 followed by Friends of the Earth International. Much of the western world was developing an acute environmental conscience and awareness. Influential organisations that were devoted to the preservation of the environment and outspoken champions against the adverse use of it were emerging.

Furthermore, June 1969 saw an event that arguably galvanised America's environmental awareness and linked it to industrial activity. The incident was the spontaneous combustion of the Cuyahoga River in Ohio, an image that became etched in the nation's consciousness as it was published in TIME magazine during the period. This was not the first time the river had been ablaze for similar reasons. Because of this, the National Environmental Policy Act (NEPA) was introduced to US Senate in 1969, making the US the first country to pass a legislative framework that was devoted to the preservation of the environment. By the early 1970s, a strong environmental consciousness had taken hold with links to industrial activity (Gardner, 2014).

A staunch advocate for sustainability and the industrial BE is the American physicist Amory Lovins who was the UK's representative of Friends of the Earth. His environmental specialisation was energy use, including low energy use transportation. In addition to this, he was and remains, a vocal exponent of sustainability within the BE and an influential thought leader in the promotion of sustainability awareness. Lovins has a practical understanding of science with the real and possible applications of sustainable design notably within the BE. His own home in Snowmass Colorado is a model for sustainable construction and energy efficiency has had over 100,000 visitors since it was built in 1984, (Rocky Mountain Institute, 2015).

2.8 The Growth of Environmental Awareness, 1970 - 1979

The environmental movement may not have been initiated by concerns relating to the BE, despite the industrial revolution and later industrial links. Arguably, the foundations of the environmental movement in the 1970s could be attributed to individuals such as Rachael Carson (1907-1964) and her research into Dichlorodiphenyltrichloroethane (DDT). She singly made her views known, and arguably her voice and book Silent Spring (1962) led to an evolving awareness, which would manifest in the creation of environmentally aware organisations that were prepared to take their beliefs and principles onto the world stage. This included the Environmental Defence Fund (EDF) (1967), whose prime directive of pursuing legal resolutions to damage inflicted on the environment.

Other organisations that were founded during this time included Greenpeace, who led aggressive campaigns but raised awareness of environmental concerns at unprecedented levels. However, it should be noted that they had the benefit of the mass media particularly after such well-publicised environmental disasters as the Cuyahoga River fire. Although not directly associated with the BE, it could be suggested that Greenpeace remains a nexus organisation in the promotion of environmental awareness, a phenomenon which perhaps evolved into sustainability awareness. Greenpeace as an organisation is recognised globally by name.

The United Nations Conference on Human Environment was held in Stockholm in 1972 under the auspices of Maurice Strong (1929-2015). The conference centred on the issue of acid rain in northern Europe and its effect on the environment. It recognised at an international level, supported by compelling evidence, the adverse effects that anthropogenic activity had on the environment. In particular, a link between industrial activity and environmental impacts were being proved beyond reasonable doubt, which attracted growing interest and increased awareness. Seyfang and Jordon (2002) argue that the Stockholm conference was the first mega conference, which successfully identified the terms of the continuing environmental debate and laid the foundations of the system of environmental law and development.

During this time, many environmentalists and authors published papers and books outlining in graphic detail the impacts on the environment caused by human activity. “Only One Earth” (Dubos et al., 1973) postulated that an international effort based on the founding principle that we shared a common future, could address and remediate the damage caused. There were, however, less benign and more controversial views well publicised at the time. For example, “The Limits to Growth” published by the Club of Rome in 1972, outlined that the rate of population growth in the western world would have to be curbed and reduced significantly in developing countries (Meadows et al., 1972). Five variables were examined in the original publication, which included world population, industrialisation, pollution, food production and resource

depletion. The BE's expansion, arguably a direct result of industrialisation and population increase would affect at least three of these. Since its first publication in 1972, the Club of Rome has published regular updates to "Limits to Growth". Even today, it has many supporters who have analysed its findings using modern predictive models and supercomputers (Simmons, 2000). The Limits to Growth was controversial. However, its publication galvanised opposition in creating counter arguments and brought the environment to international prominence. The southern hemisphere's response to The Limits to Growth argued for growth and equity for the developing world.

One year later in 1973, the World Conservation Strategy was released by the International Union of the Conservation of Nature (IUCN) "Towards Sustainable Development". This strategy identified the main element of environmental destruction as industrialisation, which was identified in The Limits to Growth. An emphasis was placed on transportation and its key function in developing the expanding Built Environment (BE) and its supporting infrastructure (OECD, 2000) in addition to changing land use. The Brandt Report (1973) entitled "North-South was produced by the Independent Commission on International Development Issues. The report called for a new economic relationship to be forged between the northern and southern hemispheres, notably to help with progressing developing countries. Many were critical of this report arguing that it did not come to terms with contradictions suggested within the strategies or the suggestions it made for restructuring international financial institutions, which failed to consider capitalist systems. The report, although well intentioned, contained little real economic substance (Williams, 1980).

Walter Stahel, a German architect, focused on more than just energy and co-wrote a research paper with Geneviève Reday (Stahel and Reday, 1976), illustrating a vision of a circular economy for all resources. This outlined the benefits of job creation, economic viability and the prevention, if not the complete elimination of waste. In effect, this was a research paper that laid the foundation for the three pillars of sustainability. Later in 1982, the paper was published as a book "Jobs for Tomorrow, The Potential for Substituting

Manpower for Energy. Stahel first coined the term “Cradle to Cradle” which illustrated perhaps for the first time through 30 case studies that a circular economy could be profitable. His detractors, however, argued that only the Cradle to Grave route could be competitive within the typical linear economic model (take, make, dispose).

This illustrated that environmental concerns were secondary to economic ones, illustrating a certain short-sightedness or notable lack of awareness. According to Juniper (2012) George Osborne (then leader of the Finance Ministry) in October 2010 said that “saving the planet risked putting our country out of business“. Osborne in his speech went on to claim how “a decade of environmental laws and regulations are piling costs on the energy bills of households and companies.” Juniper (2013), argues that one hundred per cent of economic activity is dependent on the services and benefits provided by nature. This suggests a chronic lack of awareness of a very basic concept by someone who was at the very heart of the UK Government. This statement displayed a fundamental lack of understanding that human activity cannot occur on a planet that can no longer support life, and a lack of awareness of the adverse effects being caused by industrial activity, and not understanding the basic need to change.

Legislation in the UK tried to keep pace with the environmental resonances around the world. After the war this included the Clean Air Act (1956), the Rivers Prevention of Pollution Act of 1961 in England, the Control of Pollution Act 1974, and the Health and Safety at Work Act (1974), all of which impacted on the BE in both its construction and operation. Additionally, the Control of Pollution Act 1974 imposed regulations in many areas including land and water pollution, specifically within the BE. The regulations, however, seemed to centre on noise and vibration caused by the activities of the BE. The application of legislation regarding sustainable construction was limited, but it could be argued that what legislation was in place had responded to events such as the London fogs. So, the stage would be set for the next decade, one where the greater emphasis would be placed on the environment and sustainability, which in turn

would impact on the BE, rather than be specifically designed to direct sustainability and the environmental agenda in the BE.

Kellogg (1986) argued that the 1970's saw an immense advance in the evolution of environmental awareness, because of the increased level of public and scientific discussion. However, the movement continued to progress exponentially into the 1980's.

2.9 The Growth of Environmental Awareness, 1980 - 1989

Following the 1970's growing environmental agenda, the first major climate change meeting was held in Villach Austria by the World Meteorological Society in 1985. At this meeting, UNEP and the Council of Scientific Unions (ICSU) reported on the build-up of CO_2 and other greenhouse gases from human activity. Furthermore, in 1987 "Our Common Future" (Brundtland, 1987) was published. The Brundtland report suggested that equity could be used to overcome environmental issues, which meant that inequality between developed and undeveloped countries had to be countered by raising the living conditions in developing countries that were impoverished. One argument took the view that it supported ecological sustainability in tandem with capitalist development and therefore was profit orientated (Crawford, {No date}). Crawford (No date) also stated that the Brundtland Report promoted economic growth as the solution to global environmental and social problems and that perhaps the answer was to be found in the "sustainable use" of planetary resources and raw materials rather than "Sustainable Development". Whatever the arguments for or against the Brundtland definition, it remains the most widely used (Kono, 2014).

The Association of Environment Conscious Building (AECB) was reformed in 1989 as the Sustainable Building Association. They had a number of forward-thinking stated aims, such as the promotion of the use of products and materials, which were safe, healthy and sustainable. They encouraged members to ensure their projects respected, protected and enhanced the environment. They made available comprehensive information and guidance

about products, methods and projects and to support the interests and endeavours of members in the BE to achieve their aims (AECB, 2016).

As of June 2018, the AECB has over 700 members throughout the country. Members are all stakeholders in the BE, including architects, designers and consultants, who continually stress that education is the best tool for awareness promotion (AECB, 2018).

2.10 The Growth of Environmental Awareness, 1990 - 1999

Agenda 21 was the main outcome of the 1992 Rio Earth Summit[4] and was a global plan of action by organisations of the United Nations, governments and major groups in areas where human activities affected the environment. Agenda 21 was adopted by more than 178 Governments at the United Nations Conference on Environment and Development (UNCED) and still exists and guidance for governments in 2017.

A major theme of Agenda 21 was to eliminate poverty and give the poorer undeveloped nations the resources they would need to live sustainably, which included infrastructure improvement, housing, land use and agriculture. By adopting Agenda 21, the industrialised countries took on greater environmental responsibility.

These countries pledged to help less developed countries develop in ways that encouraged sustainability that were less damaging to the environment. This help would go beyond funding and aid; and would encourage these nations to create stable economies, eliminate poverty, improve the BE by creating universally available housing, water distribution systems and develop efficient infrastructures. In précis, Agenda 21 recognised the key role towards a sustainable regime of a developed BE. Agenda 21 opponents offer several arguments against the initiative and according to Hodges (2014); it has destroyed people's lives from all occupations, further citing that Agenda 21 removes people from rural areas through the enforcement of anti-small farmer

[4] In 1992 the United Nations held the first conference on Environment and Development (UNCED) in Rio.de Janiero

policies. He also states that Agenda 21 proponents allow no discourse as to the veracity and legitimacy of its policies. Harman (2015) perhaps takes this view a step further citing Agenda 21 as a linchpin in a plot to subjugate humanity under an eco-totalitarian regime. Although this may seem an extreme argument, it can be argued that this debate fuels awareness of sustainability. The researcher's opinion remains that it galvanised awareness, albeit perhaps, more to the scientific, academic and political communities than the public and also it could be said the primary stakeholders within the BE.

An outcome of Rio 1992 saw the establishment of the Commission of Sustainable Development (CSD). The CSD was created in December 1992 to ensure follow up from the United Nations Conference on Environment and Development (UNCED), and report on the agreements at local, national and international levels. A 5-yearly review was agreed by the United Nations, which meant the first would be held in 1997. The UK Government's response to this was the 2000 Climate Change Programme (CCP). The CCP had several stated strategies such as to improve business's use of energy, stimulate investment and cut costs, stimulate new and more efficient sources of power generation, cutting emissions from the transport sector and improving the energy efficiency requirements of the Building Regulations. Arguably, many the outlined strategies impacted favourably on the BE and sustainability, particularly energy efficiency strategies and notably the improvements in building regulations.

Following the success of Agenda 21, China released its version in 1994. This was a white paper published exclusively for the Chinese population; it centred on the environment and industrial development. The white paper argued that Rio (1992) was a failure. Part of the deal brokered required developing countries to adhere to multilateral environmental agreements while richer developed countries would aid by writing off debts, remove trade barriers and provide technology and knowledge transfer. Little appeared to happen at a practical level. The trade barriers were not lifted which benefited the industrialised countries, developing countries did little to action environmental agreements they had agreed, and the BE was given little consideration.

Following Rio in 1992 “Constructing the team” also known as, the Latham Report was published in 1994 by Sir Michael Latham was a joint review of the contractual and procurement sectors within the UK’s construction industry. Although sustainability as a word is not mentioned in the report, it does emphasise the relationships between the stakeholders to BE related sectors; such as clients, contractors, architects, and consulting engineers. With this approach, many beneficial aspects would emerge, for example, costs and contract delivery periods. Gardner (2014) argued although there were discussions around the report’s effectiveness, it highlighted several issues that were consistent within the construction industry, adversarial attitudes being one example. He commented that Latham’s report was the start of modernising an industry, which, despite setbacks, rendered it unrecognisable from the primitive and antagonistic building sector of the 1980s. Although sustainability was not a core consideration of the report, it started the thinking, and initiatives such as the CSCS card system for construction workers that demonstrate an operative is trained and capable of undertaking an element of work, e.g. operating a forklift truck, is aware of the benefits of training and, Health and Safety awareness within the BE.

Gardner (2014) outlined that the Latham Report had material benefits within the construction industry including the way people and stakeholders, worked together. It is debatable what this effect has had on the construction industry since and how it relates to sustainability and its implementation. However, it is arguable that without a more cohesive cross-disciplinary approach that was possibly triggered by the Latham Report, promoting awareness of sustainability across all of the BE’s stakeholders could be harder to achieve.

Latham echoed several points relating to inefficiency that Bossom noted in 1934. Sustainability, or strong environmental concerns, did not seem to be at the fore of the concerns in these reports and papers. After the Latham report, the next notable construction related report, was the Egan Report (1998), “Rethinking Construction”. The then deputy UK Prime Minister John Prescott created the Construction Task Force (CTF). The CTF intended to modernise the

construction industry making it less fragmented and inefficient, two criticisms identified in the Latham report (1994).

The CTF was chaired by Sir John Egan, CEO of British Airports Authority and included in its membership the Managing Director of Nissan, the Chief Executive of British Steel and a director from Morgan Stanley. Top-tier management also represented it with BE associations, such as Bovis Homes. The report was not well received by top-tier construction companies such as Tarmac, who vocally disagreed that construction could learn any lessons from manufacturing-based industries.

'We will not continue to be taken for mugs. We are not as inefficient as they think.'

Source: Designing buildings, quoting Sir Neville Sams, Chairman of Tarmac

In 1997 John Elkington coined the term Triple Bottom Line (TBL). He was widely considered a leading authority in the fields of corporate responsibility and sustainability, arguing that the traditionally accepted business model of one bottom line (profit and loss) required revision to meet the requirements of the environmental awareness upsurge. He, therefore, considered that "bottom lines were required. These strongly reflected the pillars of sustainability unlike the Latham Report (1994). So instead of profit and loss (the economic pillar) being the sole bottom line, people (social) and planet (environmental), were also considered.

However, at this time companies were still focusing heavily on economic considerations, with social, ecological or sustainability seemingly given little thought.

In 1997, the Global Reporting Initiative (GRI)[5] was created by a number of organisations, including the Coalition of Environmentally Responsible

[5] GRI's vision was to create a future where sustainability is considered in every organisations decision making processes (GRI, 2016). Companies voluntarily report annually on their sustainability impacts.

Economies (CERES), in addition to the Tellus[6] Institute and the United Nations Environmental Program (UNEP), organisations who had a vision of a sustainable world were committed to achieving sustainable development. As part of their remit, the BE was a consideration going forward.

The Dow Jones Sustainability Index[7] (DJSI) was launched two years later in 1999 by the Dow Jones organisation. The index takes the GRI one-step further and is a system, which evaluates the sustainable performance of the largest 2500 companies on the Dow Jones Stock market index (DJSI). The indices are an important evaluation tool for investors who want to capitalise money into sustainability-driven organisations. The Index is based on the environmental, social and economic performance of the companies and assesses the following: corporate governance, climate change, supply chain standards, and labour practices. Companies that do not satisfy the required sustainability standards are rejected.

The DJSI includes BE stakeholders within its industrial sectors. A notable example would be Hyundai Engineering and Construction, a South Korean multinational construction company founded in 1947. Hyundai has an aggressive strategy to foster growth in the green sector. To initially capitalise on substantial investments in the country's infrastructure, it encompasses projects on energy conservation, recycling, carbon reduction, flood prevention, green development and the maintenance of forest resources (Pearce and Yong, 2012). Hyundai is featured along with several other construction and engineering companies in the "heavy construction" category of the DJSI.

To join the index, a company is assessed and judged based on long-term plans, specifically social, economic and environmental. It is expected that companies will achieve their long term plans through monitoring and continual improvement. The concept that is introduced with the DJSI is that clients can be

[6] The Tellus Institute, sought to bring a scientific systematic approach to studying the environmental and social issues of the day. Their evolution has been progressive and dramatic as they have evolved with the issues that have led to the requirement for sustainable development.

[7] The DJSI enabled investors for the first time to make informed judgements on the sustainability performance of potential investment opportunities.

informed about the sustainability credentials of a proposed supplier, as can internal stakeholders and employees. Choices can be made therefore whether to use a supplier that actively practices a culture of sustainability. The argument, therefore, manifests that the promotion and awareness of sustainability can generate both profit and future business opportunities, particularly with mechanisms and prominence that DJSI possesses. The researcher, however, would question if knowledge and awareness that may well exist in the upper management levels of these DJSI companies is disseminated throughout the company to its lowest levels. The argument being that a multi-strata approach to awareness training in a company which already has such high credentials as being a member of the DJSI would make all the employee's sustainability aware. A point that will be explored in the main survey and semi-structured interviews.

It could be said that the 1990s saw a shift towards environmental bias, although sustainability as a word was uncommon, particularly within a contemporary context (Rimanoczy, 2017). This shift saw a growing sense of environmental awareness, one that saw producers looking past the acceptability and properties of their products at the point of sale, to one where they considered a more through life, or Stahel's (1972) cradle to cradle approach. Walter Stahel developed the term cradle to cradle in the 1970s (Making It Magazine, 2013). However, Stahel preferred the term "circular economy" or "closed loop economy", because for him the economics was the most influential part. By this Stahel meant that the smallest loops such as recycling, repairing and remanufacturing had the biggest profit potential while offering the consumer the lowest prices. Stahel argued (Making It Magazine, 2013) that the smallest loops also had positive benefits to social and environmental considerations such that labour-intensive requirements promoted high employment while at the same time decentralisation reduced energy use and material resource consumption.

The 1990's was a decade where damage to the environment caused by human activity was identified and acted on. Evident damage to the environment raised international conscience. Attitudes to conservation and the environment started

to change. Sustainable Development implied using renewable resources in a way, which does not eliminate, degrade or otherwise decrease their utility for future generations. It also implies that non-renewable resources are used at a rate slow enough to ensure a high probability of an orderly societal transition to a new alternative, for example, renewable energy technologies (Pearce et al., 1989). An example of a notable piece of energy-related legislation affecting sustainability within the BE during this time frame is the Energy Performance of Buildings Directive (EPBD): The EPBD was the EU's response to the Kyoto protocol (1997). The directive was first adopted in 2002. However, by 2007 tighter requirements were outlined, such as a commitment to reduce the EU's total energy consumption by 2020, and a commitment that 20% of the total supply of the energy by 2020 would be from renewable sources.

It should perhaps be noted that individual EU states tended to agree on their targets. Arguably, perhaps in part, this variety of responses created a requirement and update of the EPBD and a second directive was drafted and then adopted in May 2010.

The recast of the directive introduced some additional provisions that influenced sustainability within the BE, and arguably to the stakeholder's promotion of the awareness of it as well, such as: The requirement for new buildings developed after 2020 to be nearly zero energy buildings with an earlier deadline of 2019 for a number of public buildings and the extension of the requirements for a Display Energy Certificate (DEC) in public buildings over 250m^2.

Formed in 1993, the British Institute of Facilities Management (BIFM) is the largest professional body in the UK associated with Facilities Management (FM). (FM is the integration of processes within an organisation to maintain and develop the agreed services which support and improve the effectiveness of its primary activities". FM encompasses multi-disciplinary activities (see table 2.2) within the BE and the management of their impact upon people and the workplace. BIFM (2015).

FACILITIES MANAGEMENT	
HARD SERVICES	**SOFT SERVICES**
Building Fabric (Including)	Cleaning
Building Maintenance	Catering
Contract control	Postal
Operation and planned maintenance	Security
New Build	Health and Safety
Refurbishments	

Table 2.2 Illustrating examples of the two services of an FM contract. Adapted by Harrop Source BIFM (2015)

The BIFM, unlike the Royal Institute of Chartered Surveyors (RICS) and the Royal Institution of British Architects (RIBA), is a recent player as far as professional bodies go, yet despite this and the relatively new profession that FM is, the BIFM would seem to have embraced the need for sustainability within their sector, which may be demonstrated by their annual sustainability in FM survey which has been undertaken since 2007. Although the survey covers a number of areas, it was perhaps the results concerning a lack of awareness and knowledge of sustainability within FM that piqued the researcher's interest and arguably in part influenced the direction of research.

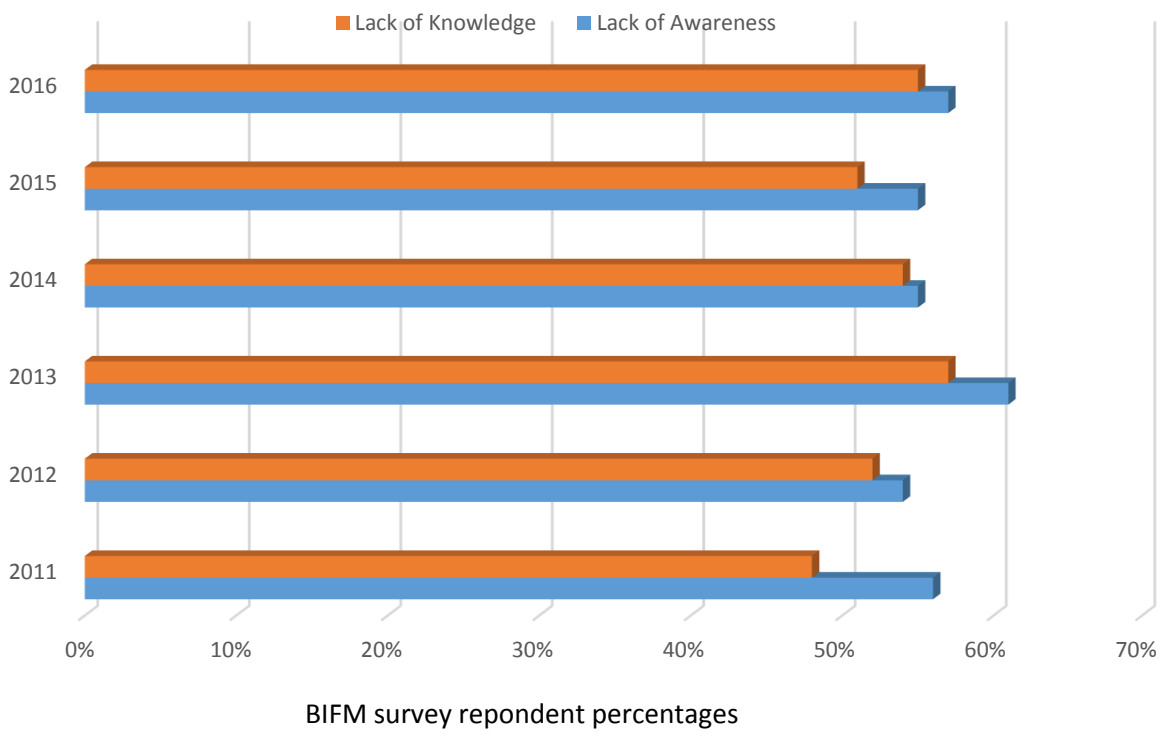

Figure 2.6 Illustrating BIFM sustainability survey results between 2011- 2016 under categories of lack of awareness and lack of knowledge. Source BIFM adapted by Harrop (2016) to illustrate a comparison between the two issues.

The results from the BIFM surveys illustrate that the respondents considered that a lack of awareness and a lack of knowledge of sustainability were notable barriers to its implementation in Facilities Management. (BIFM, 2017). This was a survey conducted on members of the BIFM, no details were available regarding the sample set choice, so it assumed that it was a mix of FMs from both soft and hard disciplines. Regarding this being representative of the BE is far from certain, so it will be necessary for the methodology to include a number of different sectors, such as consultant engineers, suppliers and contractors.

It should also be noted that the result from their 2007 survey (the first of its kind), also showed a marked result regarding “lack of awareness” is a significant barrier in the implementation of sustainability in Facilities management. It was perhaps this survey when completed by the researcher in 2011 that led to the question regarding awareness of sustainability, and why it was significant.

2.11 The Growth of Environmental Awareness, 2000 - Present

This period arguably witnessed the largest rise in sustainability awareness and related legislation relevant to the BE. Legislation examples include the Sustainable Energy Act 2003, the Sustainable and Secure Buildings Act 2004, the Kyoto Protocol, which came into force in 2005, the Climate Change and Sustainable Energy Act 2006, and, the Climate Change Act 2008.

However, before the introduction of legislation mentioned above, the Hannover Principles were introduced in 2000 (McDonough and Braungart 2000), “Design for Sustainability” for the EXPO World Fair held in Hannover Germany. These founding principles which could be achieved globally for the first time were closely associated with the BE and were associated with reducing the impacts of climate change. They focused on areas including design considerations, aspects of human settlement, i.e. community, dwelling, industry and trade, creating objects of long-term value, eliminating waste, reducing energy and optimising the full-life cycle of products and processes. Although these principles apply to the BE and are still relevant in 2018, they do not appear to form part of mainstream academic courses related to the BE such as facilities management and building surveying. This alone reduces the promotion of awareness because as previously established education is an important part of awareness, a point illustrated by principle no 9 of the Hannover principles (McDonough and Braungart, 2000), which states, “seek constant improvement by the sharing of knowledge”.

The Carbon Disclosure Project (CDP) was founded in 2000 with a focus on associated climate change impacts. It collates climate change information from 3000 of the world’s largest companies. This initiative is therefore different from the GRI and Dow Jones Index, which considered all three pillars of sustainability. The institutional investors have two points of interest in using them (aside from any environmentally altruistic ideals). The first being that the CDP can act as a mechanism which will ultimately protect investments from the risks that are being associated with climate change (resilience), including weather pattern shifts and flooding. Secondly, those investment programs are

directed to similar companies increasing chances of long-term corporate survival. The CDP has created the largest database in the world regarding corporate greenhouse emissions. As of August 2018, the CDP had over 827 institutional investors, works with 6000 corporations with a combined $100 trillion in assets (CDP, 2018). It has the backing of a large number of blue chip companies and has active partner organisations in the US, UK, China, France, India, South Africa, Australia, and New Zealand. Many large companies active within the BE have become signatories to the CDP including Carillion (Multinational provider hard and soft facilities management (FM) services) Source: Carillion (2016), Turner Construction, (Turner, 2015), and Group Five (South Africa) (Group 5, 2016).

These companies have a major presence in the BE and are some of the largest of their kind in the world. The researcher could not ascertain the relative percentage of all BE activity between the larger players and SME's, for example, those larger players who are CDP signatories. It has to be questioned however, despite the well-documented evidence on websites and published policies, to what extent is sustainability understood at all levels of an organisation.

As argued by Ryan (2012) critics state that the CDP has had little effect in influencing how big business views carbon and its environmental impacts, stating that the CDP does not impose any form of penalty when an investor is non-compliant. The data collected by the CDP has a variety of uses for stakeholders' clients and regulators; it also serves as demonstrable proof of legislative compliance. In addition to this, the CDP can assess the carbon emission of differing business sectors giving clear indications regarding which industries have greener credentials in the BE.

According to Seekings (2018), all large companies will be required to report their carbon emissions from April 2019, under a new framework announced by the UK Government on the 18th July 2018, these proposals will apply to all unquoted organisations with at least 250 employees or those with an annual turnover of greater than £36 million. This provides a platform the researcher

would argue for these companies to further promote the awareness of sustainability within their organisation due to its increasing relevance to the business, if for no other reason.

2.11.1 Notable Environmental Conferences

Following on from Stockholm 1972, and Rio 1992, this period saw some notable conferences including Johannesburg 2002, and the Conference of Parties (COP 21). The World Summit for Sustainable Development Earth Summit in Johannesburg 2002 was the fourth environmental mega-conference organised by the United Nations after 1972. This conference highlighted the relationship between human society and the natural world (Seyfang and Jordon, 2002) and was attended by 65,000 delegates, including 100 heads of state from 185 countries, (Oliver & Jeffrey, 2002) with the notable exception of the US president, George Bush. The premise was to improve on the positive trends from Rio 1992 and attempt to address some of the issues.

Furthermore, several agreements were made in Johannesburg with specified goals that impacted on the BE. These included minimising the adverse effects of chemicals on human health and the environment by 2020, the provision of reliable and affordable energy services, reversing natural resource loss, and urgently and substantially increasing global use of renewable energy: increase energy efficiency (HM Govt, 2005).

Opinions were mixed as to the success of the summit. The critics argued that no concrete targets were achieved on the use of renewable energy. The poorer countries hoped for fairer trade terms by way of the richer nations reducing subsidies, which would have the effect of opening up markets (Oliver &Jeffrey, 2002).

The wealthiest countries also had agendas, including fairer trade policies, particularly on electronic goods and services. A further criticism levelled at the wealthiest nations was that sustainable development was a goal although pursuance of it was contingent on the costs. There was one centre stage event at the Johannesburg summit directly related to the BE. This was called

“Aspiration and Reality: Building Sustainability conference”, a UN-designated World Summit parallel event (Badescu, 2002) and was aimed at stakeholders in the fields of construction, property development, and was the only summit side event that was related to the BE. It was high profile, with Kofi Annan, the UN secretary-general, fully recognising the importance of the BE’s position relating to sustainability and its related issues. The conference had the support of over a million practitioners worldwide from facility managers, accountants, architects and town planners (Badescu, 2002). It was unprecedented in its scope and under the leadership of the Royal Institute of Chartered Surveyors; fourteen other professional institutions were represented. Their primary goal was to promote sustainability in both the built and natural environments and promote private sector advances and accomplishments.

In December 2015, the Conference of Parties (COP) 21 meeting took place in Paris, which had some successful outcomes. Unlike previous climate summits including Copenhagen which failed to make lasting material contributions to climate change. On the 3rd December 2015, the BE took centre stage in the COP21 event, when the first “Buildings Day” took place. This marked the launch of the Global Alliance of Buildings and Construction (GABC), which are collectively committed to:

a. Helping put buildings and construction sector on the “below 2°c path
b. Aligning existing initiatives, commitments and programmes to achieve greater scale and increase the pace of efficiency actions, and;
c. Catalysing stronger collaboration/communication and targeting sectoral and cross-sectoral climate action and solutions for all (UNEP, 2016).

The GABC aimed to bring together public and private BE stakeholders at every level and every stage of the BE’s lifecycle, with its primary goal of achieving a global warming target of under 2°c. According to UNEP (2016), the GABC perceived that this could only be achieved if stakeholders communicate and raise awareness of what and how it is to be achieved. Importantly, the alliance recognised that urbanisation would scale up to the point where it is estimated 70% of the world’s population will live in urban societies. It also recognised that

the BE and its associated sectors would have a major part to play in combating climate change. An example of the action taken by one of its signatories, the World Green Building Council (WGBC) made several commitments because of COP21. The WGBC made two commitments with arguably far-reaching and beneficial implications to decarbonising the BE. All new buildings to be net zero carbon, and existing stock to be refurbished with an emphasis on energy efficiency.

Within the BE's context, COP21 seems to have polarised thought and action throughout many of its most influential players and stakeholders. COP21 was not simply a conference on the BE; it recognised the role that it has played in the production of GHG and has already galvanised the thoughts and actions of some key stakeholders, for instance, the WGBC which is the world's largest organisation influencing green building with 100 plus member countries.

Seyfang and Jordan (2002) argue that the agreements and principles signed at such conferences mentioned above are rarely binding with common criticisms including high cost and providing an illusion that the world is changing. However, these conferences are a source of "soft Law" being the halfway stage in the development of binding legal frameworks, where soft often becomes hard and therefore legally binding.

Following on from Johannesburg the UK government in 2005 published its Sustainable Development Strategy "Securing the Future".

The activities within the BE repeatedly feature in the UK Sustainable Development Strategy including the intention to promote stronger associations with key business sectors. This included the construction sector while recognising the BE's adverse effects. The strategy also states that the government would encourage sectors associated with the BE such as civil engineering, steel fabrication and concrete manufacturers to develop sustainable strategies.

Policies such as the Aggregates Levy introduced in 2002 were arguably a stick incentive in encouraging the economic use of aggregates and promoting

material recycling. According to Seeley (2011), the Aggregates Levy had a direct and positive impact on sustainability within the BE. This resulted in the “Sustainability Fund”, an initiative paid for by the Aggregates Levy. It was proposed that the fund would not support the responsibilities of the quarrying industry but should be directed in promoting sustainability within the BE, including contributions to WRAP, the Countryside Agency and the DTI’s Construction Innovation and Research management programme (Seeley,2011). Although the “Sustainability Fund” was closed in 2011, its success in its aim remains open to debate regarding promoting sustainability to the wider industry, unquestionably much was done at a material level such as the funding of 194 projects, reducing the effects of aggregate extraction and restoring natural habitats (National Archives, 2018).

Securing the Future also considered sustainable communities and a fairer world. This element mostly impacted the social pillar of sustainability where it considered investment to revive communities, tackling such issues as low housing demand and regeneration.

The Bristol Accord was a meeting held in Bristol in December 2005 and took sustainable communities further. The benefits of building sustainable communities were outlined to member states as well as funding through the European Investment Bank where the promotion of skills would be required to maintain a sustainable community, such as technical and administrative skills including leadership (ODPM, 2005).

Further to the theme of communities and construction, in 2016 the Council for Research and Innovation in Buildings (CIB) was formed in 1953. It set up task groups that focused on different areas relevant to the BE, and which were defined as “priority themes”. Sustainable construction was cited as a priority theme and in February 2016, the following task groups (TG) and working commissions (WC) Many were directly relevant to the promotion of sustainability within the BE such as “TG79” Building regulations and control in the face of climate change, “TG, 86” Building healthy cities, “WC80” Prediction of service life of building materials and components and “WC115” Construction

materials stewardship. According to Berardi (2013), after the first international conference in 1995 on sustainable construction, “WC 80” and “WC115” articulated seven principles. These were to reduce resource consumption, reuse resources, recycle resources, protect nature, eliminate toxic materials, apply a life cycle approach, and, focus on quality.

Further to the 1995 conference Berardi (2013) further stated that in 2010 the CIB reinterpreted its vision of sustainable construction, and, reinterpreted the seven principles in line with the BE. These were to:

1. Apply the general principles of sustainability, promoting continual improvement, equity, global thinking and local action, a holistic approach, long-term consideration of precaution and risk, responsibility and transparency
2. Involve all interested parties through a collaborative approach in design construction and maintenance processes so that it can meet occupants needs individually and collectively
3. Be wholly integrated into the relevant local plans and infrastructure, and connect to the existing service networks, urban and suburban grids
4. Be designed from a lifecycle perspective covering planning design construction operation and maintenance, renovation and end of life
5. Have its environmental impact minimised
6. Deliver economic value over time; considering operation maintenance refurbishment and eventual disposal
7. Provide social and cultural value over time, providing a sense of place and integrated into the local culture
8. Be healthy, comfortable and safe, including thermal quality. It must provide safe working conditions
9. It must be user-friendly
10. It must be adaptable in life and have an end of life strategy. (ibid)

Berardi (2013) suggests that this may represent an emerging common vision of sustainability within the BE, a view reinforced by Ferdig (2007), who argued that there exists an “emerging conscience” relating to sustainability. However, the

researcher would maintain the argument that the BE does not appear to be awash with the awareness of sustainability which arguably the CIB's principles were at least in part designed to promote.

A school of Architecture that fits well into the CIB's reinterpreted vision of sustainable construction is that of Adaptive Architecture, illustrating that the BE has an awareness of the concept of sustainable design albeit possibly motivated by economic incentives. According to Hunting. (2010), there are four schools of adaptive architecture, including that already discussed in this chapter, namely vernacular architecture.

The four forms are:

Adaptive re-use: Arguably a school of architecture best suited to an existing building, using it for a purpose other than its intended design. This may include a warehouse that has been converted into domestic dwellings. A well-known example of this form of architecture is the Bankside Power station in South London converted into the Tate Modern. As argued by Murray. (2010) this had a direct benefit to the area and therefore a directly positive effect on the pillars of sustainability, as materials were reused, jobs were created, and, money invested into a depressed area of London.

Figure 2.7 Illustrating adapted former Power station (internal perspective) to Art gallery, the Tate Modern Source e-Architect .com (2016)

Functionally generic As Hunting. (2010) comments there are some forms of structure, which lend themselves to alternative uses without extensive changes in design. As long as their form does not have to change, then physical

adaptation is kept either to a minimum or not undertaken. (ibid), compares this to “sky break architecture”, the provision of a weatherproof cover such as a geodesic dome, under which if it is large enough, parks can be built, crops could be grown, or cities could be built.

One structure is, therefore, allowing for a variety of ultimate uses. It would in effect permit many more forms of human activity within the BE context to occur. Something, which an individual building might require extensive adaptation to achieve. An example of this is the Eden Project in Cornwall.

Functionally generic architecture, when applied to a single building with the sky break reference, will see a building as a collection of permanent structural absolutes, for example, foundations, framing, floors and a roof. All else is temporary, partition walls service ducts, even exterior wall cladding can be removed and replaced with modern composites such as the wide-scale replacement of asbestos cement cladding to flats and council residential accommodation in favour of traditional masonry external skins. The researcher worked in Andover in the early 1990s converting the former asbestos clad 70’s system-built London overspill development called King Arthur’s Way. The concrete framed domestic dwellings were stripped, with only the reinforced concrete frames, party walls, floors, roofs and foundations remaining. All other elements were replaced, and although arguably the use was, like for like, the former and latter structures were only alike in as much as they both shared a common supporting frame. In every other respect, the buildings were different. Building with this level of reuse and adaptability has managed to accommodate the new office form to a higher degree than older buildings particularly in accommodating the infrastructure required to accommodate IT services (Hunting, 2010).

Figure 2.8 Illustrating the former Northern Isles Hotel in Yell, Shetland demonstrating both functionally generic and adaptive system architecture. Source: Google Maps (2016)

Adaptive systems: An example of this form of architecture might be a prefabricated sectional form of construction such as that manufactured by Portacabin, which may be either a single unit or a large number forming a variety of different uses, domestic or commercial.

Natural Capitalism: The four principles of Natural Capitalism direct simple changes and can have a positive effect on protecting the environment, creating awareness as well as making a profit while supporting all the pillars of sustainability. The principles include dramatically increasing the productivity of natural resources, thereby reducing wasteful and destructive resource flows from extraction to end of use, which is achievable through improved technology and production processes, such as whole system design.

The second principle could be compared to the Cradle to Cradle model espoused by McDonough and Braungart, (2002). The idea being that most outputs of an industrial process would either be integrated back into the environment or remanufactured into a superior or equivalent form, Lovins. (2000).

The third principle focused on solution-based models, rather than owning a product, continuous satisfaction is one of quality, utility and performance

(Lovins, 1998). In effect a form of leasing which is part of a circular economy way of thinking. This shift to a “Solutions Economy” according to MacArthur (2012), has benefits for provider and consumer. Many manufacturers have joined the circular economy movement, including Schindler who manufacturer lifts. They are now selling lift services as opposed to selling lift systems.

The final principle is reinvesting in natural capital. This is contingent on restoring, replenishment and replacement of resources where required. Without reinvestment, ecosystem resources will diminish. In a macro context, the economy is wholly dependent on the wellbeing of the environments argued by Juniper (2013). Examples of Natural Capital reinvestment are numerous today, with a well-known toilet paper manufacturer claiming that three trees are planted for every one roll used (Baker, 2012).

So the four principles of Natural Capital are fundamentally based on sustainability through life and if achieved can support all four pillars of sustainability creating a positive effect for the environment and the BE through reuse, remanufacture and recycling of materials.

2.11.2 Environmental Assessment Methodologies (EAMs)

Environmental assessment methodologies (EAMs) are frameworks which have been developed and applied to BE related projects to demonstrate the environmental aspects of the design and construction of a building. Popular EAMS include the Building Research Establishment Environmental Assessment, Methodology (BREEAM). The Leadership in Energy and Environmental Design (LEED), and the Defence Related Environmental Assessment Methodology (DREAM) Environmental building assessment methods contribute significantly to the understanding of the relationship between buildings and the environment (Cole 1998). However, the interaction between building construction and the environment is according to Ding (2008) still largely unknown.

According to the BREEAM (2016), there are 538,200 certified developments with 2,230,600 buildings registered for assessment since its inception in 1990,

in 72 countries. BREEAM has four primary aims that underscore its sustainability direction: To mitigate the life cycle impacts of buildings on the environment. To enable buildings to be recognised according to their environmental benefits. To provide a credible environmental label for buildings and; to stimulate demand for sustainable buildings. (BREEAM, 2011)

BREEAM's purpose is to promote sustainable construction, ensuring that best environmental practice is followed. This should allow organisations to demonstrate that they are adhering to strategic initiatives about sustainability, which arguably became more relevant with the 2015 updates to the ISO 14001 standard. It is obviously up to the organisation to ensure that after they have gone to the trouble and expense of perhaps achieving BREEAM accreditation that the building users are informed and made aware of why this was done.

It should be noted on the latter point that the section in the BREAAM assessment "Innovation", reinforces BREEAM's stated aim to support innovation within the BE. An award given for this element might include additional methods for energy saving or educating its occupants, thus improving their level of awareness of the sustainability aspects of the building that they use. The role of the Facilities Manager (FM) is referred to repeatedly in the BREEAM technical manual, which may illustrate the pivotal role that this sector is seen to have in promoting a sustainable regime within the BE, and also a stakeholder that may have a greater awareness of it.

Leadership in Energy and Environmental Design (LEED) is perhaps the next most used EAM after BREEAM. In 2016 LEED has awarded over 7,000 schemes in 31 countries covering more than 140 km^2 of development.

This LEED rating system was developed by the United States Green Building Council, one of a 100 members of the World Green Building Council. Its founding intention was to ensure that building owners and occupiers acted in an environmentally responsible way, which suggests the greater inclusion of the building users of the EAM's core intention of integrating sustainability within the BE. LEED ratings are achieved over six categories, sustainable sites, water efficiency, energy/atmosphere, materials/resources, indoor environmental

quality, and innovation in designs. Although rewarding “Innovation” is shared with BREEAM, LEED has a broader scope of initiatives to educate and promote awareness of a buildings green credentials to the public, its users, and its owners. This can be achieved in several ways, such as explanatory signage highlighting the features that promote sustainability, for example, energy-saving glass, power regeneration systems and green building materials. Another method of awareness promotion is the publication of a manual that can be accessed by any building user outlining the buildings features promoting sustainable design. Also, an educational outreach program or a guided tour can be conducted focusing on the sustainability features of the building’s design (United States Green Building Council (USGBC), 2010).

The Defence Related Environmental Assessment Methodology (DREAM) tool comprises of four stages survey, design, construction, and operation. A predicted environmental performance assessment rating can be generated and maintained throughout the design process, with the objective of ensuring that environmental considerations are adequately addressed. The operation assessment is required to establish a final rating following the occupation and use of the building for one year.

DREAM is the first tool of its kind designed specifically for the environmental performance assessment of the MoD’s new and refurbished construction projects via the internet. It was designed by Defence Estates Organisation (DEO) Property Directorate for use by Project Managers for construction projects on the MOD estate (MoD, 2011). Although the researcher is unable to discuss DREAM’s effectiveness regarding promoting the awareness of sustainability within the MoD estate, there will be a limited opportunity to investigate this point in the semi-structured interviews. The material difference with this EAM, as opposed to BREEAM and LEED, is that its use is not optional within the MoD purview whereas BREEAM and LEED are not undertaken on all commercial projects.

According to Ding (2008), EAM’s are beneficial in helping us to understand the interaction between the BE and the environment, but they have limitations in

use especially in assessing environmental performance and therefore arguably limited to furthering sustainability within the BE. However, that said LEED's "innovation" category does proactively attempt to promote awareness of sustainability within the BE.

Despite the widespread use of the LEED, its critics have been vocal, for example, a study of 953 office buildings was undertaken in New York City, 21 of the LEED-certified buildings showed no indications of energy savings compared to buildings that had received no LEED ratings (Schofield, 2013). LEED certification is based on computer modelling as opposed to actual real-life figures. This has led to concerns that the LEED may not accurately assess the efficiency of a building and therefore its sustainability rating. On that point USGBC made the following unfortunate and well observed used quotation.

"Buildings have a poor track record for performing as predicted during design" (USGBC, 2007).

However, LEED is starting to appear as the choice EAM in the UK's construction industry (Aspinal, Seryesilisk, Sourani, Tunstall. 2012). BREEAM requires external assessment whereas LEED encourages greater participation and training, which it might be argued is consistent with their "Innovation" award rewarding education of the building users, creating a level of awareness of sustainability. According to the United States Green Building Council (USGB, 2018), there are 202,000.

According to Aspinal et al. (2012) who conducted a survey relating to the effectiveness of BREEAM, some criticisms were levied against the world's oldest EAM. All of the respondents agreed that only one aspect of sustainability was considered within the BREEAM assessment. This being the environmental impact of buildings. Therefore, economic and social aspects were inadequately covered, also the cost of a BREEAM assessment could be very high. It could be argued that BREEAM started out as an environmental assessment methodology and has remained close to those ideals

However as Ding (2008) argues, EAM's are beneficial in helping to understand the interaction between the BE and the environment, but they have limitations in use when assessing environmental performance and therefore limited to furthering sustainability or promoting awareness within the BE.

EAMs can be particularly complex. There can be complications when considering regional and cultural differences that an EAM may not account for; (Ding, 2008), requirements which can be a primary driver or barrier to a project. In which case a valid question might be how sustainability can be considered when at least two of its pillars may not be considered. A project may score maximum credits and yet be far too expensive to build, again defeating the premise of sustainability.

Although the effectiveness of EAMS generally is not a heavily discussed topic in this thesis, the researcher would have to question how well they are understood at all levels by the company using one. EAMs are designed to promote sustainability within the BE, therefore the researcher has to question how far that is that being achieved. If many of a company's employees simply hear the word tied to the project, they may not have an awareness of what it is really trying to achieve, in which case much of the EAMs effectiveness in promoting sustainability within the BE, is being lost. A point that will be considered in the surveys

2.11.3 Building Information Modelling (BIM)

According to HM Government (2015), BIM is the first truly global digital construction technology; they argue that it will be deployed in every corner of the planet and it is a true "game changer".

Essentially BIM is a software package which builds 3D models holding an enormous quantity of data relative to the BE.

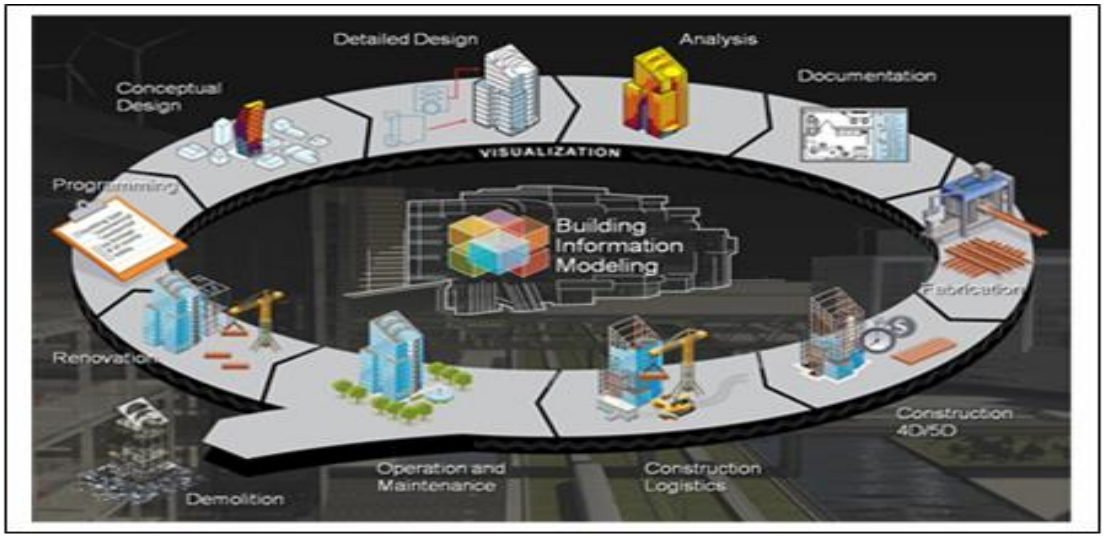

Figure 2.9 Illustrating a visualisation of the core capabilities of a BIM system. Source: Calvert (2016)

There are several maturity levels of BIM that exist and are in operation, with more being developed, in précis these are:

Level 0 Unmanaged computer-aided design (CAD); Level 1 includes managed CAD systems, a more developed and advanced software system than level 0. Level 2, might be considered a 3D managed environment (Designing Buildings, 2015), as it can include data relevant to the BE and the particular context that the model is being used for such as built drawings, visualisations maintenance specifications. Level 3, according to the NBS (2013), is the “Holy Grail” of BIM or Integrated BIM is the Holy Grail of BIM capabilities. It represents a fully collaborative effort of all the disciplines and offers a fully comprehensive model. It is known as “Open BIM”. The government’s target date for its implementation is 2019; however, arguments against its implementation centre on copyright and liability risks (NBS, 2013). According to Livingstone (2012), both GIS and BIM have a great deal to offer, regarding operating the BE, arguments are inconclusive with seemingly equal numbers for and against.

Any software system that can track inventories and catalogue the materials of the BE can offer distinct advantages in the promotion of sustainability awareness within the BE. Both GIS and BIM would seem to be able to offer this, Although Livingstone sees the possibility of a harmonious convergence of the

two systems, a respondent to her blog (Livingstone, 2012) disagreed and furthermore argued that GIS is less supportive of sustainability (Barry J, 2012, blog respondent to Livingstone, 2012).

A criticism of BIM has been the cost, its use in the UK Government's estate is mandatory and is arguably a positive thing for the consideration of sustainability in the BE. Shepherd (2015) states that 76% of UK architectural practices consists of 10 or fewer fee earning staff, using a BIM system can, therefore, be disproportionately expensive with a typical cost of £4,000.00 per licence. Despite the cost, three principal drivers encourage SMEs to adopt and obtain the technology, these being client pressure, government pressure and competitive pressure. This will be explored in the methodology.

Shepherd (2015) argued against his detractors who believed that BIM was too expensive for smaller companies who seem to make up the majority of architectural practices and that the benefits of 3D design are not worth the outlay. His arguments were based on the transition of technology in the last 30 years from the use of the drawing board to software systems like BIM. Shepherd (2015) concedes, however, that BIM has still to evolve.

In real-world applications, BIM would seem to be well utilised. The question remains if its use can be spread to the majority of stakeholders and thereby have a material effect on the sustainability agenda within the BE or whether barriers such as cost and ease of use defeat its wide-scale implementation. Shepherd (2015) argues that it is possible that small-scale SMEs can use BIM; if so that could potentially have a positive outcome on the global sustainability agenda.

Information technology can promote sustainability within the BE, particularly if it is a system such as BIM. BIM is ideally suited to the delivery of information needed for improved design and building performance, the two most significant benefits of BIM for sustainable building design are integrated project delivery and design optimization (Kam, 2013).

BIM has the potential to provide its user with a very broad spectrum of information that can positively influence the promotion of awareness of sustainability within the BE, particularly for those stakeholders whose activities impact on the environment. This does not guarantee improved sustainability awareness. All levels and all stakeholders within the BE regardless of whether they can directly influence the design of a project and through life stages, should still be sustainably aware. Sheth and Malsane (2014) argue that the continued development of BIM is an important part of complementing the sustainability agenda and should be considered a priority.

According to Oke et al. (2016), there is a low-level adoption of BIM systems, and despite many organisations being aware of it, barriers to its use include complexity and cost. Because of its site / project-based nature, BIM has limited use regarding the research aim. However, the researcher believes that it is an indication of how technology is shaping the future of sustainability in the BE and that barriers such as complexity and cost need to be tackled for a system that actively promotes sustainability awareness to be accepted, and of course used.

With 47% of the world having access to the internet (internetlivestats, 2018), information technology, aids are the logical tools to promote sustainability to a wider audience, in a way that systems such as BIM cannot. However, BIM is a building management tool and not an awareness support system, which the research aim is looking to develop (SIR).

2.11.4 Initiatives, Non-Government Organisations (NGO’s) and policies

The UK government during this time launched several initiatives and policies relating to sustainability and the BE. A Strategy for Sustainable Construction (SSC) was published in 2008 According to the SSC (2008), the construction sector was then worth approximately 8% of the UK’s gross domestic product (GDP) employing three million people. Furthermore, the SSC stated that this industrial sector will significantly influence the UK's ability to maintain a sustainable economy and that the BE and construction will play a central role in promoting sustainable growth and development. As previously stated the BE

plays a significant global role in the production of GHG emissions which is a significant cause of anthropogenically caused climate change (Oreskes, 2004). The reason behind the SSC report was to clarify and promote the government's position on sustainability within the BE, and its associated sectors, because the size of this sector and its influence on GHG emission generation is significant, and logically, therefore, its influence could be equally significant in reducing emissions.

The SSC (2008) published several targets headed the "Means" and the "Ends" which were related to the BE. The "Means" included a target of creating sustainable procurement chains, recognising the vital importance of sustainable supply chains. Another target was design, arguing that good design was synonymous with sustainable design. The broad objective was to ensure that design allowed for material efficiency, energy efficiency, and, sustainable, resilient building construction design. One of the deliverables from this element was to achieve BREEAM accreditation for new build and refurbishment works for the BE.

"The Ends" outlined in the report, were the anticipated benefits of the strategy such as achieving a decrease in CO_2 production by 2020, achieving a degree of climate change resilience in the construction sector, and, futureproofing designs, such as flood protection. According to Smith (2016), human-induced climate change increased the risk of severe storms like those that hit the south of England in the winter of 2013/14, causing devastating flooding, particularly to the Somerset levels. The report recognised that green infrastructure has a significant role to play in making new developments resilient against environmental impacts. Many of the actions were placed on DEFRA as a government department, for example, a review of the UK Risk assessments and production of a national programme on adaptation. The actions for the waste and materials targets were relatively short-term and included actions such as developing guidance for waste reduction for small builders, the formal launch of the Construction Waste Commitment strategy which established a target for the

diversion of demolition waste from landfill, and, a 20% reduction in construction packaging waste which would aid sustainability within the BE.

The SSC 2008 strategy furthered initiatives, such as “Construction 2025”, which was a joint strategy published in 2013 by the UK Government and built on the SSC 2008 report. Construction 2025 had three ambitious aims:

1. 33% reduction on construction costs over the construction full life of the asset 50% reduction in the time from inception to completion
2. 52% Lower emissions of Greenhouse Gases
3. 50% reduction in the trade gap between exports and imports for construction products and materials (UK Government, 2013)

NGO’s promoting sustainability in the BE The role of the government in promoting sustainability within the BE cannot be underestimated, arguably their most powerful tool being legislation, according to the CIOB (2010), a lower carbon future is now a matter of legal obligation with an 80% reduction in the UK’s CO_2 emissions required by 2050.

Outside of the Government there are a great many organisations that work at local, national and global levels, to promote sustainability within the BE some of which have already been outlined, and have influenced the promotion of awareness of sustainability both within and out with the BE.

The World Green Building Council (WGBC) The WGBC formed in 2002 is the largest international organisation influencing the BE (WGBC, 2016), and it is exclusive to the BE.

The WGBC’s stated aim is to ensure that local green actions are supported with a larger mandate to tackle issues such as climate change. The WGBC’s view appears to be global in its scope and has set up a large number of initiatives, which are promoted through the 100 plus members organisations, the United Kingdom Green Building Council being but one. These initiatives include he sustainable cities initiative, where the WGBC encourages its member organisations to forge strong links with local Governments to promote and work

towards more sustainably based cities through collaboration with other like-minded organisations.

Perhaps in testament to the influence and prestige of the WGBC, it should be noted that in April 2018 China's own Green Building Council officially partnered with the WGBC. This was hailed as "hugely significant", especially considering that China has the largest building construction market in the world, with approximately 2 billion m2 of new construction every year (Businessgreen.com, 2018).

The Institute of Environmental Management and Assessment (IEMA) With approximately 15,000 members IEMA is perhaps the world's largest professional body geared towards environmental practitioners. Their agenda is a broad one and centres on promoting sustainability with governments, professions and business leaders. Although IEMA is not solely dedicated to sustainability within the BE, it could be argued that they recognise the BE's relevance. For example, they run a course on environmental management in construction as well as environmental legislation and environmental awareness courses.

Ellen MacArthur Foundation. The Foundation champions the promotion of the circular economy, which was originally pioneered by Walter Stahel. The Foundation has been very active in promoting the circular economy, and the sustainable agenda including the publication of the report entitled "Towards the circular economy", which quantified the value of the circular economy potential in Europe at $630 billion (MacArthur Foundation, 2018). Of note to the BE is the MacArthur Foundation's recent partnership with the engineering firm Arup, who employ 13,000 people and operate in 35 countries. According to Schofield (2016), it is the Foundation's intention to work with Arup to develop circular economy principles for four key areas of Arup's operations, namely cities, transport, energy and water which all impact on the BE.

Waste and Resources Action Program (WRAP) A final example of an NGO promoting sustainability in the BE is WRAP. They are a UK charity established in 2000 with a goal of helping businesses and communities relate to the circular economy through waste reduction and the development of sustainability-biased products.

Figure 2.10 Illustrating the Circular economy. Source: WRAP (2016)

According to WRAP (2016), the construction sector has 800 companies committed to reducing waste, which has meant that 4 million tons of waste have been diverted from landfill. This has culminated in savings of £400 million according to WRAP (2016) which has contributed to sustainability in the BE.

2.12 Real-world Examples of Sustainability in the Built Environment (BE)

Willmot Dixon is a UK based construction company with a wide range of services, including commercial and residential construction and maintenance. Although it could be said that there are a number of peers in the country regarding activity base and turnover, the company arguably unusually has a very strong sustainability ethos, which permeates through the entire organisation. The company's initiatives would seem to comprehensively cover the fours pillars of sustainability. These include social investment programmes,

investing in local communities, and local procurement policies. Willmot Dixon cite that they are a carbon neutral contractor and have an in-house sustainability team (Willmott Dixon, 2016). Furthermore, the company works in association with IEMA to validate their internal courses geared towards sustainability in the BE.

Although there are almost certainly many likeminded contractors elsewhere in the UK and globally, it could be argued that from a holistic viewpoint Willmot Dixon is the exception that proves the rule. That rule being the trend that the researcher has observed relating to the relative lack of awareness of sustainability in the BE. Willmot Dixon has a sustainability ethos running through it at every level of the employee strata (Wilmott Dixon, 2016). Sustainability is showcased and promoted through the supply chain where it can trace down various tiers to identify where building materials are sourced. Examples include: Polyflor who promote and practice sustainability within the BE through the introduction of products that are environmentally consistent with their intended use by providing a high level of durability, reliability, ease of maintenance and safe disposal at end of life, compliance with the circular economy principles and importantly, raising awareness through regular communication with stakeholders.

The Pacific Steel group (PSG) is another supplier with a similar ethos. It imposes stringent water and energy consumption controls. The company is New Zealand's largest user of recycled steel which includes the annual recycling of 90,000 car bodies, which are reused for their product line, including steel for the BE (Beveridge, 2004). The company would seem to have strong sustainability credentials, which include sponsoring local events and prioritising the health and safety of its 300 employees (Beveridge, 2004); in effect, this company promotes awareness of what it does and why it does it to its workers and the surrounding community, displaying a positive impact on the four pillars of sustainability.

Many construction materials are inherently sustainable because they are hardwearing and relatively easy to reprocess. An example of this is one of the

world's most used construction materials, concrete. As alluded to in Chapter 1 the BE is responsible for immense quantities of waste which are often not recycled. However, according to the Concrete Centre (2016), it is increasingly being recycled, in the UK and recycled aggregates account for 28% of the market (The Concrete Centre, 2016). This material is used in the sub-base layer of concrete slabs, in roadways and runways including runways at Heathrow Airport and the M6 toll road (The Concrete Centre, 2016).

Similarly, to the other cited examples in this chapter of sustainability in the real world, there are larger examples ably illustrating the practice of sustainability within the BE. This includes the London Olympic Venue of 2012, which was one of the largest construction projects that have been undertaken in the UK, and particularly, one where sustainability was a major consideration. Sustainability was an overriding central theme, unprecedented for a project of this size. According to the UKGBC (2012), the number of targets for sustainable construction was met and exceeded. This included the Velodrome which achieved a 31% reduction in carbon emissions over the 2006 building regulations requirements, where 85,000 tonnes of embodied carbon were saved with efficient building design, and 98.5% of demolition waste was recycled or reused for further use in the BE. This project was vast in its scope with ambitious sustainability-driven goals; it was indeed known by the researcher who both visited it and read a great deal about it, from sources such as professional body magazines. Knowledge of the project should, therefore, be well known with the BE stakeholders in general particularly in the UK, a point that the researcher will test in the Main Survey.

Sustainability reporting (SR) and the BE Further to examples of sustainable initiatives in companies, reporting was introduced in the 1980's where a small number of companies started to consider the impacts of their products and services through life, which aligned to the fourth principle of natural capital. Since then the principle of SR has moved to integrated reporting. (Global Reporting Initiative (GRI), 2016), although many organisations are only partially reporting annually. As outlined by Confino (2014), the Canadian investment advisory company Corporate Knights Capital claimed that 97% of companies

failed to publish sustainability indicators, for example, employee churn, GHG emissions, waste generation, recycling figures, energy use, and, water use. This is a concern for the BE which contributes significantly to GHG emissions and ultimately as a large producer should be expected to reduce its impact.

In 2014, 60% of the world's largest listed companies including many associated with the BE consistently failed to disclose their GHG emissions, with approximately 75% not disclosing water consumption, and 88% not revealing employee churn rates (Confino, 2014). These figures include some of the world's largest construction companies and many others active within the BE's other sectors. The reasons behind these negative trends are unclear. However, it is apparent that for whatever barriers exist the opportunity for transparency and an integrated sustainable regime are not being capitalised on. An example of where this is taking place is Holcim, a Swiss-based global supplier of cement and aggregates. David Kingma the Sustainable Development Reporting Coordination Manager for Holcim stated, "the discipline of setting and monitoring targets focuses the organisation in allocating resources in meaningful areas ensuring that effective structures are in place to drive the triple bottom line agenda." (GRI), 2011),

One aspect of sustainability reporting is the management of the environment, which came to the fore when the International Standards Organisation (ISO) introduced ISO 14000 and 14001[8] in 1996 and 2004. These environmental management standards were formally adopted as a basis for many corporate systems.

According to Shankleman (2014), the increase in ISO 14001 certificates rose markedly between 2010 – 2013. ISO 14001 is in an international environmental management standard in which many companies globally are accredited including those within the BE.

[8] ISO 14001 was updated in 2015.

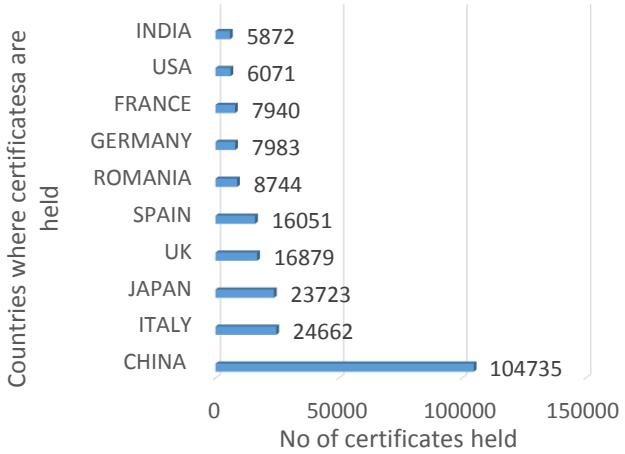

Figure 2.11 Illustrating no of ISO14001 certificates held in 2013 according to the country, Source: business green.com adapted by Harrop (2016)

Companies holding ISO14001 accreditation may demonstrate their commitment to sustainability in a number of ways, i.e. energy efficiency, reducing waste and raising environmental awareness. Arguably, one of the better known is to publish a sustainability policy. Although different from environmental policy, they are not mutually exclusive and often form part of the same set of documentation.

Similarly, and arguably far more frequently held, is an environmental policy, particularly in those companies that hold the ISO 14001 accreditation but more frequently companies that do not have this accreditation also have them.

Further to embedding sustainability in companies whether through the implementation of international standards such as ISO14001 or a company environmental policy, Herron et al. (2013) state that critical gaps remain in environmental awareness when considering how companies operate, the types of environments in which they operate and the materials they produce. Olivier et al. (2016), state the production of materials such as cement and steel are global indicators of national construction activity, and that the emissions produced from production are key to greenhouse gas mitigation. CO_2 emissions from cement production are a significant greenhouse gas producer and make up the largest sources of CO_2 from industrial manufacturing, which in 2014

accounted for 4.1% of global emissions (Ibid). With this in mind Olivier et al. (2016) note that the BE could help mitigate the production of greenhouse gas emissions if they considered production processes used with more consideration of the environmental impacts. The BE contributes approximately 50% of the UK's CO_2 emissions from the burning of fossil fuel in the construction and operation of buildings, with figures of 30% contributing to global CO_2 emissions (UNEP, 2012). Further to emissions, according to UNEP (2012) it is difficult to determine the cumulative raw material requirements consumed by the BE, although it is estimated that the construction industry globally is responsible for more than three billion tonnes of raw material extraction (UNEP, 2012), which equates to 70% of the total raw materials extracted (Berardi, 2013).

Before the operation and maintenance phase of a facilities life and the resulting CO_2 produced, a company should be addressing the through-life requirements at the feasibility stage of a BE project according to Tolson (2008). Tolson (2008) argues that the concept of sustainability has to be given an explicit purpose associated with the project and its environment and that the through-life aspects of building materials such as steel with its high reprocessing potential, or timber from sustainable sources should be considered through life. He also goes on to say that stakeholders should be active participants in the sustainable agenda driving a project. Shaika (2014) also argues that sustainability within an organisation is influenced by stakeholders and suggests their knowledge is particularly important as they are the principal decision makers influencing sustainable practices within the BE. Hibberd (2009) argued that most of a project's cost is determined at the initial stages of design and that the procurement stakeholder may have considerable influence in determining sustainability provisions in contracts. Tolson (2009) predicts that in the future, even a well-intentioned commercial sector may not be able to achieve sustainability within and without the BE and must move away from the "cradle to grave" model.

The Natural Step (TNS) (2016) cite that everything starts with awareness, which they believe to be lacking in the BE sector. They argue that for sustainability to be understood, it must be defined and based on through-life considerations of a company.

Awareness starts with education, a point reinforced by the views of Ullah et al. (2013), who strongly believe that education is the key to environmental awareness. It is evident that many organisations such as TNS and all those who work hard to promote it still have reason to believe that a gap exists in sustainability awareness.

2.13 Summary

One of the prime reasons for the practice of sustainability in companies is to combat climate change. We are witnessing a shifting paradigm in company practices to support sustainability and the circular economy. From a global perspective the, defining mega conferences such as Rio 1992, Johannesburg (2002) and the COP 21 in Paris (2015), all served to try and raise awareness, while also confirming that the BE was a major contributor to greenhouse gas emissions and ultimately climate change.

Despite this, there remains a significant barrier, one that inhibits sustainability from being universally embraced within the BE. This barrier seems pivotal and once removed, could have a positive effect on other barriers that impede the universal acceptance of a sustainable regime within the BE. This barrier has been evident throughout the chapter albeit in various forms, starting with the barriers of ignorance and self-interest encountered by Rachael Carson (1907-1964), who arguably managed to both expose and overcome them. Organisations, such as Greenpeace, fought to raise awareness in the public arena, have been successful.

Why then, considering all that has been discussed in this chapter does the researcher believe that a lack of sustainability awareness exists among stakeholders in the BE. As discussed in this chapter much is being done to promote sustainability within the BE. However, questions can be asked as to

why the Green Building Council have councils in only 70 countries when there are 196 countries in the world? Why is it that not every company has signed up to the United Nations Global Compact or the CDP? Why doesn't every company use Triple Bottom Line accounting or be part of the circular economy movement? Why is it that not every listed company is signed onto the DJSI? Why is it that there is no overarching umbrella legislation for sustainability within the BE. Why is it that a senior Government Minister did not seem to fully understand the relationship between the economy and the environment? Finally and perhaps most perplexing, is when history has already taught us the lesson that not acting in a logical, sustainable manner has disastrous consequences. This latter point was ably illustrated on Easter Island, outlined earlier in this chapter, which as argued by Pakandam (2009) was due to a lack of awareness, and yet we still do not perform in a global unified, sustainable manner.

There are precedents for unified human action; an obvious one would be World War Two. Within the BE there are smaller examples of this, albeit successful ones, such as the rebuilding of a small town called Greenburg in Kansas USA which was all but decimated in 2007 by an F5 tornado. Greensburg, the town was rebuilt according to sustainable principles with the highest number of LEED-certified buildings per capita, in the world; sustainability awareness is a concept understood by all of the town's residents, (Quinn, 2013). The researcher believes that there is a general lack of awareness of sustainability with the stakeholders of the BE, and this is of consequence because it may be the barrier preventing a unified approach to sustainability within the BE. It is this lack of awareness that the researcher intends to explore through the methodology, with the aim of developing the Sustainable Infrastructure tool (SIR) to aid this lack of awareness.

3 BARRIERS AND DRIVERS INFLUENCING SUSTAINABILITY WITHIN THE BUILT ENVIRONMENT

3.1 Introduction

Chapter 2 illustrated that there are variables which influence the level of awareness and the practice of sustainability within the BE. These variables for this thesis will be referred to as “barriers” and “drivers”. They have the effect of either impeding or encouraging the implementation of sustainability in the BE. They can be interrelated and interdependent. Understanding the barriers and drivers that influence sustainability within the BE will have a marked influence on the research aim; the development of the SIR.

The following table provides examples of the barriers and drivers that were largly distilled from Chapter 2:

DRIVERS	BARRIERS
Green company image	Investment
Adherence to legislation	Lack of organisational / management interest
Sustainable building materials	Lack of customer interest
Sustainable sourcing	Lack of training
Planning	Lack of interest from employees
Senior management leadership	Lack of legislative guidance
Increased rental income from green buildings	Lack of applicable IT Aids
Client pressure	
The Triple Bottom Line	
Increased revenue and market share	
Reduced energy expenses	
Reduced waste expenses	
Increased employee productivity	
Pressure from employees	

Table 3.1 Illustrating Barriers and Drivers affecting Sustainability within the BE. Source: Harrop (2017)

3.2 Drivers

3.2.1 Driver definition

“Something that creates and fuels activity, or gives force or impetus” (Collins, 2014)

In this context, a driver is a variable that can influence the implementation of sustainability within the BE. Examination of these drivers can in part help to answer the research question and influence the development of the research aim.

3.2.2 Driver Importance

As the definition states, the driver creates and fuels activity, without a driver arguably a thing will not happen, or making it happen will be far harder to achieve. The importance of drivers in sustainability has been increasing for a number of years, a point illustrated in the BIFM survey results in Figure 3.1, most of the drivers in Table 3.1 were outlined in the literature review and will be further discussed in this chapter.

Figure 3.1 Illustrating the increase in the importance of Sustainability Drivers within FM Source: BIFM (2015)

3.2.3 Green company image

The importance of green company image as a driver resonates throughout Chapter 2, and according to Schaltegger and Hörisch (2015), this is an important driver (in addition to profit) for the integration of sustainability in a company, and arguably perhaps, the most important driver.

Chapter 2 outlined the drive to achieve a green company image through a number of ways. This includes membership of a recognised “best in class” sustainability index - the DJSI (Robinson et al., 2011) joining the World Green Building Council and signing onto the UN Global Compact.

According to the BIFM (2015), the protection of corporate reputation has been one of the main drivers behind the sustainability agenda. Salleh (2013) states that “risk to reputation” is recognised as a concept and further points out that a company’s reputation can affect customer loyalty, which can cause significant damage to a company if the reputation is negative. There is growing evidence that environmental consideration is one area where a company’s reputation can be damaged. The Volkswagen (VW) emissions scandal in 2015, was a deliberate attempt to defraud its customers over the environmental credentials of its products (Isidore & Gordon, 2016), by using rigged software to falsify emission test results. News of the VW issue spread quickly across the globe and caused a 40% drop in the value of VW shares within a week (Jopson,Magee & Cambell, 2016). Shortly after the Which magazine, in the UK conducted a survey in 2015 which suggested that 86% of VW drivers were concerned about the vehicles environmental impact, and more than 50% stated that they would not buy a VW diesel car in the future (Ruddick, 2015). However, Ruddick (2015) does not clarify if this was due to the scandal or another reason, the Financial Times (2015) noted a drop in share price due to a lack of investor and consumer confidence, or perhaps put another way a reaction to the new and heightened awareness of their customers, over VW’s apparent dishonesty.

Within the BE, reputational damage can be detrimental to a company. In 1983 the Granada World in Action television programme exposed significant flaws in Timber Frame construction, including condensation. The building company in

the firing line at the time was Barratt Homes, a high-volume house builder. According to Smit (2003), this negative publicity reduced high demand for timber frames. Barratt Homes, rather than avoid further reputational damage, switched construction method to a traditional base (brick and block cavity construction), which would have required a massive shift in the companies organisation and colossal reinvestment.

The researcher's personal experience at the time was that the Barratt name became synonymous with poor design and substandard workmanship and that this translated directly and almost immediately into a lack of confidence in the housing market. The material point is that public awareness once raised can have a powerful positive or negative influence on an organisation's reputation and public image.

It is becoming increasingly important that a company has a green corporate image (BIFM, 2015). To extend that point, being associated with companies are known for having poor ecological standing can end up being detrimental for a business (Schutte, 2013). Schutte (2013) cites an example of the supermarket chain Waitrose wishing to expand a partnership with Shell, who had recently suffered adverse public reactions from their aborted attempts to drill for oil in the Arctic. Spector (2012), argues that fostering positive consumer relations through sustainable initiatives, and creating awareness among potential clients, generates new revenue opportunities. Although the researcher agrees with this, it should be noted that Spector's (2012) opinion, though valid, may not be quite so "cause and effect" in the commercial world. An example is an SME which often have limited risk capital and limited awareness of sustainability. The combination of these demonstrates that many barriers are connected.

3.2.4 Compliance with legislation

Chapter 2 highlighted the close links between BE related legislation and sustainability, although it can be argued there is little primary legislation regarding sustainability in the BE (Tolson, 2007).

There exists, however, an immense amount of legislation that impacts on the four pillars of sustainability as discussed in the literature review. This legislation focuses on waste, energy use and CO_2 emissions all of which impact on the economic and environmental pillars, and those related to the social pillar such as the Health and Social Care Act 2012 According to the Advisory, Concilliation and Arbitration Service (ACAS) (2018) Legally, employers must comply with relevant health, safety and employment law, as well as common law, a duty of care. They also have a moral and ethical duty not to cause, or fail to prevent physical or psychological injury and must fulfil their responsibilities about personal injury and negligence claims.

It is contrary to most company policies and codes of conduct to break the law, to do so would attract large fines, possible custodial prison sentences and reputational damage. The BE is no different and is affected by an immense array of legislative requirements including health, safety and environmental legislation. Therefore in addition to legislation being a stick, it may also be considered a driver is promoting sustainability within the BE as a statutory compliance requirement. The existing sustainability-related legislative framework within the BE was explored in Chapter 2, and as outlined there is no bespoke umbrella act centring on sustainability.

Legislation is a driver within the BE because it impacts heavily on a number of areas where sustainability and the BE are interconnected such as:

a. Waste management (Disposal, including the landfill tax)
b. The Waste Framework Directive (WFD 08/09) (2008/2009EC) (revised in England and Wales in 2011) became relevant in 2008; Article 40 required EU countries to activate the regulations and laws to comply with its edicts by 2010. It is a driver and promotes sustainability within the BE

in that it requires the UK to formulate and encourage waste prevention initiatives, setting targets such as those for recycling / reusing 70% of all C&D waste by 2020.

c. The Duty of Care Regulations impose a legal duty of care on companies (not exclusive to the BE) relating to any generated waste. The duty has a wide application and is imposed on any organisation that transports, stores, imports, or treats controlled waste. Controlled waste is defined as commercial industrial or household wastes which includes hazardous and special wastes (Steel construction 2016)
d. The Hazardous Special Waste Regulations, the Landfill Tax and Aggregate levies in similar vein impose duties and fiscal incentives respectively that are outlined in Chapter 4 and impact on the BE from design, construction and final disposal.

As drivers the legislation above would seem to be influential, ensuring that companies behave in a manner consistent with a sustainable regime. Although it was argued by Tolson (2009), that there is a legislative bias towards the environmental pillar. According, to Tedorescu, (2015) sustainability is a multi-dimensional concept and an indissoluble relationship existing between the pillars. Furthermore, Tedorescu (2015) does not refer to the 4th pillar “culture”. Allowing for the interrelationship between the pillars provides benefits for the BE. In BE terms an example includes the reprocessing of demolition waste to be reused as hard-core, which saves the contractor financially through reusing the material and avoiding landfill tax for disposal which will benefit the business and its employees.

Legislation may impact directly and indirectly on sustainability within the BE; however although compliance with legislation may create awareness of the topic such as those outlined above, the researcher would argue it may not have the same effect, i.e. creating an industry-wide promotion of awareness of sustainability within the BE. This will be explored in the surveys and interviews.

3.2.5 Sustainable Building Materials

Closed-loop production was discussed in Chapter 2 in the context of the "material domain" (Ben-Eli, 2012), Walter Stahel's closed loop ethos, BREAAM award credits, and, the rebuilding of the city of Greensburg in the USA.

Tools which can be applied to closed loop production also promote the use of sustainable building materials for example, the "Green Guide to Specification" an IMPACT tool produced by the BRE; others include the PHAROS projects database which identifies dangerous chemicals typically found in construction materials and BREEAM assessment award credits if, sustainable materials are used.

At the time of completing this thesis (2018), there is little primary legislation dictating the use of sustainably based materials in the UK. However, it does exist albeit in a limited context such as the European ban on the import and sale of timber obtained through illegal logging (Murray, 2010). It may also be argued that the ban of certain materials, such as asbestos and lead in paint, may be considered sustainability-related, from a social (health and safety) perspective. It is possible this position will improve, particularly with the growing awareness of embodied carbon in building materials (Steel construction, 2016) linked to carbon footprinting. As outlined in the introduction of this chapter, drivers and barriers are interconnected, and in this context, a company's green image may increase if it is known they use sustainable materials and have a stable supply chain with strong sustainability credentials.

This is a driver that may enhance profit and encourage repeat custom and ultimately promote awareness of sustainability within the BE to contractor and client alike. The more that recycled materials are used, the more these effects will become noticeable, including driving cost down through economies of scale.

The researcher would argue that increased awareness towards the promotion of recycled and recyclable materials is required, and although use is rewarded in BREEAM and LEED accreditations, there is no legislative requirement for a minimum percentage of components to use recyclable materials, or a

requirement stating that materials should come from sustainable sources in the supply chain. If materials from a sustainable source were defined in the specification of a construction project, as argued by Tolson (2009), this would ensure that sustainable construction materials were used.

The researcher has to question how often this is considered at the pre-planning meeting of a construction project; in his experience, not often. Reasons for this might include that stakeholders lack awareness of such projects or a perception on cost, or procurement channels had simply not considered this option; again possibly through lack of awareness of the options, a point reinforced by Rowley (2016) who cites that over half the British public are unaware that sustainable and ethical financial products exist. This will be explored in the surveys and interviews and may translate to a similar lack of awareness in the BE regarding building materials which are considered “sustainable”.

3.2.6 Sustainable sourcing

As other drivers increase in importance and promote sustainability, the integrated relationship between the drivers becomes more apparent. Using materials with sustainable credentials suggests that companies will procure from concurring suppliers, which might underline a previous point that the procurement stakeholder may have an influential role to play in sustainability within the BE.

There are two standards related to sustainable procurement, the BRE standard BES 6001, (The responsible sourcing of construction materials (BSI, 2016) and BS 8902 (2009) a responsible sourcing sector certification scheme for construction products certification (BSI, 2016). Nidumolu, Prahalad.& Rangaswami. (2009) argue that once companies have learnt to keep pace with regulation, they become more proactive about environmental issues, and further argue that these companies then focus on reducing the consumption of non-renewable resources, citing coal and petroleum as examples. The researcher would strongly argue that this is not often the case in the BE sector and that legislation is adhered to because of the potential penalties and reputation to the company.

Sustainable supply chains can influence decision making and purchasing power of many larger companies as evidenced by Unilever's declaration, as one of the world's largest consumers of palm oil, (Nidumolu etal., 2009) that this product would be sourced sustainably by 2015. This date, according to Lucas (2012), has moved back to 2020 as Unilever came under attack for relying on achieving this by using offsetting certificates. However, it seems evident that the importance of sustainable sourcing was evident to Unilever and other companies who have followed, because of widespread well-publicised concerns about the destruction of rainforests and wetlands to accommodate these crops (Nidumolu et al., 2009).

Shaika (2015) argues that the level of awareness and level of implementation are closely linked and that the effort put into action and adoption towards the concept of sustainability and green building application depends on awareness and knowledge. The researcher would concur with Shaika's (2015) stance. Awareness of sustainability in the BE would provide an insight not only into its relevance to stakeholders but also the benefits to the organisation's bottom line, and that alone might be incentive enough to pursue sustainability. A firm way of doing that is to ensure that supply chains are as sustainable as possible.

3.2.7 Planning

The National Planning Policy Framework (2014) as outlined in Chapter 2 highlights the impact on the pillars of sustainability.

Arguably, planning is an important driver in promoting sustainability within the BE. If a project is not approved, in theory, it should not get built. Therefore if sustainability legislation existed, no project large or small that required planning could avoid compliance with explicit sustainable directives. However as previously discussed Acts such as those outlined in s3.2.4 have an impact on sustainability regarding the economic and environmental pillars, for example, waste generation and waste streams.

The purpose of the planning system is to contribute to the achievement of sustainable development (HM Govt, 2016). According to HM Govt (2016) as illustrated in table 3.2, planning guidance can positively influence three of the pillars of sustainability:

Economic	*Contributing to building a robust, responsive and competitive economy, by ensuring that enough land of the right type is available in the right places and at the right time to support growth and innovation; and by identifying and coordinating development requirements, including the provision of infrastructure*
Social	*Supporting robust, vibrant and healthy communities, by providing the supply of housing required to meet the needs of present and future generations; and by creating a high quality-built environment, with accessible local services that reflect the community's needs and support its health, social and cultural well-being*
Environmental	*Contributing to protecting and enhancing our natural, built and historic environment; and, as part of this, helping to improve biodiversity, use natural resources prudently, minimise waste and pollution, and mitigate and adapt to climate change including moving to a low carbon economy*

Table 3.2 Illustrating the roles of planning outlining the driver function for sustainability Source: Planning Guidance HM Govt. Adapted by Harrop (2015)

Hawkes (2001) argues the importance of the fourth pillar "Cultural" and its place in public planning. Hawkes (2001) cites that society's values are the basis upon which all else is built. Culture contributes to a sustainable BE through the protection of historic buildings, sustainable urban retrofit schemes, regeneration programmes, sustainable architecture and smart/sustainable cities. However, Opoku et al. (2015) state that "Planning" is a legislative tool, and when (or if) primary BE related sustainability legislation is introduced to implement sustainability in the BE, greater awareness will be evident to stakeholders.

3.2.8 Senior management leadership

Organisations are controlled in a variety of ways, with smaller organisations such as small and medium-sized enterprises (SMEs) working under autocratic leadership. Equally, SMEs may have a more democratic approach with initiatives and policies being enacted once the majority have agreed to them. It, therefore, stands to reason that policies driven from the top and turned into company policy stand a greater chance of successful implementation. Promotion of a concept such as sustainability can require a catalyst such as training that needs to be led, encouraged and probably authorised from the top. This training might take various forms from a short Continued Professional Development (CPD) based course to a post-graduate qualification.

Senior management aspiring to an ethos of sustainability will potentially achieve very little if it is not prepared to invest its resources (time and money) in training and awareness promotion. If this investment is refuted, a driver can quickly become a barrier. The researcher would argue that it should be the responsibility of senior management to lead by example and ensure that the message is sent to all strata within the company. This point is arguably the most important element for the genuine implementation of sustainability within an organisation. A point as discussed in the literature review practised by Willmott Dixon, a UK based contractor.

“We ensure that all our site teams are aware of our sustainability strategy and policy objectives, and cover waste, energy, water, ecology and sustainable procurement in site inductions. On top of the sustainability modules training developed for our operational teams, we raise awareness of our sustainability strategy and policy aims (Willmott Dixon, 2016).

Ferdig (2007) argues that sustainability leadership is an emerging consciousness among people who wish to pursue sustainable ideas and direct their organisations in that direction. It is necessary to rethink our definitions of leadership, and not look to others to provide guidance and leadership (Ferdig, 2007). Ferdig’s (2007) comments have a ring of truth. However, the researcher would ask the question, how can any leader provide guidance in sustainability

and its relationship with the BE, when they possess limited knowledge and awareness of the subject? This will be explored and analysed in the interviews.

3.2.9 Increased value / rental income from green buildings

It seems unlikely that an initiative such as sustainability will be considered by many companies if there is no positive benefit to the bottom line. An investor may not want to invest financially in upgrading its portfolio in line with a sustainable regime or building new if it cannot be proven to increase the value and utility of their investments, such as increased premium rental income.

According to Davis Langdon (2007), there is a move away from financial modelling that focuses on payback (capital cost reduction), which is being replaced with life cycle costing and includes energy efficiency and employee productivity. There is sufficient evidence to demonstrate that green buildings are more valuable and that they improve the conditions by providing a healthier working environment, which can command higher rental rates due to higher occupancy potential and lower tenant churn. (Davis Langdon (2007).

According to Soulti and Leonardm (2016) who refers to BRE research undertaken to quantify the impact on the capital cost of a building project, the achievement of lower level BREEAM ratings incurs a minimal additional capital cost. Higher level BREEAM ratings can increase the capital cost by only 2%, which can be paid back between 2–5 years through utility savings. There is emerging credible evidence of the benefits of green building design (UKGBC, 2017), which are illustrated in Figure 3.2.

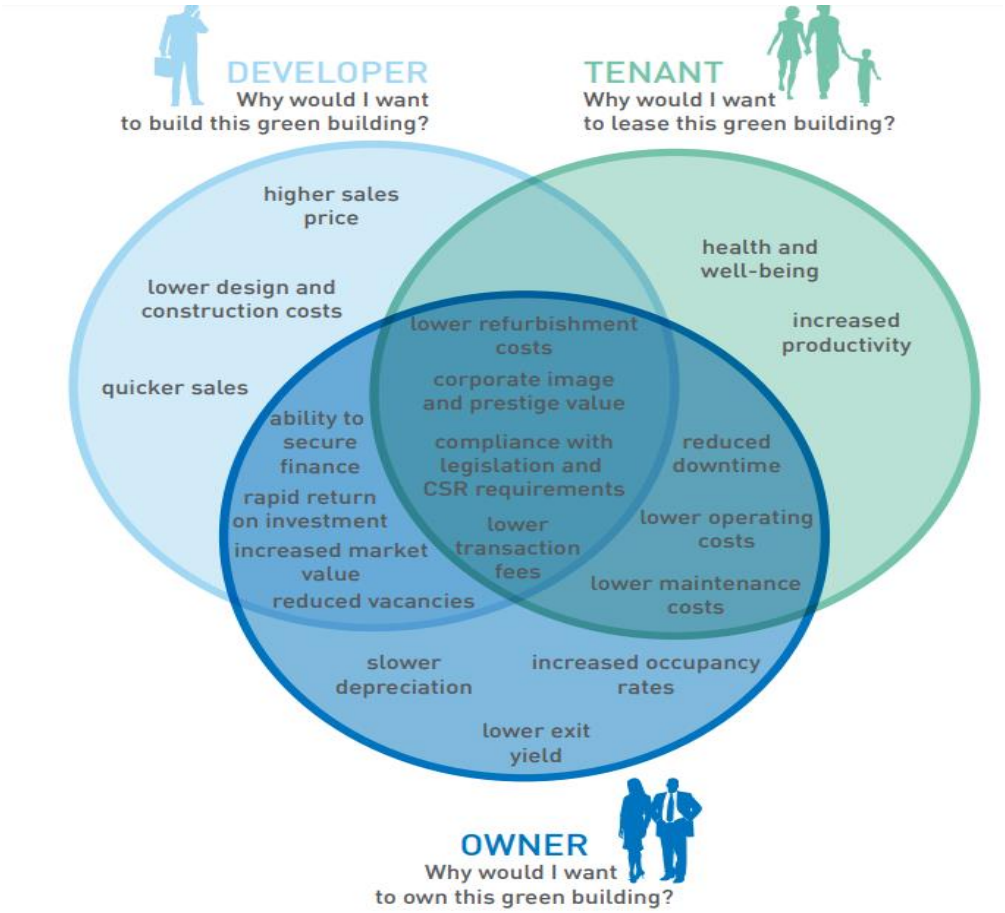

Figure 3.2 Illustrating the benefits to the three primary stakeholders in the case for green buildings. Source: UKGBC (2017)

The UKGBC business case study (UKGBC, 2017) found benefits of green design in four main areas, asset value, design and construction costs, operating costs and workplace productivity. When this report was published according to Soulti (2016) evidence to support these benefits was anecdotal.

The benefits of green design according to the WGBC (2017) report are clear and are being taken seriously by several high-profile stakeholders such as the Grosvenor Property Group and Skanska. The researcher would argue that the WGBC's 2017 report though comprehensive, compelling and widespread, suggests that the movement is increasing and also those considered and referenced in the report may have higher levels of available risk capital and are therefore better able to accommodate longer periods for investment return.

Smaller organisations are likely to have lower levels of risk capital and need a shorter period of return for their investment, so may require more convincing for the case of green buildings, particularly when considering that 99.8% of enterprises in the 28-member states of the EU are SME's (Eurostat, 2015). The researcher would suggest that convincing these organisations would require increasing their levels of awareness of sustainability in the BE and its relevance.

3.2.10 Client (Customer) Pressure

An apt adage perhaps in this context is that the customer is always right; certainly, a valid argument bearing in mind that the customer's money is usually what dictates and shapes a BE project. According to Myler (2016), customer expectations put pressure on companies to constantly innovate to keep up with consumer demand (Myler, 2016)

A client may want their project to have recognisable sustainability credentials such as BREEAM or LEED accreditation, and with all that entails such use of sustainable materials and sustainable supply chains. Clients may insist that their contractor and suppliers hold ISO 14001(2015) accreditation. This should illustrate that the supplier(s) has, or is working towards, a company-wide culture of increased sustainability awareness, and may include sustainable supply chains.

3.2.11 The Triple Bottom Line (TBL)

With TBL, also known as People Planet Profit, the accounting procedure of a company can be at least considered part of its core working process. Therefore, if a company considers its TBL as the primary accounting method, it is hard to see how a company cannot move towards a sustainable regime.

According to Willard (2012), there are several benefits to employing a TBL accounting process. This includes increased revenue and market share, reduced energy expenses, reduced waste expenses and increased employee productivity. The TBL can be considered a driver, Robinson,Kleffer & Bertels. (2011) argue that sustainability is becoming an increasingly integral part of doing business and is no longer the purview of a few leading-edge companies.

According to Elkington (1997), the environmental agenda in the 1990s was emerging and tomorrows CEOs would have greener business ideals. Elkington (1997) cited that the (then) batch of university graduates considered the environment a priority. This assertion from the 2018 perspective may perhaps be viewed with some scepticism as there are not many battalions of CEOs in BE related sectors waiving the sustainability banner. However, based on the date it may be a decade too early to see the proof of his theory. Despite that, the researcher would argue that much has been achieved regarding sustainability within the BE and the following chapters will consider the relative level of stakeholder awareness within it.

According to Schaltegger and Hörisch, (2015), there are two dominant arguments for companies regarding the integration of sustainability, profit-seeking and legitimacy seeking. These two arguments are condensed by Willard (2012) who states that a powerful rationale for sustainable development is enlightened self-interest, fed by the prospect of higher profits.

Markets can be delicate and unpredictable responding to a variety of variables. It, therefore, stands to reason that a company or an industry is required to adapt to tidal changes such as societal shifts if it is to survive and succeed. Sustainability might be considered such a shift of paradigms. Willard (2012) argues that there are three revenue streams open to a company that considered practising the TBL for accounting, which can promote profitability.

Many companies today prefer to do business with ethical companies working with and buying from a “Sustainable Brand” a consistent point with the first driver discussed in this chapter. According to Robinson et al. (2011), there is substantial evidence that corporate reputation has an increasingly significant impact on shareholder value. Robinson et al. (2011) argue that a company can demonstrate its sustainable credentials by becoming a member of, for example, the DJSI, thus proving its reputation for being socially responsible, which in turn can increase the value of its expected cash flows and increase its revenue.

Secondly, the company can obtain new revenue from green products. In the case of the BE, this might include projects such as building components or entire projects.

Thirdly, as also outlined by McDonough and Braungart (2002), there can be a shift in the way that we understand services, such as leasing a product instead of purchasing. A product such as a carpet can be leased, like a car. The product rented for a fixed or indeterminate period which could include a service contract for cleaning and repairing and finally a commitment by the supplier to ensure that the material is removed recycled and replaced.

Several companies follow this business model such as DESSO and Interface. Interface is a forward-thinking American manufacturer of carpet tiles and synthetic carpets who was considering this business model twenty years ago in 1998 (Fishman, 1998), Interface's leasing scheme is called the Evergreen Lease Scheme (Willard, 2012). The scheme did not have a smooth start, but as Kilbert (2008) argues, they were ahead of their time. The scheme faced numerous hurdles at the start of the mid-1990s such as convincing the banks to finance the work, problems with fitting the work to financial accounting standards whereby the terms of a standard operating lease was less than 75% of the estimated life of a product with a 15% residual value at the end of the lease. Financial institutions questioned whether carpet tiles met these restrictions, and so Interface found it challenging to get the Evergreen lease scheme funded (Kilbert, 2008).

3.2.12 Reduced energy expenses

Buildings are responsible for more than 40% of global energy use and one-third of global greenhouse gas emissions, (UNEP, 2009).

Efficient lighting systems for example (LED bulbs instead of Halogen), according to Hawken et al. (1999), in the US could save $300 billion per annum through the implementation of energy saving measures.

Dailey (2013) cites a 2003 study of 33 LEED projects and found that although they were more expensive to start against a comparable non-LEED project, they would yield savings of over ten times the initial investment after 20 years. However this figure included variables that might be hard to measure such as increases in productivity and health due to a better building, it also looked at operational costs and that included energy saving, which according to Dailey (2013) were in the 2003 study at $5.97 per square foot.

3.2.13 Increased employee productivity

Oswald et al. (2013) conducted a study to demonstrate that happy employees returned greater productivity. After the studies, a figure of 12% greater productivity was attributed to this. Willard (2012) argued this point just as forcefully and expanded it by saying that there are four factors that can make an employee happy, engaged and have a desire to go the extra mile. 1) The employee understands the work, the project its goals and relevance; 2). They can see how it benefits the company they work for; 3) they have a stake in the project and can influence its shape and directions and 4) the work/project "resonates with their own beliefs and ethics".

Arguably, a happy workforce has significant value in any organisation certainly extolling the social pillar of sustainability. The researcher would argue that implicit within each of the above four points is communication, transparency and awareness. As previously mentioned, this can be linked with training and awareness development. As a driver, it might almost be considered self-sustaining. A BE related company with a committed generational workforce with

a firm belief in sustainability probably has the strongest chance of achieving a sustainable regime within its context.

The more productive the employees, the more money a company makes, which is a driving factor for many companies to go green. Dailey (2013) further argues that energy savings do not make much difference to companies, because approximately 1% of workspace costs are spent on energy while 85% go towards employees' salaries and benefits. Employee productivity is not an instant result of pleasant and environmentally sustainable surroundings, because eventually, they become the new "normal". Other variables include the terms and conditions of the employer, however good the working environment. If the wages are low, there is a perceived lack of employer care and lack of communication, and morale may well take a down turn however pleasant a place the building is to work in. The researcher would reiterate that sustainability has four pillars and that they are interrelated and must be successfully integrated to achieve a sustainable regime within an organisation, and in this case only improving the working environment may have a marginally ameliorating effect on the social pillar.

3.2.14 Pressure from employees

According to the BIFM (2015), pressure from employees regarding the implementation of sustainability within Facilities Management organisations has risen dramatically. This is encouraging and highlights a greater awareness of sustainability within FM. However, this may not be universally applied across other BE sectors such as building contractors whose opinions generally might be more traditional and backward thinking, particularly to the sole traders and SMEs.

Notwithstanding this, it should be noted that the researcher works for a civil and structural engineering consultant, an SME comprising of 80 people with six offices in Scotland and two overseas. One of the benefits that have occurred due to this research was changing company perception 180o regarding accepting and implementing sustainability within the company.

3.2 Barriers

3.3.1 Barrier Definition

“Anything that prevents access, progress or unison” (Collins, 2005)

While it should be celebrated that the momentum, behind the sustainability agenda, is seemingly gathering pace, the equal acceleration in the barriers preventing performance highlights a need for change in approach from FM teams at various levels and either side of the in-house/service provider coin (BIFM, 2015).

The importance of drivers has been discussed. However the researcher would argue that consideration of the barriers is of greater relevance because they can be more influential than most drivers. For example, the barrier to a lack of funding could be difficult to counter, unless the financial controller is made aware of the argument for a sustainable BE.

3.3.2 Investment

There are at least two ways that investment can be a barrier impeding sustainability in the BE. Firstly, a lack of appreciation on the part of a client, or a procurement department, that a sustainable option or methodology exists (Rowley, 2016). Secondly, there could be concerns there may be associated heavy costs to being green, particularly in the BE. According to Ireton (2008), the argument expounding high costs in sustainable construction relies on a narrow definition of cost, typically reducing it to upfront costs and ignoring any rewards, such as energy savings. Willard (2012) argues that building sustainability does not necessarily mean higher costs, as savings can be made in many areas, such as energy use, greater employee productivity and less employee churn (Davis Langdon, 2007). Convincing an SME of this might be difficult as their margins and available risk capital are often substantially less than larger companies. These perceived costs might include staff awareness training, which in an academic context might be costly, even seminars and conferences can cost between several hundred to several thousand, which might be a lot to take from the bottom line.

Finding new suppliers, upgrading facilities to become greener and adopting corporate policies such as the triple bottom line method of accounting might present a financial risk that cannot easily be quantified.

This might be considered unchartered waters for an SME and may only be motivated by a powerful stick driver, such as legislation or client insistence.

3.3.3 Lack of Organisational interest and Knowledge

Lack of knowledge and awareness means that something will not be understood and therefore possibly not acted on. This might be considered a major barrier. Regarding sustainability within the BE, it would certainly impact on all stakeholders. It can only be countered through education and or training (Butler and Keaveney, 2014).

The practice of sustainability might be hindered within the BE through a lack of knowledge or comprehension. A lack of knowledge of a subject is one issue, a lack of understanding as to what the word means is another. The word sustainability is seemingly used in increasingly wider contexts from business resilience to environmental preservation. Hakkinen (2011) states that sustainable building may be hindered because of ignorance or lack of shared understanding.

As previously discussed the leadership in sustainability is an emerging consciousness (Ferdig, 2007), where organisations are led by its leaders and influenced as well as other variables such as legislation. If as Ferdig (2007) suggests there is an emerging consciousness, and the researcher believes that it has yet to fully emerge, catalysts for this may include realisation, awareness and further education in sustainability.

3.3.4 Lack of customer interest

Lack of customer interest is potentially a very powerful barrier. A client may have little interest in their project having sustainability credentials for several reasons, such as concerns over the perceived costs to the project by implementing a sustainable regime as argued by Hakkinen (2011), a lack of knowledge of sustainability and its relevance to the BE as argued by Bungwon, Dabo and Ishaya. (2016).

According to Bungwon et al. (2016), a lack of awareness exists within stakeholders in the BE regarding sustainability. This barrier links others and as previously mentioned a barrier can be hard to counter unless its cause is challenged. If successfully challenged a stakeholder such as a client could very well change. If that is achieved, barriers such as lack of interest and withheld costs could easily vaporise. A new awareness of the positive aspects of a sustainable BE might encourage clients to follow sustainable routes and understand the reasons why, such as helping to mitigate climate change (Bulkeney and Betshill, 2003). An improved awareness, therefore, may reduce concerns over the marginally increased costs associated (Soulti, 2006) with sustainable building practices.

If the customer/client belongs to the climate change denier camp in terms of the acceptance of anthropogenic climate change, arguably the sustainability cause may be harder to justify unless the advantages of the social and economic pillars can appear advantageous, such as the possibility of higher rental values and increased office productivity (WGBC, 2017)

3.3.5 Lack of interest from employees.

Employee demotivation can be a significant barrier that impacts on the awareness of sustainability within the BE, and there are several reasons for this. These reasons include unrealistic workloads and job insecurity, two such issues that might impact on an employee developing an interest in sustainability might include poor leadership and fears that there are limited development opportunities within the organisation (Page, 2016). Development opportunities

may be translated as training, which is something that organisational leadership might provide, either proactively or in response to an employee request. Either way, a lack of awareness can be provided through theoretical and practical training.

An employee may have a climate change denier or a “not in my backyard” attitude, or just cannot be bothered, in which case strong and effective leadership can be the answer, according to Page (2016); which is another reason why an employee may feel demoralised.

The researcher would argue that this is important, as an employee may be the employer of tomorrow. So every effort should be made to encourage them to pursue a sustainable agenda, but as Ferdig (2007), argues a new consciousness is emerging. What Ferdig (2007) does not make clear is how the “chicken and egg” cycle can be broken, this being where an ill-informed employer in unable to encourage an employee to garner knowledge when they do not know it is available.

The question that resonates throughout this thesis is, “what can be done to encourage this emerging consciousness?” This will be explored to answer the aim, objectives and develop the SIR.

3.3.6 Lack of legislative guidance

As highlighted in Chapter 2, legislation that impacts on sustainability within the BE is extensive, but there is little overarching holistic primary legislation that encompasses sustainability. The available legislation as argued by Tolson (2009) has an environmental bias, and sustainability in its broader sense often gets diluted, and although on aggregate a degree of sustainability may be achieved in the swathe of existing legislation, such as the previously discussed waste and energy-related Acts, if there is a holistic effect, then arguably that would be achieved by default.

However, the researcher argues that if there was an umbrella act that focussed on sustainability in the BE as a whole, integrating the four pillars, then there could be many positive effects. These would include promoting awareness by

centralising the entire concept in the way that the Environmental Protection act was considered an “umbrella Act” because it covered every kind of pollution arising from any source. (Rattan, 1999).

3.3.7 Lack of training

The researcher’s premise based on professional experience, and a trend that became apparent in the literature review, indicated that there is a lack of awareness of sustainability within the BE. Arguably this might be considered a significant “core” barrier. Once fully “aware” of sustainability within any context, a person can make an informed choice whether to adhere to the denier arguments as outlined by Stirling (2007) or follow the view that climate change is being affected by anthropogenic activity as argued by Oreskes (2004) and Powell (2012). Once informed, they may decide to change their perceptions and become a responsible and informed stakeholder. There is, as outlined in the literature review organisations such as “the Natural Step,” an internationally active NGO that specialises in helping organisations become more sustainably aware, including many organisations within the BE.

There exists a danger that stakeholders may not be aware they have access to tools to achieve a better level of understanding. It can be hard to ask the questions that one does not know need to be asked. This is the question the SIR aims to answer by providing an awareness empowering framework from the data gathered in this thesis. If awareness is gained through a medium such as training and frameworks (Butler and Keaveney, 2014), then it is reasonable to assume that a cascade effect of falling barriers such as cost concerns may follow because an employer can quantify the benefits of training to the company and the bottom line.

3.3.8 Lack of Information Technology (I.T) aids

The BE and society, in general, has become IT dependant with 49% of the planet having access to the internet (internetlivestats.com, 2017). Accessing the internet for information and research is a daily routine for many in developed countries. Older techniques within the BE such as hand drawing a blueprint has

become a thing of the past and has been replaced with software driven systems such as Computer Aided Design (CAD).

Computers and IT have transformed the workplace and society as a whole. Most organisations (the BE is no exception) have become increasingly dependent on computers and IT, to access and store information (Markovich (2018). Systems such as Building Information Modelling (BIM) and CAD have changed the BE workplace immensely. When the researcher first started working in the BE (1996) drawing offices were large rooms with dozens of “AO” drawing boards with reams of drafting film, and large numbers of architects and designers drawing blueprints using thin ink drawing pens. This familiar image has changed to what by appearances could be an administrative office, with computers and keyboards on the desk. The question that the researcher would ask is, has the limitless information access capability IT has created improved awareness of sustainability within the BE; because easy, instant and often free access to information would certainly help spread awareness.

However, as argued by Markovich (2018) there are drawbacks in using IT, and there are barriers that need to be considered before the research aim’s SIR was designed. Such barriers include communication breakdowns because e-mails are a preferred form of communication. Also, according to Markovich (2018) reliance on emails can cause miscommunication issues, the decline of writing and interpersonal communication skills. The SIR would, therefore, need to be accessible, informative and to communicate the message correctly.

The researcher uses the internet to access publications that were once delivered in hard copy such as the Barbour index, and manufacturer’s details are generally internet based, such as product specifications and material safety data sheets (MSDS).

IT, including bespoke software in the BE, exists and its use is commonplace. Building Information Modelling (BIM) for example as discussed in Chapter 2 is software that has several positive attributes which can encourage sustainability within the BE, but it is not without its drawbacks, such as excessive cost especially for a small organisation (Shepherd,2015). What has become evident

to the researcher is that information regarding sustainability in the BE may be widely available (102 million hits on the Google search engine accessed by the researcher on 11.08.2018) inputting “sustainability in the Built Environment” in the search box), but does not seem to be “centrally” accessible. Bridging the gap between the wealth of available information and imparting it to every stakeholder is the key function of the SIR, a tool to promote awareness of Sustainability in the BE.

3.3.9 Lack of reference to published materials

The researcher would argue that there is an immense amount of published material available in hard and electronic format about sustainability within the BE. However, the researcher’s personal experience and observation of friends and colleagues, highlights that very few read their professional journals cover to cover. In many instances, they remain wrapped in cellophane covers for extended periods. Reasons for this included lack of time, a problem compounded when the next issue arrived, and so on (Owens, 2015). A further argument for a framework like the SIR is that it could be accessed from anywhere with WIFI at any time. The shift from hard copy to electronic format and whether or not this is a preferred medium will be explored within the surveys and interviews.

3.3.10 Lack of subject matter experts

Several professional organisations have strong associations with sustainability such as IEMA and the Institute of Corporate Responsibility and Sustainability (ICRS). Within the BE subject matter experts tend to be the first point of reference for areas such as asbestos or environmental issues. It is reasonable to assume that experts in sustainability would have a similar status, however according to the University of Salford quoting a research study undertaken by McGraw-Hill Construction, the skills shortage currently being experienced by the sector risks acting as a roadblock to any real expansion of sustainability across the construction sector (University of Salford, 2016). Subject matter experts provide a single reference point for advice and a knowledge base. However, the lack of an informed point of reference may hinder broader

awareness and may mean that certain decisions affecting sustainability are unfavourable within a company's working context.

3.4 Summary

Overcoming barriers and encouraging drivers would seem to be the key to achieving sustainability within the BE. The emerging trend that was evident in Chapter 2 of a lack of universal awareness of sustainability in the BE has been further explored in this chapter through the lens of the barriers and drivers affecting the application of a sustainable regime in the BE, and as noted it was an evident component of several of the barriers.

Ultimately the research aim is the development of the SIR, the successful design of which will be wholly dependent on it being able to counter the barriers and take advantage of the drivers discussed in this chapter. The ultimate aim of the SIR is to promote the awareness of sustainability, the discussion in this chapter has frequently alluded to the fact that a lack of awareness is a significant barrier. It could be argued that a lack of awareness is an overarching barrier, because it can adversely influence several of the barriers discussed in this chapter simultaneously, such as a lack management interest, which might lead to a lack of investment, which in turn would reduce or obviate training and education.

Investigating and ascertaining what the researcher suspects to be a widespread lack of awareness of sustainability within the BE and its associated sectors will be the thesis to be tested, the methodology of how this will be achieved will be explained in the next chapter.

4 METHODOLOGY

4.1 Introduction

This chapter will outline the methodology that will be used in the thesis, the paradigm employed, and, the primary and secondary data collection methods used. It will also discuss the rationale for question type and question choices linking back to the research question and aim.

The aim is to develop a Sustainable Infrastructure Resource (SIR). The SIR will provide a framework to promote a genuine intergenerational sustainable regime within the global BE, through developing awareness of the topic amongst stakeholders.

As outlined by Yencken & Wilkinson (2000), sustainability is considered to have four pillars Economic, Environmental, Social, and Cultural. It will be necessary therefore to ensure that these are woven into the fabric of the methodology.

4.2 Research Paradigm

According to Collis and Hussey (2003), there are two research paradigms, Quantitative (Positivistic) and Qualitative (Phenomenological). The term paradigm refers to the progress of scientific practice based on people's philosophies and assumptions about the world and the nature of knowledge; in research terms, it is about how research is to be constructed.

Collis and Hussey (2003) argue that the terms positivistic and phenomenological have become "loosely used" in academia, the positivistic approach seeks the facts or causes of social phenomena with little regard to the subjective state of the individual, and its approach is largely quantitative based. However, Collis and Hussey (2003) state the term "positivistic" is not used as an alternative to quantitative because it can also produce qualitative data.

The advantages of a positivistic approach and the reason why it was chosen for this methodology is that it has a structured approach, the information obtained can be more objective, and, can provide objective information (Johnson {no date}). However, Johnson (no date) cites inflexibility as a disadvantage to this

approach, because positivists believe that everything can be measured and calculated, which deters lateral thinking. It was primarily the latter reason why the researcher chose to adopt a non-pure form approach because it seemed likely that there will be times where closed questions may not provide responses with sufficient depth.

Although there are two main research paradigms, Collis and Hussey (2003) argue that there is “considerable blurring”, between them and that very few researchers “operate within their pure forms”. Similarly, according to McGrath (1982), there are no ideal solutions in research choices, just a series of compromises.

A strength of the positivist approach is that statistics are aggregated from large samples, such as surveys, which will form part of the research methods for this thesis. Positivistic methods of data collection can be fast and economical (Amaratunga, Baldry, Sarshar, & Newton, 2002). Whereas phenomenological methods of data collection can be resource intensive (ibid). However, as previously stated there can be a considerable blurring of the paradigms, and as McGrath (1982) infers, there may be compromises in research. Therefore, a “non-pure form” positivistic method was selected for this quantitative research based on surveys and semi-structured interviews.

4.3 Sampling Framework

4.3.1 Stakeholder selection

The term stakeholder within the context of this thesis refers to different professional disciplines within the BE and not individuals, who will be separately identified in the methodology. “The first and most critical stage of the methodology is to select the sample. It is important to ensure that the sample is not biased and is representative of the population from which it is drawn” (Collis and Hussey (2003). The companies and individuals selected will be largely based in the UK. Names and company details will be taken from personal contacts within the researcher’s purview in addition to membership directories from professional bodies including the British Institute of Facility Management

(BIFM), the Chartered Institute of Builders (CIOB) and the Royal Institute of British Architects (RIBA).

Although a small number of blue-chip companies will be approached. The principal targets are intended to be small and medium enterprises (SME's) this category makes up the majority of EU member businesses. 99.8% (Eurostat, 2015), of businesses in the 28 EU member states are SMEs. It is anticipated that a lack of awareness of sustainability within the SME's will provide the researcher with a representative aggregate of the state of awareness in the BE[9].

Equal numbers of respondents will be selected from differing disciplines (stakeholders) within the BE, which will include; building contractors, facilities managers (hard and soft), civil engineers, structural engineers, suppliers, architects, planners, building control officers and manufacturers. It is felt that this selection represents the principal stakeholders that influence all the life stages of the BE, as illustrated in figure 4.1. Although it must be stressed that this will represent a small percentage of the total numbers of these disciplines within the BE.

However, it is anticipated that the response rate will provide representative data for analysis.

Except possibly for micro businesses, organisations often have a management hierarchy, with larger organisations having multiple management layers. However, the most referred to for this sampling framework are illustrated below in Figure 4.2.

Achieving a genuinely sustainable regime within the BE will be influenced by these stakeholders. It is partly for this reason that it is essential to ascertain the level of awareness within these stakeholder groups, because if it lacks amongst

[9](1) The European definition of SME follows: "The category of micro, small and medium-sized enterprises (SME's) is made up of enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding 50 million euros, and/or an annual balance sheet total not exceeding 43 million euros"
(2) Generational classifications ages ranges as of 2016

these influential stakeholders, then this will inevitably have a detrimental effect on the implementation of sustainability within the BE.

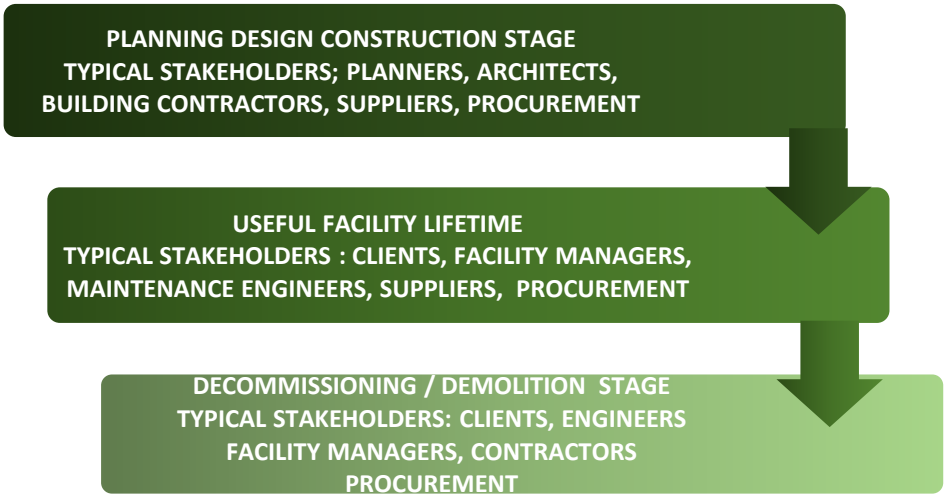

Figure 4.1 Illustrating simplified facility lifetime, showing principal stakeholders all stages of a facility lifetime; Source Harrop (2018)

4.3.2 Targeted management levels

According to Herron et al. (2013), the construction industry has been a slow responder to environmental issues and ultimately to sustainability; a point that is investigated in the methodology. Except for micro businesses, most companies have a multi-layered strata of employee levels (See Figure 4.2), in the BE, that can include a company CEO at the top and a tradesman/ apprentice at the bottom, with numerous levels in between, depending on the size of the organisation. For this methodology, this strata will be referred to as, upper, middle and lower management. An attempt will be made to question as many of the respondents as possible from the lower management levels, as the chances seem high that the lower level of management will be younger individuals whose awareness of sustainability may be superior to their older counterparts (Morgan Stanley, 2017), particularly when it comes to investing. Also as outlined by Matiolli (2007) a recent poll on green employment by MonsterTRAK.com found that 80% of young professionals are interested in securing a job that has a positive impact on the environment and 92% would be

inclined to work for a company that was environmentally friendly. Although it has to be said that this is an American reference, there is no reason to assume that this attitude is exclusive to that side of the Atlantic. If this is the case, the young professionals and students of 2007 are the young professionals and possibly lower / middle management levels of today (2018). It is important to ascertain the level of commitment and awareness of sustainability that exists at this management strata and ascertain the level of awareness and comprehension of the concept.

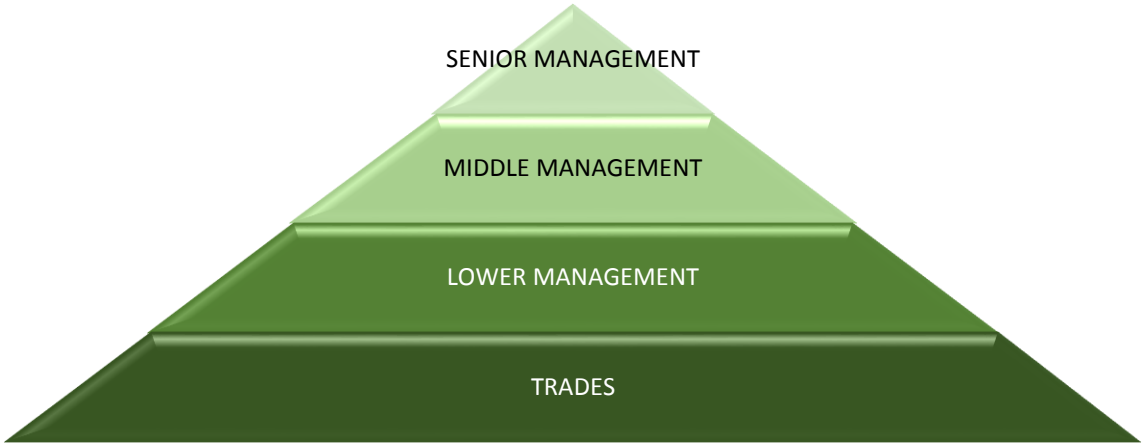

Figure 4.2 Illustrates typical employee pyramid Source: Harrop (2015)

The research aims to establish the views and level of sustainability awareness within the lower management levels illustrated in Figure 4.2. Further to this according to Scott (2017), the UK Government launched its “Get into apprenticeships “campaign with the expectation of recruiting 202,000 new apprentices into SME’s. However this was announced too late to be investigated as part of this research methodology, it is anticipated that this management level will have a greater awareness of sustainability and would be the most receptive and interested in using an awareness support system such as the SIR framework. Although younger people are often lower-level managers, there are indications that this generation is more interested and knowledgeable in sustainability. However, it should be noted that the different generations such as the baby boomers (51-69 years), generation “X” (36-50 years) and generation “Y”.

(20-35 years) (Lyons, 2016), may have different values in the workplace based on their relative life experience, and the decade in which they grew up. Baby boomers, for example, grew up in optimistic times (Kupperschmidt, 2000) and as outlined in the literature review times of great pro-environmental movements. Generation “X” grew up in a time of immense technological evolution. Generation “Y” value a work/life balance, and are very adaptable to technology because they have grown up with it in a way that the previous generations did not. Generation” Y” it could be argued are the future managers and are more concerned about political and ethical values, which includes integrating their beliefs and causes into the companies they support, which may include a level of sustainability conscience (Soloman, 2014). Many senior managers in large corporations come from the “Baby Boomer” generation 51-69 years old, (Lyons, 2016). It was through this lens that the methodology would seek to determine levels of awareness of sustainability within the BE.

4.4 Data Collection

There are two types of data sources, primary and secondary (Thompson, 2014). Primary data is information collected specifically for research, it can be obtained from surveys or interviews, and is a favoured positivistic method (Thompson, 2014). Also, it has the benefit of applying to both quantitative and qualitative approaches (Mcleod, 2018). Secondary data is usually collected by someone else for another purpose but is utilised by the researcher for another purpose. Secondary data/information was used in the literature review and will be used to justify data collection methods.

The primary data will be collected from surveys and semi-structured interviews.

As discussed in section 4.3 surveys are used in quantitative research (positivistic) (Babbie, 2010). Surveys are a research instrument that comprise of a set of questions designed to gather information from respondents and can be delivered in several ways such as face to face, telephone, post, email or online, a further benefit being that they are economical, quick and an efficient way of gathering data from a large population (McLeod, 2018).

Surveys, therefore, are considered an ideal form of data collection for this thesis, because the targeted stakeholders are based all over the country. An online resource specialising in surveys SurveyMonkey® will be used for the surveys element due mainly to ease of use, including inbuilt email delivery and analyses. This will centralise the survey, produce a professional looking tool and the SurveyMonkey® program has the added benefit of analysing the results, depicting them in statistical and pictorial form.

Perhaps the greatest weakness of a survey is that it can easily be affected by social bias, as most respondents want to present a positive image of themselves (McLeod, 2018), even when they have total anonymity. This bias will also be considered in the survey design, and when undertaking semi-structured interviews; however, with probing, it may be possible to address the bias.

There are a number of interview types, such as the structured, unstructured and semi-structured.

Structured interviews often use closed questions, unstructured use open questions and semi-structured use both types of questions (Leech, 2002). Semi-structured interviews will be used for this thesis because, an interview with exclusively closed questions would not permit any additional points from the interviewee such as opinions and perspectives, or provide an opportunity to probe further. An unstructured interview according to Leech (2002) is in effect a chat dominated by open questions. The researcher considered this approach would be difficult to control and relevancy could be lost. It is anticipated that the semi-structured interview will provide advantages in using closed and open questions and, an increased opportunity to acquire greater, detail of the respondent’s perspective (Leech, 2002).

Secondary data sources will also be utilised for this research and according to Thompson (2014), are often used for the literature review. The primary and secondary data sources outlined in this section will be the main types used to support this research.

4.5 Survey Development and Design

This research will comprise of a pilot survey and main survey. Piloting will involve testing the survey on a selection of respondents that will be used for the main survey. This should help to provide a better understanding and order of questions to be used for the main survey. The researcher will, therefore, gain experience in phrasing questions to ensure that they are relevant, impartial, precise and positive. For a neophyte researcher, it may be all too easy to ask questions that are unspecific, unanswerable due to ambiguity, or lack continuity. The importance of clear and straightforward statements cannot be overstated since a variety of respondents must uniformly understand the question being asked.

Both surveys will be developed using the SurveyMonkey® website. This will permit the researcher to send out links via email providing direct and convenient access for the targeted respondents.

4.6 Question Type

The pilot survey will comprise three individual surveys targeted at three different stakeholders. Although closed questions will be predominantly used, both the main survey and the semi-structured interviews (SSIs) will also use “open” (phenomenological) elements including comment boxes, and probing questioning in the SSIs.

4.6.1 Closed Questions

A closed question format will be used for the pilot and main surveys, and as previously mentioned, there can be some “blurring” of the two paradigms (Collis and Hussey, 2003), as the pure forms can be too extreme, and therefore often rigid. Although the questions will be in a closed format, an “open” element will be included in the form of additional “comment boxes” for several questions where clarification and further detail may be required. The open element of these questions has a number of advantages including increased response rates and permitting respondents to identify issues not captured in closed questions (O’Cathain and Thomas, 2004). According to Collis and Hussey

(2003) and Leech (2002), closed questions are better suited to a positivistic paradigm, which is the preferred paradigm for this methodology. A caveat, however, being that the positivistic paradigm will not be “pure form”.

Open questions are strongly linked with the phenomenological paradigm and are according to Lewis-Beck Bryman and Liao. (2004) known as qualitative questions. Therefore exclusive open questions would not be appropriate for research with positivistic bias.

Closed questions can be answered quickly which has positive implications for a survey that is posted or emailed to respondents with limited free time. According to Oppenheim (2004), this loses the dimension of self-expression and can be affected by bias in making the respondent choose one of the options when they might have alternative points of view. Also according to Oppenheim (2004), closed questions have the disadvantage of losing “richness “whereas open questions allow a respondent to be freer in expression responding in their format. However, he does acknowledge that the advantage of closed questioning provides for comparison and analysis from several respondents before introducing open questions. Advantages and disadvantages of each are outlined in Table 4.1;

ADVANTAGES	DISADVANTAGES
CLOSED QUESTIONS	
Requires little time No extended writing Low Costs Easy to process Make group, comparisons easy Useful for testing a specific hypothesis Less interviewer training	Loss of spontaneous response Bias in answer categories Sometimes too crude May irritate respondents
OPEN QUESTIONS	
Freedom and spontaneity of the answers Opportunity to probe Useful for testing hypothesis about ideas or awareness	Time-consuming In interviews costly regarding time Coding: Costly and slow to process and may be unreliable Demands more effort from respondents

Table 4.1 Illustrating relative advantages and disadvantages of Closed and Open questions. Source Oppenheim (2004). Adapted by Harrop (2016)

4.6.2 Closed Question Variant

Collis and Hussey (2004), argue that there are three types of closed question, Dichotomous, Scaled and Ordered. All will be used in the pilot and the main survey.

Dichotomous questions

A dichotomous question is one that can only be answered in a fixed number of ways, typically with answers such as, Yes or No, True or False, Agree or Disagree.

QUESTION	ANSWER CHOICES
Sustainability is practised in your company	YES / NO TRUE / FALSE AGREE / DISAGREE

Table 4.2 Example of a Dichotomous question, Source: Harrop (2016)

Scaled questions

Scaled questions ask a respondent to gauge their opinions against a set scale such as the Likert Scale, which can be numeric or opinion driven:

QUESTION	ANSWER CHOICES				
	Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
Sustainability is practised in your company			✓		

Table 4.3 Example of a Likert Scale closed question; Source Harrop (2016)

Ordered questions

There will be an open question element in the surveys with selected questions providing an additional comments box. It is believed this will enhance the responses.

Although the use of closed questions will predominate the main survey, an optional box allowing for a level of qualitative analyses will be provided as previously outlined. The reason for this is to counter the disadvantages of a closed question (See table 4.1) where respondents choose a response that may

not be the most appropriate, and can, therefore, justify or expand their response.

The SurveyMonkey® format will be used as it is easy to use, quick to send out and for respondents to complete, economical, and fast to analyse with configurable and collaborative attributes. It also informs the respondent of the approximate time the survey will take to complete. The targeted survey length will be approximately 15 minutes, which should reduce the risk of response fatigue. The limited time is a further justification for using closed type questions and a positivistic approach also that they are easy and less time-consuming to analyse for a quantitative method.

4.7 Bias

4.7.1 Bias variations

Bias is defined as any tendency which prevents unprejudiced consideration of a question (Dictionary.com, 2017). In research, bias occurs when “systematic error [is] introduced into sampling or testing by selecting or encouraging one outcome or answer over others” (Merriam-Webster, 2017).

Question bias can detract from the value of a survey as an instrument of research. It is essential to consider question bias because the actual structure and type of questions chosen could have had an impact on the responses received. It is also important that the questions will reflect the aim and objectives of the thesis so that essential information can be gathered and analysed.

Response bias according to Goetzman et al. (1976), is the reason a respondent may answer a survey question in a way which does not reflect true thoughts or feelings. Therefore, survey data may reflect various degrees of response bias which render survey findings questionable or useless.

Interviewer bias can be caused by the way a question is worded or phrased. Bias can affect and taint a response and ultimately the information that is to be analysed and used.

Technical Jargon bias. Chambers (2012) argues that there is a tendency for one's knowledge to limit the ability to think from a less informed perspective. We, therefore, assume that everyone else knows what we know, and because of our own bias it is hard to imagine that these concepts are difficult for others to understand. However, it should be noted that it will be necessary to establish a baseline of what may or may not be considered technical jargon. This will be challenging because although many terms such as Environmental Assessment Methodologies (EAMs) should be universally understood among the targeted stakeholders, other terms used might only be familiar to a sustainability professional, for example, "intergenerational equity". The interviewees in the semi-structured interviews will be asked if they are aware of the meanings and concepts behind a specific word especially if the researcher believes that they have any doubts.

There are several forms of bias that can influence responses from surveys, many of which are discussed and considered in the question design. It is important to ensure that a secondary question is not asked as part of the same question such as "Do you have a sustainability policy? If so how long has it been active?" This is so the respondent answers one question at a time, and that the researcher knows which part of the question the respondent answers (Choi and Pak, 2005). Also, short and ill-defined vague questions should be avoided because of the risk that the question may not be answered accurately, be misinterpreted and perhaps encourage the respondent to consider the question and topic of the survey.

Although the survey questions will exclusively be directed to stakeholders within the BE, technical jargon should be avoided in the questions, as far as possible.

"THE RETRO-ENCABULATOR USES UNILATERAL PHASE DETRACTORS. BUT YOU KNEW THAT ALREADY, DIDN'T YOU?"

Figure 4.3 Illustrating technical Jargon with no covering explanation; Source http://uxmas.com/2012/i-knew-you-were-going-to-say-that (2018)

Questions with too few options do not provide for comprehensive answers, i.e. “Yes” and “No “and may hold the risk of “forced choice” bias. If the respondent does not know, they might be forced to answer one of the two choices and answer incorrectly (Choi and Pak, 2005). It is intended that all the scaled questions will be used in the surveys and should provide the respondent with an opportunity to state that they “Don’t know” or are “Unsure”.

The construction of a question itself can have pitfalls and associated bias risks. One such example would be overlapping interval bias (Choi and Pak, 2005), who argue that this bias can cause confusion and elicit an inaccurate response. Such as where choices may be scaled. Overlapping numbers would have been 1-10/ 10-50/50-100. The numbers highlighted in red illustrate if the answer is “50” then the respondent might be uncertain which category to choose. It is less ambiguous therefore to scale without overlap, for example, 1-10, 11-50, 51-100.

According to Henning (2013), leading question bias is a very common problem, particularly in pilot surveys. The issue according to Henning (2013) is that the question suggests the answer an interviewer/researcher is looking for.

For example, a question asking “EAM’s have a positive impact on the four pillars of sustainability, YES or NO?” could be considered leading and would,

therefore, be phrased “Do you believe that EAMS have a positive impact on the four pillars of sustainability?”

Response burden, according to Rolstad, Adler and Ryden. (2011) is often defined as the effort required to answer a survey. Rolstad et al. (2011) outline that this can be caused by survey length. The more questions that a survey contains may result in less time spent on each question, limiting the quality and reliability of the data (Chudoba {no date}). The surveys will be trialled for completion time before sending. The reasons for trialling completion time is that on average a good survey should take no longer than 15 minutes to complete.

Arguably an element not relevant in the surveys is the human factor, one that the interview process is unavoidably exposed to. As already discussed, leading questions will be avoided, however, according to Choi and Pak (2005) there are other dangers for the interviewer that can result in bias, such as, dress, manner and body language. Every effort will be made to reduce “interviewer bias” in the semi-structured interviews by undertaking in an informal setting where possible and conducted in an informal and relaxed manner. If for example it is undertaken in an interviewee’s workplace, a neutral venue will be considered. The researcher will conduct all interviews in a neutral, and relaxed manner, particularly as a risk in this instance is the interviewee picking up on the researcher’s enthusiasm for the topic.

Social desirability bias is an ever-present danger in interviews. It is additionally acknowledged that it may also be a danger in anonymous surveys. The bias refers to the tendency of the interviewee to answer questions that make them look good rather than honestly (Supino and Borer, 2012). Although this bias is arguably harder than most to edit and control, the researcher will probe, through asking additional questions to cross-check answers where appropriate and if time allows. For example, if an interviewee claims that their company is a paragon of sustainability practice and training, then cross-questioning and examining evidence including that of additional training with a copy of the Sustainability Policy may help counter this pervasive bias.

4.8 The Surveys

4.8.1 The Pilot Survey

The intention of the pilot survey is to explore the pillars of sustainability and attempt to baseline the level of understanding within a selection of stakeholders within the BE. The pilot survey will also ascertain the depth of knowledge and appreciation of sustainability within the stakeholder's sectors. Through the lens of the research question and the research aim, knowledge gained from the literature review will develop the theme of the questions for the pilot. There are four root themes threaded through this element of the methodology; Firstly determining the current implementation level(s) of sustainability within the built environment. Secondly to establish the level(s) of understanding of stakeholders within the BE. Thirdly, to recognise the drivers and the barriers that can affect the comprehensive inclusion of sustainability in the BE, and finally to identify any future legislation or trends that might influence the research.

The list of stakeholders and professions within the BE is extensive, and it would be impractical to target all of them with a bespoke survey. Therefore, for the pilot survey, three stakeholders were chosen, as it is considered that they represent the disciplines that have the greatest influence in the BE concerning the central theme of this thesis, "sustainability", and therefore the greatest relevance for responding to the research question.

4.8.2 The Main Survey (See Appendix A)

The main survey will seek to build on the pilot and capitalise on any lessons learned. Care will be taken to ensure the main survey is not sent to anyone who participated in the pilot. Further to this, potential respondents will be chosen from member directories within professional organisation websites including the Chartered Institute of Builders (CIOB) and the British Institute of Facilities Managers (BIFM).

The stakeholder sample for the surveys will be confined within the BE, justification for the targeted stakeholders will be provided in Chapter 5, where

the surveys are discussed at length However, the respondents will include: architects, civil engineers, structural engineers, suppliers, facility managers, building contractors, planners and tradesmen, such as carpenters, bricklayers, plumbers and electricians.

4.8.3 Semi-Structured Interviews

The researcher felt that although a strictly positivistic methodology often uses closed questions, the semi-structured interviews would use a combination of open and closed questions so that the respondent could respond more widely to a question. There are advantages to the research using a qualitative approach; perhaps the most relevant is that they allow respondents to share motivations and concerns that the interviewer may not have anticipated (Farrell, 2016). This is important because it adds detail to the discussion and more thorough response. As Farrell (2016) states, “open-ended questions prompt respondents to give deeper and new insights”. However, there are disadvantages to using open questions, such as the additional time required for the interviewee to respond, the limited control over the length of response, and, the interviewee perhaps having difficulties expressing their own opinions (De Franzo, 2014).

Further to this Collis and Hussey (2003), state that structured interviews suggest a positivist approach, and unstructured a phenomenological approach, each in its pure form may be too rigid or too ill-defined respectively. Therefore triangulation will be employed which uses more than one method to collect data on the same topic. This is a way of assuring the validity of research through the use of a variety of methods to collect data on the same topic and involves different types of samples as well as methods of data collection (Leech, 2002). Triangulation is discussed further below.

Although similar in construction to the surveys, semi-structured interview questions will be a mixture of open and closed. Probing will be undertaken, as illustrated in Figure 4.4 below.

Question: Does your company operate either of the following? a) Environmental Policy YES / NO /UNSURE b) Sustainability Policy YES / NO /UNSURE	**Comments box** **Probe question** If NO / UNSURE, Why? What are Barriers? If YES, ask for evidence How long has it been operational? Do they understand it?

Figure 4.4 Illustrates an example of a closed question with the open element "Comments box"; Source Harrop (2016)

Leech (2002), concurs with this view by saying that unstructured interviews can be conversations and although may be a source of insight the interviewer usually requires specific answers to specific questions which is more conducive to structured interviews. As previously stated the researcher considered that a blended paradigm approach would benefit the research because it will be necessary to gauge the level of awareness to sustainability which may be less easy to achieve using one data method and closed questions alone. To collate valuable data, the interviewer will also gather the interviewee's opinions, and perspectives which are should identify their motivation, level of interest and any counterfactual perspectives to sustainability (Kennedy, 2006).

Interviews provide an opportunity which surveys do not always achieve, this being the ability to probe and discover any underlying opinions which might enrich the results, offering perspectives on the choice made in, for example, a dichotomous question.

The subject matter can be considered confidential for two reasons, the commercial in confidence element and secondly, with a subject in emotive roots such as sustainability and the environment, it seems unlikely that anyone would want to be seen in a bad light even in an anonymous context. It is possible that any social acceptance bias risks might be reduced in a face to face interview where probing can be undertaken to ask for proof of written policies.

Each semi-structured interview will be closely linked to the respective survey regarding the questions posed. Interviews are involved and may cause issues for the interviewer and interviewee, but there are many advantages to this

method of data collection. According to Brenner (1985), as cited by Collis and Hussey (2003) several rules can be applied during an interview with a positivistic bias, such as; reading the questions as they are worded; reading slowly and using correct intonation and emphasis. Additionally; asking the questions in the correct order; posing every question that applies; recording precisely what the respondent says; not answering for the respondent; and, importantly, not showing either approval or disapproval of an answer.

According to Collis and Hussey (2003), there are other factors which can adversely affect an interview. The interviewee, for example, may have certain "expectations" and strive to provide what they may consider being a favourable response. Variables such as promotion, a raise, or a reprimand could also affect the interviewee's mood and response. They argue that there is wisdom in perhaps turning up a little early to "assimilate" the atmosphere and taking time to put the interviewee at ease. The questions will allow the interviewee to answer from their professional perspective and probing will permit the interviewer to gauge the interviewee's personal opinions. Oppenheim (2004) states that the interviewer's physical presentation and attitude should be considered and matched as far as possible with the interviewee. He goes on to suggest that flamboyance should be avoided as well as obvious evidence of social class, ethnicity and educational background. In short, according to Oppenheim (2004), the interviewer should aim for "respectable social neutrality". The researcher will attempt to achieve this by dressing smartly but not formally, and being at ease.

There are known disadvantages to this method, which include the time taken to undertake the interview and, difficulty in recording the results (Collis and Hussey, 2003). These issues will be countered by ensuring that the interviewee has the required time available. The researcher intends to have the option to allow for a limited degree of voice recording and note taking. The researcher will undertake the interviews, without any additional help.

Leech (2002) argues the importance of gaining a "rapport" with the interviewee. This should also demonstrate that the interviewer is listening and interested in

what they have to say. There are some ways of achieving this, according to McCracken, (1988), the interviewer may appear more agreeable by appearing slightly less informed so that the interviewees do not feel threatened. However, the researcher would disagree with this position because of the risk that the answers might be suitably scaled down by the interviewee to accommodate the interviewer's perceived level, and as argued by Leech, (2002) they may feel that they are wasting their time.

Oppenheim (2004) outlines the risk of what he refers to as "situational problems", or the location of the interview. For example, the factory floor might allow managers to overhear the interview, eliciting biased results from an intimidated interviewee. It is, therefore, the researcher's intention to ensure that the interviews are always held in a place where privacy is guaranteed with no risk of being observed or overheard.

4.8.4 Probing

According to Kennedy (2006), the initial question opens up the door to an issue, and that the interviewee's first response can be considered the first draft of their answer. Therefore, to get the full story to follow up questions can be beneficial. These can cover clarification of what was said, getting more detail, cataloguing their feelings and perspectives, and, perhaps test their ideas from a counterfactual viewpoint. Each question in the semi-structured interviews will have a section to enable the researcher to probe the interviewee if required. It should be possible to gain an insight into the interviewee's level of interest in sustainability and any underlying interests and gauging their concerns within personal and professional contexts.

Both directed and non-directed probing questions will be used in the interviews:

DIRECTED PROBE QUESTION	NON-DIRECTED / NONSPECIFIC PROBE QUESTION
Could you tell me why this was?	Could you tell me a little more, please?

Table 4.4 Illustrating probing question types; Source Oppenheim (2004) adapted by Harrop (2016) into a table format, for ease of reference

Probing can be replete with dangers, for both the interviewer and interviewee. The interviewer might, for example, be somewhat fixated on the research subject and reinterpret the answer (Leech, 2002), with the possible outcome being translated by the interviewer in a good light and so favourably reinforce the aim of the research. A notable danger with probing is that of digression; it can be easy to wander off course (Kennedy, 2006). However it is important to let the interviewee finish, then bring them back to the question, while not being "controlling" (Leech, 2002).

4.9 Survey and Interview Evaluation

All the questions will be individually evaluated where possible, providing statistical figures where appropriate. The questions will also be evaluated, and assessed against the research question, aim and objectives.

4.9.1 Triangulation

According to Collis and Hussey (2003) and Denzin (2012), the blending of paradigms is called triangulation, which they define as "the combinations of methodologies in the study of the same phenomenon". As mentioned above triangulation uses more than one method to collect data which is a way of assuring the validity of research through a variety of quantitative and qualitative methods. This is commonly termed mixed methods and may involve different types of data through surveys, interviews, and different locations. Holtzhausen (2001) also states that triangulation implies the collection of accounts from different participants. This research has used surveys, semi-structured interviews, numerous locations and many different disciplines with the BE.

Further to the above Cohen, Manion and Morrison (2000) state that triangulation attempts to map out or explain the richness and complexity of human behaviour by studying it from more than one standpoint. Denzin (2012) states that there are different types of triangulation data, methodological, source, investigator and theory. The latter two refer to research using more than one investigator and theoretical model respectively and are not relevant to this research, data, methodological and source triangulation, however, are.

Data and methodological triangulation are qualitative techniques and can be used to avoid potential biases arising from the use of a single data source. It can also be used to confirm suggested findings and to determine the completeness of data.

This research will also use source triangulation as it allows for the possibility that each respondent will have a differing view, therefore allowing the researcher to look for patterns or contradictions, it also allows for data that is collected at different times (Turner, 2016). This is relevant for this research as different stakeholders will be sampled for the surveys and semi-structured interviews.

As both qualitative and quantitative methods of data collection will be used (Collis and Hussey, 2003), there will be value in permitting an element of open questioning within the research, although it is accepted that closed question form is the optimal method for data collection. Within this paradigm, open questions will permit the researcher to gain a deeper understanding of a respondent's view after a closed question, for example, a question asking a respondent's perceived level of awareness of sustainability within their employment context can be quickly responded to using the Likert Scale. However, the underlying reasons for supporting this opinion might be valid in support of the research and not be evident from a Likert scale response. So where appropriate an additional comments box may be provided.

It is envisaged that using triangulation for this research will highlight a lack of awareness and understanding of sustainability within the BE as well as enhancing the rigour of this work.

4.10 Research Ethics and Confidentiality

4.10.1 Research Benefits

The researcher believes that the potential benefits of this work could be significant. However, it fully recognised that the scale and nature of the barriers would be challenging.

This research aim is to develop the Sustainable Infrastructure Resource (SIR) which will promote sustainability within the BE and thereby provide the researcher with an answer to the research question. It is anticipated that the SIR will help the stakeholders within the BE to increase their awareness of sustainability and influence their professional decision making processes and mind-sets to prioritise sustainable thinking in their professional and personal life contexts. The data gathered from this research will form the framework for the SIR.

4.10.2 Ethics - monitoring

The process of ethical monitoring will be continuous during the emergent divergent and convergent stages of the research. The first two stages will involve the interaction of respondents and interviewees, for example, those who will take part in the surveys and semi-structured interviews. The concerns outlined in this section will be uppermost in the thoughts and intentions of the researcher during all stages of the research, regarding confidentiality, neutrality and fairness.

4.10.3 Ethics - surveys

Influencing a person in any context has ethical risks, a point that will be kept in mind during the entire process. However, it is not the researcher’s intention to influence opinions or beliefs, however extreme. In the surveys, the researcher will be careful to ensure that his opinions are not revealed and thus remove the risk that the respondents or interviewees own opinion may be swayed, which would introduce bias and taint the results.

The SurveyMonkey® survey participants will be e-mailed links with a covering note indicating that all answers will be treated in the strictest confidence and are anonymous; it will not be required in the SurveyMonkey® format to disclose any information regarding the participant's name or their employer's details.

The surveys will be sent to stakeholder organisations all of whom are members of their respective professional bodies.

4.10.4 Ethics - Interviews

It will be made clear before the interview commences that the process is voluntary and that there will be no risk of the participant's opinions being made known to any other party other than the researcher. If at any time the interviewee feels that they are uncomfortable, the interview will be terminated and the noted data to that point destroyed. The researcher will be careful to ensure that no discussion regarding his opinions on the topic influences the interviewee. Interviews will not be undertaken on groups perceived to be vulnerable or those affected by cognitive impairment, or those who cannot make decisions, or, who are similarly affected during the research. Therefore, a reference to appropriate parties as per the Mental Capacity act (2005) or the equivalent in Scotland under the Adults with Incapacities (Scotland) act 2000 is deemed unnecessary.

No children will be interviewed during any of the research. It should be further noted that ad hoc interviews that the researcher may carry out outside of the UK will undertake with the permission of the interviewee's line manager.

4.10.5 Data Protection

The researcher works in an area where classified and above material is routinely accessed, therefore it was always intended that the research and its core data such as surveys and interviews would be archived according to these protocols. It is proposed that this will be done for the standard time determined by the researcher. The research and all associated material will be stored on a hard drive with a hard drive back-up and a 64GB Data Stick. These resources are stored on a secure computer that is not WIFI capable.

4.10.6 The Nature of research

The nature of research is not considered to be a sensitive topic such as nuclear, substance abuse, ethnicity, abuse, exploitation or gender-related. Outside of this thesis, the research has not been shared with any other party except Cranfield University, up to the publication of the thesis.

4.10.7 Confidentiality

A covering letter of confidentiality will be included for any posted surveys, and a section of confidentiality will be provided in the e-mail for survey monkey. The pre-amble will also serve to reassure the recipients that their answers will be treated in strictest confidence outlining that the reason they are being approached is related to academic endeavour, not commercial gain and that unless permission is given, no names or company associations will be published. All emailed surveys (pilot and main) by design will provide the respondent with an opportunity to remain anonymous.

Although the SurveyMonkey® website does record IP addresses on the survey return details, no attempt will be made to track them. The surveys will be deleted from the SurveyMonkey® website on completion of the PhD and then only hard copies kept by the researcher in conditions as previously described.

In both posted and emailed surveys the respondent will be informed that the survey is purely voluntary, and the inclusion of a stamped addressed envelope in no way should force the respondent to reply to return the survey

Any digital recordings taken during interviews were destroyed after the researcher had disseminated the required data for the research. Skype interviews were not digitally recorded.

4.11 Chapter Summary

This chapter outlined the methodology to be used, to capture the raw data necessary to answer the research question. It justified the reasons behind the use of a blended research paradigm, the question type choices, the reasons behind the stakeholder selection, and detailed some bias risks that the researcher will attempt to avoid in the methodology.

Both primary and secondary data collection methods will be used, which will be questionnaires, and semi-structured interviews. Other data collection methods will be the pilot survey (and semi-structured interview), the results of which will be outlined only when appropriate in Chapter 5, but not in full. In addition to the literature review, the other data collection method was the project duration word association survey, although it is accepted that this is not a standard collection method, its results are included within this thesis both for interest and to reinforce anticipated conclusions only (or not). It is anticipated that the methodology will be robust and flexible enough to gather the data needed to help answer the research question and provide a specification for the framework foundation structure of the research aim, the SIR.

5 SURVEY RESULTS

5.1 Introduction

Certain trends became apparent from the literature review, the pilot survey and the associated semi-structured interviews: Firstly, there is mounting evidence that sustainability is becoming a significant business driver in the BE, with an evolving appreciation that it needs to be integrated into core business strategy. Secondly, as previously discussed there would seem to be a general lack of appreciation and awareness of sustainability within the BE by many of its stakeholders. This may seem to be a contradiction, on the one hand, it is accepted that this is a significant driver, yet many are unaware. The chapter will explore this apparent ambiguity.

5.1.1 Pilot Survey

The pilot survey was discipline-specific and applied to three BE related sectors areas; these were: 1) Facility Managers, 2) Procurement departments, and 3) Building Contractors. There was some blending of disciplines which is not uncommon within the BE sector such as engineering consultants who are also contractors.

Several lessons were learned from the pilot survey that were incorporated into the main survey, such as;

1. Increasing the numbers of lower level management and younger respondents and interviewees. The relevance of this has been alluded to. In précis the younger generation who may be considered statistically the lower management levels (and non-management) are likely to be those who will champion the future of sustainability within the BE.

2. Simple dichotomous question styles will not be used in the main survey, and more comments boxes will be included in the survey and semi-structured interview to broaden the scope of answers

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3. Not enough investigative probing was undertaken in the pilot interviews this will be increased in the main survey.
4. Physically review Sustainability Policies and evidence of training in the main semi-structured interviews during interviews.
5. A single survey and single interview template will be designed and used for all targeted sectors, with less emphasis on sector specific responses.
6. Ascertain respondents/interviewees understanding of the concept of sustainability, increase the list of sustainability related terms from just two used in the pilot (closed loop and cradle to cradle).
7. It was felt that a broad enough respondent list within construction was not sought i.e. labourer's trades etc. This will be addressed in the main survey, surveys and interviews.

The pilot demonstrated that there was one strong consistency shared by these three disciplines, that being that there was a lack of awareness in varying degrees about the concept of sustainability. There were many concerns that information was not passed down and therefore company policies that might have been sustainability related were not made relevant regarding the concept and how it related to the BE. Sustainability was generally known of and in some respects practiced, although most respondents and interviewees identified it strongly from an environmental perspective. However, as a holistic concept with 4 pillars related to the BE the respondents and interviewees were largely unaware.

Although the importance of raising awareness is a logical route to making an issue universally known, success in creating awareness does not guarantee that action or a shift in mind-sets will follow. The well-known saying of "leading a horse to water", would perhaps apply, a point argued by Seymour, (2018).

5.2 Targeted Management Levels

According to Herron et al. (2013), the construction industry has been a slow responder to environmental issues and ultimately to sustainability, a point that is explored through the surveys and interviews. Except for sole traders, most companies have a multi-layered strata of employee levels in the BE, which includes a company CEO at the top and a tradesman/apprentice at the bottom with numerous levels in between, depending on the size of the organisation. For the purposes of this research, these strata will be referred to as, upper, middle and lower management. An attempt was made to question as many of the respondents as possible, in particular, lower management levels, and as previously outlined it was anticipated that this stratum of management will be younger and their general awareness of sustainability may be higher (Morgan Stanley, 2017), particularly when it comes to investment. Also, as outlined by Matiolli, (2007) a poll on green employment by MonsterTRAK.com found that 80% of young professionals are interested in securing a job that has a positive impact on the environment, and 92% would be inclined to work for a company that considered environmental credentials. If this is the case, then it is arguably young professionals, and students who responded to the poll in 2007 are the young professionals and possibly lower / middle management levels of today (2018).

It is therefore essential to explore the level of commitment, and awareness of sustainability that exists at this level, the level of understanding, and if there is a real comprehension of the concept.

Main Survey

One notable change from the pilot survey, was the design of a new survey question format. The pilot surveys had been stakeholder specific albeit limited to three, (facility managers, procurement and contractors). For the main survey the researcher felt after the results of the pilot survey that the main survey had less relevance being discipline specific. The reason for this was partly because not all disciplines were approached in the pilot therefore thus it could have been

argued that the results of the main survey were less representative of the BE stakeholder cross section.

Question 1: Which of the following best describes your employment context?

The BE is made up of many professional disciplines and sectors, too many to be explored individually to create specific surveys. However, this was partially attempted in the pilot and main surveys where three of the widest ranging and influential sectors that might influence the promotion of sustainability within the BE, were surveyed namely Facility Managers, procurement and building contractors. This question enabled the researcher to gauge (to a degree) the general level of awareness and interest for that sector and view the responses through the lens of that discipline. Although as mentioned this was not considered as much a priority for the main survey as it had been for the pilot.

The highest response rate came from the facility management sector, 31% followed by consulting engineers 14%.

Some of the response rates were disappointing, notably Building Control (3%) Planning (3%), Building Contractors (4%) and Architects (3%). The shortfall will as far as possible be corrected during the main survey interviews. The views of building control and planning are of interest as their role at the start of any project is important, ensuring compliance with legislation and policy at an early stage. It could be argued that the highest levels of response might come from the most interested stakeholders, in this case, Facilities Management (FM).

5.2.1 Question 2: How would you categorise your position within your company structure?

Except for FM, the levels of management for each discipline were not further broken down. This was due partly to a poor response rate from the other disciplines, but also because the emerging trend suggests that FM's are the most interested stakeholder regarding sustainability, and possibly the most influential during a facilities useful lifetime.

The aggregate responses from lower management were 25%, which represents 54% of the total FM responses. Overall, senior management responses were 47%, 25% less than lower management and 20% for middle management. 8% other represented non-management staff who were delegated to respond to the survey.

A priority with the main survey was to increase lower management responses, because of their potentially contemporary perspectives on sustainability and how they might react towards an IT-based tool like the SIR. the baby boomer generation (51-69 years as of 2018) are, according to Lyons (2016) called "digital immigrants because "digital" is their second language, and therefore they need to learn the language of the "digital natives", such as Generation "Y" with an age range of 20-35 years old.

The increase in responses from younger managers was partially successful improving on the relative percentages achieved in the pilot survey. However, 47% of respondents were Senior Management, and therefore any demonstrated lack of awareness from the survey results may demonstrate a lack of management leadership as discussed in Chapter 3. Failure of senior management to implement a change in behaviour towards the adoption of sustainability may inevitably lead to a lack of awareness.

5.2.2 Question 3: Which of the following institutions do you belong to?

Belonging to a professional institution provides several advantages including recognition, career opportunities, information, and, advice and networking (CTB, 2016). Many individuals turn to respective professional bodies for advice and reference during their careers, because many have extensive information/literature and online resources. Many bodies also have proactive communities including special interest groups where ideals and philosophies can be exchanged and shared.

Therefore, ascertaining the number of respondents that typically belong to these bodies is of interest as literature is widely disseminated online, in journals and

special interest groups. High membership and a low incidence of awareness inform the researcher that a significant barrier is at work, which once identified can be considered within the design of the SIR. It was found that 93% belong to a professional institution and 7% did not. While it is difficult to argue that there are advantages to professional institution membership, it should be noted that the benefits are eroded if they are not fully utilised.

With 93% of respondents belonging to professional institutions, one must ask if the members fully use their resources to gain knowledge and pursue CPD. Alternatively, as argued by Gibbons (2015) they might simply become a passive professional, doing the minimum to keep themselves up to date.

5.2.3 Question 4: Does your employer have the following policies? a) Sustainability Policy? b) Environmental Policy?

Although we frequently hear sustainability as a term it is vague and unspecific. If one asks others what they understand by the term, you get a wide variety of answers (Schäfer, 2013). What became apparent in the literature review was that sustainability had several associations and different meanings to different people, such as business resilience. A weakness in the question was that it pre-supposed the respondent understood the difference and according to Schäfer (2013), the terms may not be fully understood, at least in the given context of the BE and the four pillars. This will be an easier barrier to overcome in the semi-structured interviews. There are two rationales for this question, the first being whether the respondent is aware that policies exist and secondly are they aware of the difference.

In the case of an environmental policy (EP), it is often held in a company holds ISO14001 accreditation. It should be noted that currently there is no legislative requirement to have an EP or sustainability policy (SP) in place. The researcher is aware that many companies within the BE related context have published environmental policies. It should be noted that the two policies are not the same, a common mistake frequently illustrated in the pilot survey.

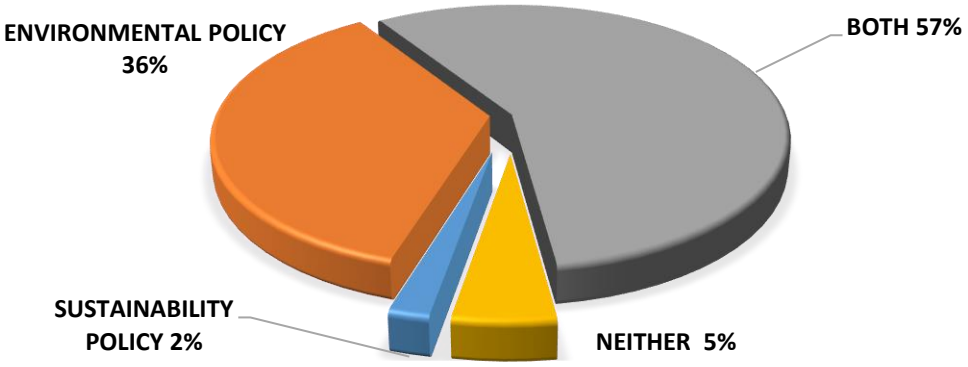


Figure 5.1 Pie chart illustrating Main Survey question 4 results; modified from Harrop SurveyMonkey® website (2015)

A great many companies within the BE sector would seem to have environmental policies. According to the results illustrated in Fig 5.1 most of the respondents have both policies.

The pilot survey demonstrated that respondents often believed that both policies were in place within their employer's organisations; however, there was often confusion as to the difference which may have stemmed from a lack of awareness as argued by Schäfer (2013). Several respondents demonstrated this. Firstly, there were those respondents who were uncertain of the difference between the two policies and secondly there were several respondents who did not know what a sustainability policy was.

Therefore, although the 57% "Both" responses may be genuine, the possibility cannot be ruled out that the respondents may have confused, or had a lack of awareness of the policies, and, therefore biased the results.

This will be explored further during the interviews to clarify understanding or awareness.

5.2.4 Question 5: How long has your company's sustainability policy (SP) been active?

The literature review outlined many initiatives that have progressed sustainability within the BE, such as the changes to the RIBA plan of work, the construction of the London Olympic Venue and of equal note albeit not confined to the BE, the 2015 updates to ISO14001 accreditation.

This question wanted to explore the length of time that sustainability has been considered within the respondent's organisation. It was anticipated that the longer the policy has been in place then potentially, the greater the level of corporate awareness of sustainability within the respondent's organisation. If a company has stated that they have had a long-term sustainability culture in place, then it is reasonable to assume that this has filtered down through company employees who may demonstrate a reasonable level of sustainability awareness. If on the other hand there is limited sustainability awareness in the company, then the barriers to its implementation will require identification.

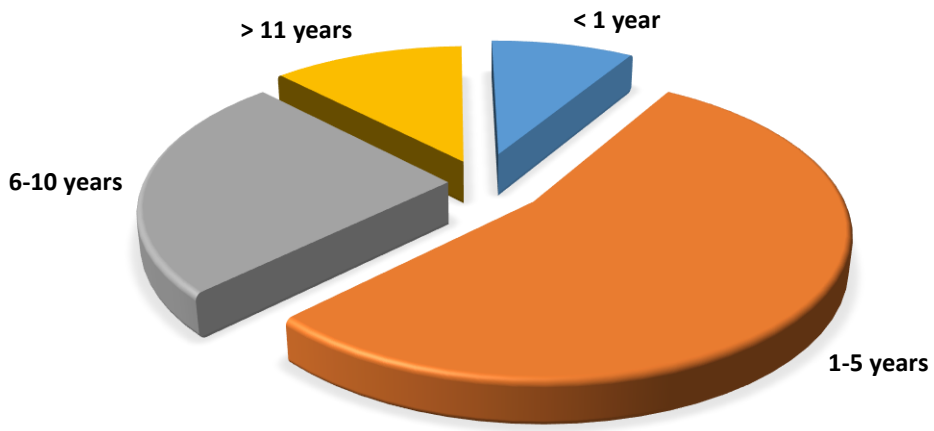


Figure 5.2 Pie chart illustrating Main Survey question 5 results; Modified from Harrop SurveyMonkey® (2015)

Although this question is strongly associated with question 8, the aim was to start the respondent's mind thinking about the timeframe relating to the company's corporate policy on sustainability. It seems relevant that the highest

percentage of respondents believed that the policies had become active within the last ten years. The choosing of this time frame is not arbitrary as it seemed apparent to the researcher that the word “sustainability” had been used to a far greater degree in the past decade, and according to Rimanoczy (2017), sustainability was an uncommon word 12 years ago. This may help explain some of the confusion related to the word particularly within the stakeholder sector (civil engineering and facilities management). Also, around this time significant and well-documented events occurred such as the Johannesburg Summit of 2002 and the London Olympic Venue.

As illustrated in Figure 5.2 the largest percentage of companies had an SP in place during the 1-5-year period, which raises further questions, such as what drivers prompted the decision?

5.2.5 Question 6: Are you encouraged to actively pursue sustainability within your professional remit?

It was evident from the pilot survey and the arguments of Aspinal et al. (2012) that sustainability within the BE could often be a “lip service” exercise. At the same time, it is recognised that corporate self-promotion of working within a sustainable regime can be beneficial, particularly with sustainability requirements appearing in pre-tender qualification documentation (PQQ). This question would allow the researcher to investigate whether Aspinal et al’s. (2012) viewpoint was justified. If this was indeed the case, then being cognisant of the barriers preventing corporate encouragement would be beneficial in considering the design parameters of the SIR.

The results were split into three management levels, and it was noted that the FM’s whose response rate ranked as the highest, reporting a higher incidence communication between the management levels all levels and greater encouragement to consider sustainability within their working contexts.

The highest level of management reported that 36% were encouraged to pursue sustainability within their remit. Middle-level management responded with 26%, and lower levels of management responded with only 20%. It might

be argued that the management strata underneath the most senior level would be led in any initiative, i.e. the promotion of sustainability within the company. This may explain the progressively diminishing positive response rates. This point was illustrated by a senior manager in an SME sized charity who stated that she was not directed by the board to pursue sustainability as a priority. Similarly, a further SME senior manager was not encouraged to pursue sustainability but was instructed to adhere to company sustainability-related policies such as waste reduction and sustainable procurement practices. As discussed in Chapter 3, leadership is an essential part of a successful company according to Satyendra (2015) where line managers are a key human resource who can influence people and turn potential into reality, and with good leadership organisational culture is not forced but developed.

Satyendra, (2015) further states that through leadership line managers can influence people in the management hierarchy to adopt a cooperative and wholesome attitude for successful work accomplishment.

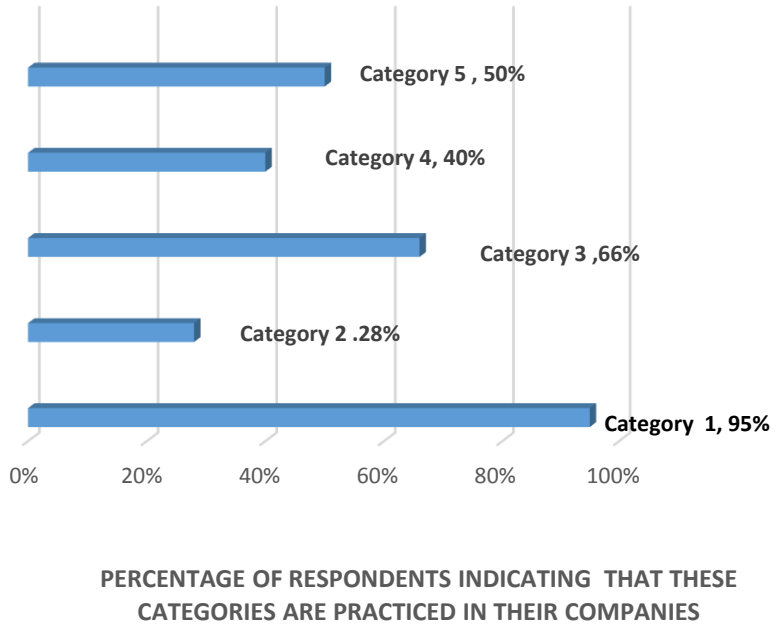
The researcher would argue that if Satyendra's (2015) assertions are valid, then the results suggest at least four issues need to be considered. Firstly, there exists a consistent lack of good leadership who did not encourage a sustainability culture. Secondly, there may be a lack of awareness of the relevance of sustainability from line managers and above. Thirdly, regarding awareness, or the lack of it, senior management may not consider the topic relevant, or perhaps because of the perceived costs to the triple bottom line. This point may well have been illustrated by several respondents who stated that sustainability was not considered essential and knowledge of it was not translated to lower management levels. Finally, sustainability may have different meanings for different companies. A senior manager of a blue-chip multinational company stated that sustainability was closely linked to business resilience, which according to Winnard, Adcroft, Lee and Skipp. (2014) relates to a company adopted strategies that can survive unpredictable competitive environments. In this context, the four pillars and the spirit of sustainability as defined in chapter one section 1.3 does not wholly apply.

As a note of caution, the question did not explore the degrees of encouragement or what form it took, for example, employee incentives or related training and education.

5.2.6 Question 7: From the following list, please tick the applicable sustainability issues which are practised within your company

It is anticipated that this question will provide the researcher with the types of sustainability practised by the respondent's company and therefore identify areas where there might be a lack of familiarity and awareness and also how sustainability may be defined within that company.

Waste management and recycling were identified in the pilot survey as the most recognisable facets of a sustainable regime particularly as they impact on both domestic and professional contexts. However, if the categories of "long-term planning of embodied building materials" and "sustainable procurement" had scored highly, this might suggest that sustainability is more integrated in a company's processes and therefore it might be expected that a companywide awareness of sustainability would exist.



Legend Figure 5.3

Category 1: Waste management and recycling

Category 2: Long term planning of embodied building materials

Category 3: Carbon emission management

Category 4: Specification of sustainable construction materials

Category 5: Sustainable procurement practices

Figure 5.3 Bar chart illustrating Main Survey question 7 results; modified from Harrop SurveyMonkey® website (2015)

Ninety five percent of respondents were aware that Category 1 “Waste management and recycling” were practiced within their companies suggesting that an emphasis is placed on these categories, and therefore arguably the categories most readily identifiable with a sustainable regime. That is if there has been no awareness training to counter that perspective.

It is worth noting that the two highest percentages illustrated in Figure 5.3 relate to waste management and carbon emission management both of which are legislation driven. A failing of the main survey that will be addressed in the interviews is the potential for confusion between Category 2 and Category 4. The former refers to the end of life and future reuse. The latter refers to the specification at the start of a project. The differences will be explained during the interview. It is encouraging that issues relating to sustainability are practised within the respondent’s working contexts. Nevertheless, it is unclear if the systems and procedures in place are adequate. The interview will probe further by considering why these systems and procedures are in place.

One respondent outlined that in their working context environmental issues were viewed through the lens of recycling and that they were adhering to company doctrine, through recycling waste paper, tins, cartons and cardboard. However, they stated that other issues illustrated in Figure 5.3 were “larger” corporate issues and therefore “somebody else’s problem”. The researcher’s experience is unquestionably that waste management is considered by most in the researcher’s workplace at a micro level, such as office waste paper and photocopier cartridge recycling. The larger contexts generally within the researcher’s experience are not considered. Probing will ascertain in the main interviews how well communicated the employer’s policies are, and if there are any attempts to increase other areas of awareness in the workforce including corporate issues.

5.2.7 Question 8: The importance of sustainability has increased in your profession within the last ten years, do you agree?

The researcher considered that ten years was an appropriate timespan as during this time there has been a considerable spotlight shone on sustainability within the BE. Examples were outlined in the literature review and include the RIBA plan of work amendments of 2013 and the 2015 amendments to ISO 14001. In addition to these, there have been some high profile multi-billion-pound projects such as the London Olympic venue, all of which have vigorously promoted sustainability within the BE and have had a great deal of publicity through the media and professional institutions. The researcher wanted to identify if any of the respondents considered that the sustainability profile had not increased in importance and if so to determine the barriers which influenced this lack of awareness, and conversely if they believed it had what had encouraged that opinion.

Although the researcher recognised that the choice of 10 years in a purely professional context might have alienated younger respondents, it was anticipated that their responses would reflect experience during their working period and additionally their opinions before working which may have been in related academic endeavours. According to the results, 92% of respondents across the sectors were aware that sustainability had increased in importance. Although the problems associated with creating a sustainable regime may not be fully appreciated, it seems that most respondents are aware that at least the concept exists, even if its definition and relevance to the BE is not fully understood

Arguably, this question relates to the research question and the SIR framework, as it raises the question that although an appreciation of sustainability seems to exist, there are barriers that appear to prevent stakeholders/respondents from finding out more and understanding it fully. 6% of respondents were not aware that sustainability had grown in importance, which suggests a narrow perspective on their part or a failure to associate their activities with the

concept. Reasons for this may have included a failure to understand the question?

This will be explored further in the interviews to ascertain the barriers to this lack of awareness. In so doing, the results will influence the SIR's design.

5.2.8 Question 9: Please tick the "Drivers" that promote the practice of sustainability within your company

Drivers promoting sustainability in the BE were outlined in the literature review, then further distilled and discussed in Chapter 3. The literature review identified that sustainability is fast becoming a significant business driver (Johnson & Matthey, 2011). The researcher wanted to explore the real-world relevance discussed in Chapter 3. The importance of determining the drivers cannot be overstated because the SIR framework or model will need to capitalise on this to ensure success.

The SIR will need to consider the drivers that promote sustainability within the BE including those variables that permit something to happen. A prominent driver in the pilot survey was Green Corporate image. The SIR's framework would, therefore need a feature that allows a company to demonstrate its use has been universal and provable to their clients, illustrating that their staff are sustainably aware.

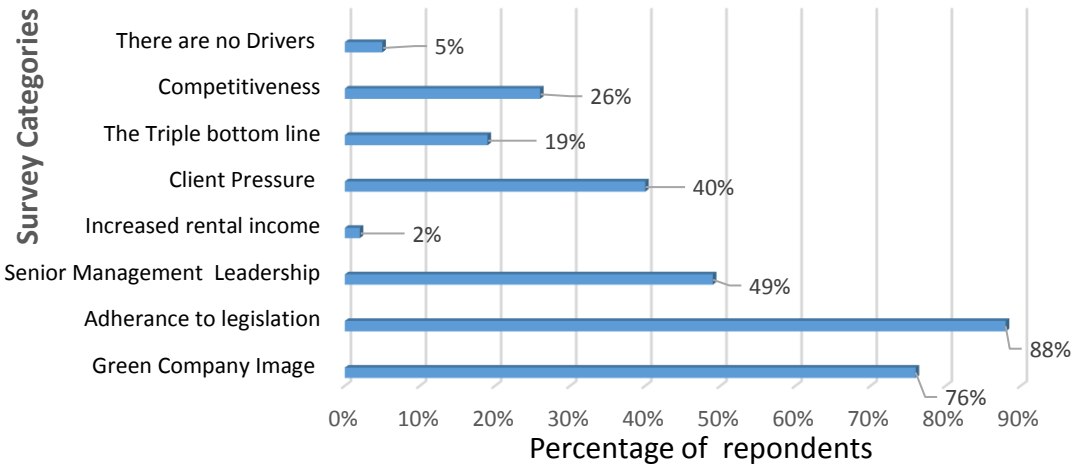


Figure 5.4 Bar chart illustrating Main Survey question 9 results; modified from Harrop SurveyMonkey® website (2015)

It is perhaps not surprising that the most influential driver is “Adherence to Legislation” as most company CEOs would not want to risk company reputational damage by contravening statute law. The most influential drivers from the pilot survey other than legislation were a green corporate image. Client pressure as a driver, however, merits greater investigation, as it seems that either this may not be appreciated by the respondents, or the client may not have insisted that sustainability is a consideration.

The main survey responses can be equated to those recorded in the pilot surveys, with a green company image, adherence to legislation and management leadership being the primary drivers.

Probing questions will be used in the interviews to ascertain why it is important to the interviewee that their company has a green reputation? What methods senior management use to promote sustainability within their place of work, and do they influence their clients, or, are they often influenced by them? Client pressure is undeniably an influencing factor as argued by Myler (2016), and one weakness with the question is that not everyone in the management strata may be aware of the commercial pressures faced by their company. This includes where the client/customer dictates exclusive communication linkages.

5.2.9 Question 10: Please tick the barriers that you feel hinder sustainability within your organisation.

Within the BE, the word “barrier” is commonly used to describe a gate or a component that prevents access into an area. In this context, the meaning is similar, a variable that can stop or impede an action. Consideration of these barriers is of paramount importance because they will influence the SIR framework.

An assessment of the barriers is a pivotal and important issue because the design of the SIR is contingent on a comprehensive understanding of them. If for example, the barriers are due to a lack of investment and lack of employer interest the SIR will reduce the impact or remove the barriers by promoting the reasons why investment is essential and what funding might be available.

Lack of investment and lack of employer interest have been two principle barriers towards sustainability in the BE and have been consistent in both the pilot and the main survey

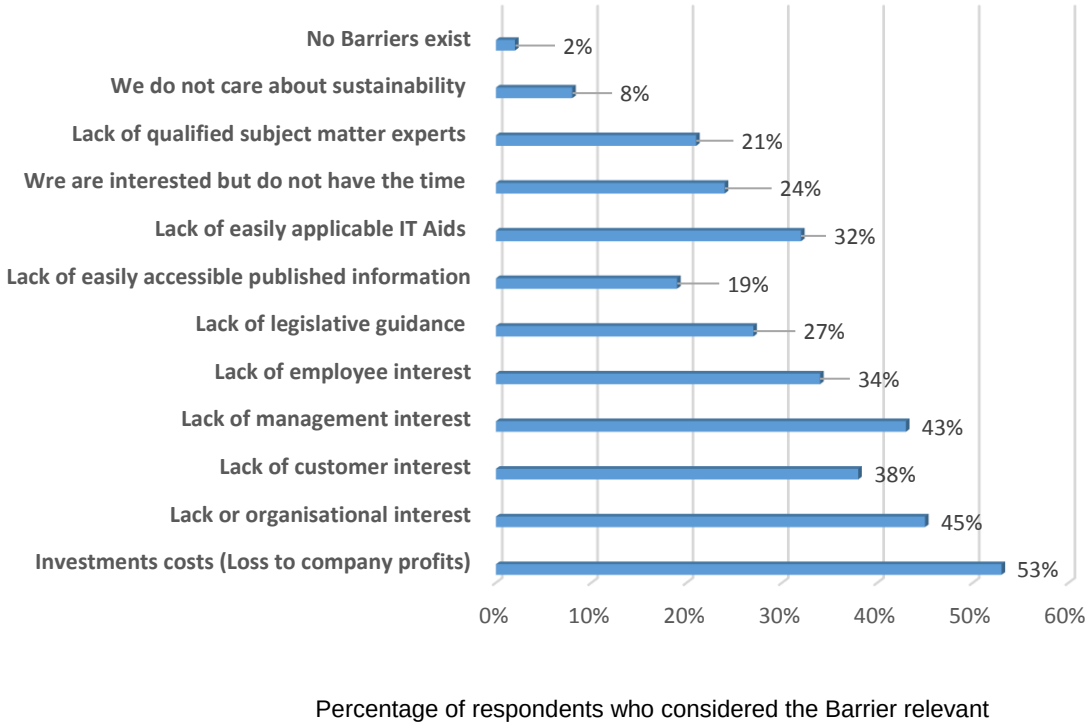


Figure 5.5 Bar chart illustrating Main Survey question 10 results; modified from Harrop SurveyMonkey® website (2015).

The results illustrated in Figure 5.5 were consistent with those from the pilot survey (the results of which are not included in this thesis). As outlined in Chapter 3 the argument that higher costs are directly associated with sustainable construction relies on a narrow definition of cost, thus typically reducing it directly to upfront costs and ignoring potential rewards as argued by Ireton (2008). The researcher would agree with Willard (2012), who argues that building sustainably does not necessarily mean greater costs because savings can be made, i.e. energy savings. Davis Langdon (2007) further argues the point that sustainable buildings can increase employee productivity, which will offer savings and increased efficiencies to an employer. The researcher would

suggest that the linear view of high costs and no returns suggest a lack of awareness of actual reality.

The next most influential barriers that were recorded in the survey centred on a lack of interest; which in order of priority were lack of organisational interest, lack of management interest, and a lack of customer interest.

As discussed in the literature review It might be argued that a single umbrella barrier exists that is the cause of these three barriers. This being a lack of awareness of the financial and ethical benefits of operating within a sustainable regime, and so a lack of awareness of sustainability within the BE at all sectors, and, at all levels of management strata. Once a broad awareness is established, and the benefits are known and where possible quantified, it seems feasible that organisational interest could increase, down the hierarchy though high, middle, and low-level management, and then the workforce in general, which may finally influence clients and supply chains. There are examples of large companies that have undergone this evolution, such as Interface as Fishman, (1998) outlined in Chapter 3.

As outlined above once certain barriers have been overcome there may be a natural and progressive cascade effect causing other barriers to fall. For example, if a company acquires funds to invest in sustainability initiatives, then the organisation may invest in other opportunities including training, and consequently the raising levels of awareness.

A salient point illustrated here is that drivers and barriers are not necessarily standalone entities, they are interconnected. These connections may be a strength of the SIR which could itself have a positive effect on promoting sustainability within the BE. Some barriers in the short term such as a lack of organisational, employee and customer interest, may be reversed once increased awareness of the benefits of a sustainable regime is identified and implemented. A secondary effect could occur where investment is pumped into the sustainability agenda within the organisation, which may be in the form of CPD training with the longer-term aim of revised or new workplace policies, again promoting awareness.

5.2.10 Question 11: Have you undergone any related Sustainability training?

The relevance of training is significant regarding the research question and developing the research aim. The Strategy for Sustainable Construction discussed in Chapter 2 emphasised the importance of training in promoting a sustainable BE. As discussed in the literature review, the emphases on the importance of training were made by the Institution of Structural Engineers (2015), who stated that training was necessary to promote sustainable construction and change. A company can demonstrate its resolve of promoting sustainability awareness within the BE by training its staff and in doing so develop a corporate ethic geared towards sustainability. Training may also indicate that the barriers of “cost” and “lack of management interest” have been overcome. The pilot asked the question posed above, albeit with fewer training categories, and the main survey increased the categories including academic training, external seminars, and, web-based training.

An organisation, irrespective of its industrial sector, may have to prove at some point that their staff are suitably qualified for the work they are involved with. This may take the form of academic post-nominals such as an MSc, PhD, or perhaps chartered membership in a professional discipline, such as the MCIOB and the RIBA. Barriers, as discussed in Chapter 3, would suggest that investment cost concerns may hinder training, particularly with academic training, where costs and time required can be significant.

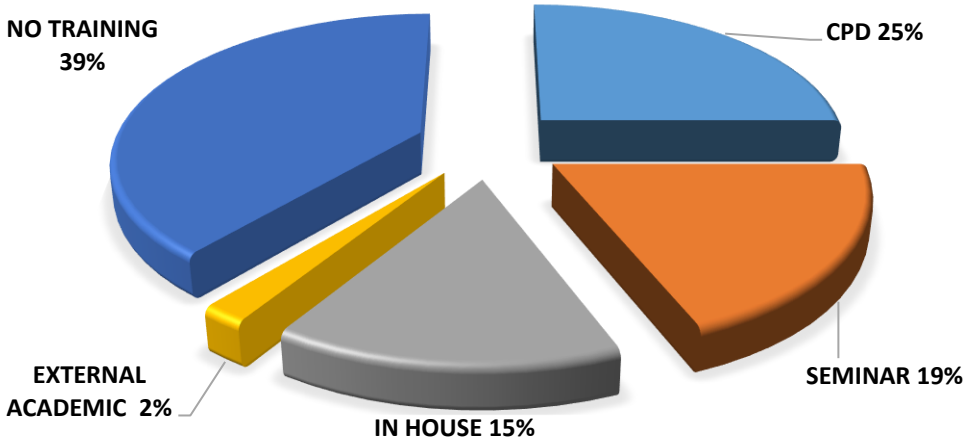


Figure 5.6 Pie chart illustrating Main Survey question 11 results; modified from Harrop SurveyMonkey® website (2015)

Thirty nine percent of respondents reported that no training had been given and that their employer was not prepared to fund any training or provide the time for it to be undertaken. Two respondents outlined that they were unaware of what training could be undertaken and that there was no incentive for being trained, such as promotion. Interviews will probe this area further to determine what the barriers are for impeding awareness training and further education, as it seems these may prevent the use of an awareness enabling framework such as the SIR.

Despite the results above many respondents outlined that CPD does occur in the office space which includes supplier talks outlining the benefits and sustainability credentials of their products and services, as well as briefings attended by their professional institutions.

One respondent stated there is very little resistance to this form of training from “Management” because if it is a supplier visiting, it is free advice. Although it is encouraging that 61% of respondents said that there was some form of training provided, the researcher accepts that bias with a tendency for some greenwashing is a risk, which will be investigated further in the interviews.

It might be noted that the most significant relative percentage of those who were undergoing some form of training was the Facility Managers

According to the Institute of Structural Engineers (2015), training is necessary to promote sustainable construction, and this is achieved through the creation of aware and informed individuals. That said, training needs to be more than a tick box exercise, and in the researcher's experience, some forms of training such as CPD can have the appearance of this, including short presentations which is part of a sales pitch with a certificate provided for attending. This is a generalisation perhaps, and even this arguably can raise awareness and pique curiosity, but in the researcher's opinion training should be consistent and thereby encourage introspective and reflective thought.

5.2.11 Question 12: Are you familiar with the following terms?

As argued by Schäfer (2013) sustainability can be misunderstood, therefore by extension as a general concept the same may apply. Respondents and interviewees from the pilot indicated that they considered sustainability another word for environment.

The pilot included only two terms, in its variant of this question these being "Closed Loop" and "Cradle to Cradle". The main survey increased to ten terms. All ten terms used were discussed in Chapter 2. This question arguably more than most, ascertains the depth of knowledge of the respondents because if these terms are recognised, and understood, it would suggest a deeper understanding of sustainability both in the BE and a wider context. For example, terms such as EAM may well be known to BE respondents. However, natural capital and intergenerational equity can also have strong BE sustainability associations, and are encountered even with minimal research into the topic, so if they are not known or at least well understood, then this may indicate a lack of general sustainability awareness.

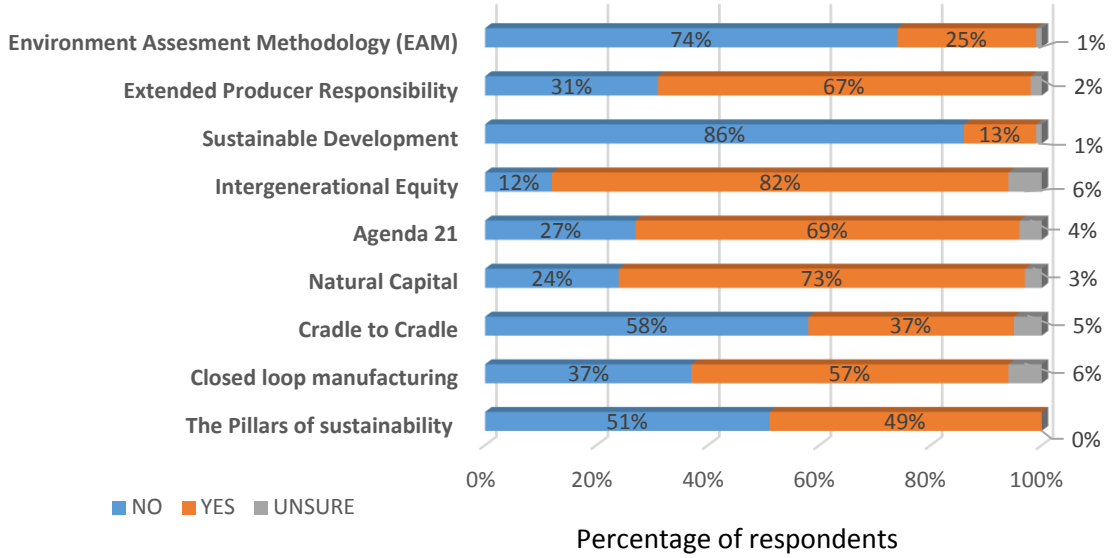


Figure 5.7 Bar chart illustrating Main Survey question 12 results; modified from Harrop SurveyMonkey® website (2015)

As discussed in Chapter 4 “Social acceptance”, “technical jargon” and possibly “response fatigue” are biases that may have influenced the respondent’s answers. Arguably “technical jargon” is the most likely. However, no apology is made for this as the researcher considered knowledge of these terms to be something of an “acid test” in determining whether the respondent had a more profound knowledge of sustainability in context with the BE.

Knowledge of all the above terms would suggest that an element of research had taken place, or a reasonably comprehensive course had been undertaken. As illustrated in Figure 5.7, demonstrates that a high percentage of respondents are not familiar with the terms. The “unsure” choice was included to remove the risk of a forced choice bias. Interviews will offer a more indicative result as the interviewees can be further probed asking for a definition and context of each term.

5.2.12 Question 13: Would you agree that Environmental Assessment Methodologies (EAMs) (i.e. BREEAM, LEED, and DREAM), have a positive impact on the four pillars of sustainability?

Those respondents who indicated that they were aware of EAM's were asked to give an opinion on how they impacted on the pillars of sustainability. This question allowed the researcher to ascertain respondent awareness levels of what the EAM does and their effect on sustainability within the BE.

Among other EAMS, BREEAM is mentioned in the literature review and is the world's oldest EAM established in the 1990s. BREEAM was the EAM most frequently referred to in the Pilot and the Main Survey. Again, this served the researcher's agenda to establish the level of sustainability awareness and determine if the respondent (had used an EAM) had considered what the EAM was for, and what it sets out to achieve.

There are criticisms regarding the EAM's as previously outlined in the literature review, including being a tick box exercise (Aspinal et al., 2012), and as a topic the researcher accepts there is an on-going argument as to the effectiveness of these EAM's, an argument that is only considered in precis in this thesis. EAM's are generally considered to be a benchmark in the BE related sustainable process and are often a demonstration of a building's sustainability and environmental credentials. The researcher considered it pertinent to determine the opinions of respondents who had used EAM's to establish whether they considered that the methodology was a genuine attempt to consider sustainability within the BE and were also asked to comment on the EAM through the lens of the four pillars of sustainability. This question was posed and may have been answered with an ignorance of the pillars, bearing in mind the results indicate that 75% were aware of EAM's yet only 51% were aware of the pillars of sustainability.

The question will be asked again in the interviews so that the researcher can determine the opinions of EAM's users and how they consider this relates to sustainability within the BE. The EAM is a framework that should promote

sustainability-related issues. If it does not, it is unclear if this is the fault of the EAM or the user.

There were several conflicting viewpoints from respondents with the familiarity with both EAM's and the pillars of sustainability.

Twenty respondents indicated that they believed EAMS had a positive (or partially positive) effect on sustainability within the BE. However, one respondent expressed a stronger caveated opinion.

"My opinion is that these can positively impact as long as the client/design team/contractor do not use them like a tick box exercise. Too many times it is used as a means to an end, without really embedding the principles in construction and design. Value engineering has a lot to answer for, and future sustainability often becomes very low on the priority list".

This opinion was reflected in several other respondents who did not believe that EAMS had a wholly positive effect. For example, three respondents believed that only the economic and environmental pillars were effectively served at the expense of the social or cultural. However, that view was countered by other respondents who indicated that EAMS in their experience had a positive impact on sustainability and the four pillars within the BE.

There may be several parts to this question, however, and this research will not cover them all. If the positive opinion of EAM's is not universal, then the genuine promotion of sustainability within the BE is arguably being damaged. A further respondent expressed that EAM's "can be used as a means to an end, a potential "selling point". If this is the case, is it the fault of the EAM that fails to have a genuine effect on the promotion of its core purpose, or the way in which it is used? This research looks at the EAM in a fairly general way and in no way attempts an in-depth study of the systems or their regulation and effectiveness. Nonetheless, their impact on the research question is important. A revised or new EAM will not be created as part of this research. However, the most that can be achieved by the SIR is to educate stakeholders by increasing awareness of sustainability within the BE. Perhaps then a more informed set of

stakeholders can universally ensure that EAMs are genuinely used for the purpose that they were arguably conceived for, a powerful tool to promote sustainability within the BE.

5.2.13 Question 14: Is your company/employer involved/ allied/subscribed to any company with links to Sustainable initiatives, for example, the United Nations Global Compact (UNGC), or the World Green Building Council (WGBC)?

As illustrated in Section 5.4.8 green company image was the second most influential driver. A number of these initiatives such as the WGBC and the UNGC were outlined in the literature review. The researcher would argue that being a signatory to organisations such as the WGBC and the UNGC shows a deeper level of commitment to sustainability and one that can be easily audited. There is no shortage of evidence tying the commercial sector with environmental or sustainability biased NGOs. This is evidenced by statistics such as the WGBC's 32,000 members (WGBC, 2016), and the commercial/NGO partnerships that are frequently in the media, such as Starbucks in partnership with Conservation International. The Nature Conservatory and Boeing, even Greenpeace, well known for their anti-corporate stance has an association with Coca-Cola (LeBaron, 2013). This strongly suggests that there are symbiotic advantages for both parties, for the NGOs possibly pecuniary, except for Greenpeace (LeBaron (2013). For the corporations there are probably two arguments that catalyse these partnerships' the drive for profit, and the drive for legitimacy (Schaltegger, and Hörisch, 2015). However, in the researcher's view, publishing a sustainability policy on a website can simply be a greenwashing exercise to entice clients who are looking for a supplier with a genuine commitment to sustainability with material evidence. When in fact, the company is not as wholly amicable as they may seem, as argued by Hoffman and Hoffman (2009).). However, the ISO14001: 2015 updates will force employers to enforce greater levels of inclusion of sustainability into their organisation's core business strategies, something that can be audited, if not then they will lose the accreditation that many clients demand they have.

Signing up to organisations like the World Green Building Council or the United Nations Global compact raises the bar as far as genuine commitment goes. It demonstrates or at least starts to demonstrate a directed intent and commitment to sustainability within the BE, at the very least membership of these organisations, should promote awareness across the company.

It is accepted that not being a member or affiliated in any way to organisations such as the two outlined above means that a company does not have a sustainability bias. However, it does raise questions about the level of commitment and the barriers that prevent membership to these organisations, particularly in gaining a perspective of the bigger picture of sustainability within the BE.

Fifty one percent of respondents were not members of an organisation that promoted sustainability within the BE, and only 15% said that they were with a few providing details of these organisations. This included one respondent whose company was a member of the Green Building Initiative. There were other names given by larger well-known organisations, such as those outlined in the question. It should be noted that organisations and NGOs that the researcher was completely unaware of promoting sustainability within the BE both nationally, and globally. This highlights that sustainability seems to be quietly practised at every level, yet awareness is not universal, so the question remains why? The 34% of respondents who replied “I do not know” would seem to demonstrate a notable lack of awareness, at many levels.

5.2.14 Question 15: To what extent do you think that the general concept of sustainability is fully understood by your company?

It was anticipated at this point in the survey that the respondent would be considering the company’s integration with sustainability to determine the level of their company’s interest and awareness.

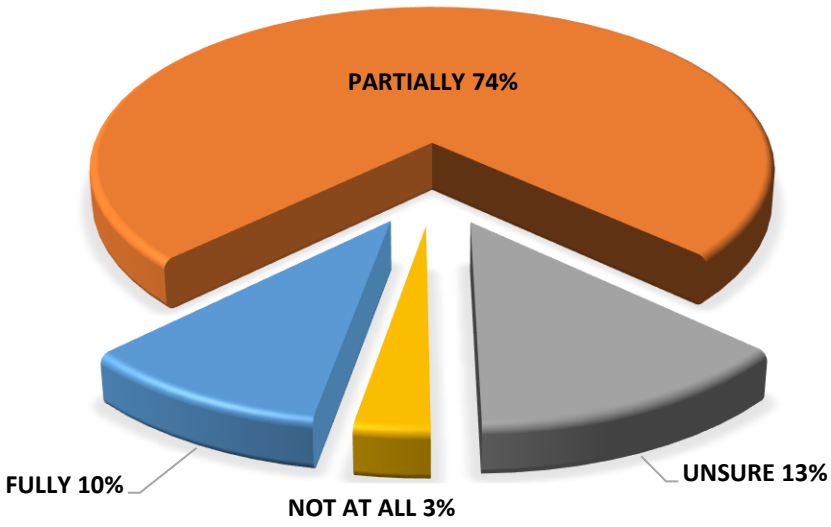


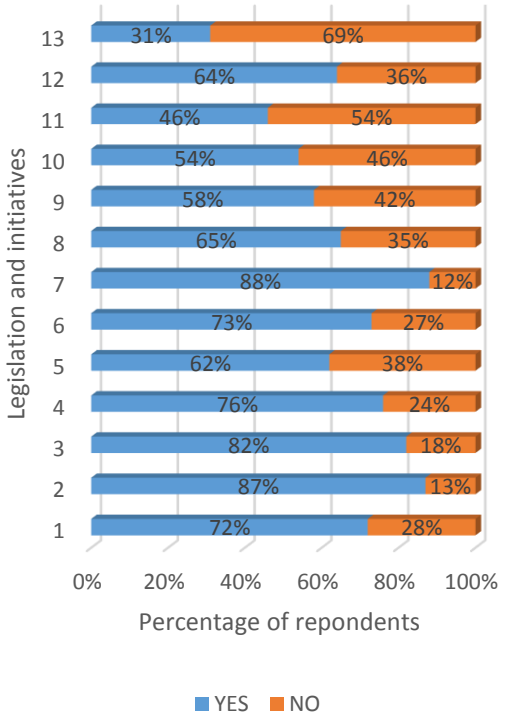
Figure 5.8 Pie chart illustrating Main Survey question 15 results; modified from Harrop SurveyMonkey® website (2015)

As illustrated in Figure 5.8, 74% of respondents reported that their employer had a partial understanding of the concept of sustainability. The 13% who responded “unsure” were lower management which further reinforced that this was an important stratum to be interviewed. Those who answered that their company was “fully aware” (10%) demonstrate a rare company that has fully integrated sustainability and has included their staff by encouraging awareness training. Such companies include Willmott Dixon (a company outlined in the literature review). However, it is accepted that some of the responses may have been affected by bias. This was on reflection, a question better suited to an interview. The main reason for this being that the researcher may be better able to judge if the interviewee’s level of knowledge is sufficient to qualify their assertion. Conversely, if they do not believe their employer has a grasp of the concept, yet indications such as a sustainability policy, training records contradict that opinion, then it may be the interviewee who has the lack of awareness, not the employer.

5.2.15 Question 16: Are you familiar with any of the following legislation and initiatives influencing UK building design and construction?

This question if positively answered suggests a deeper understanding of the legislation that impacts sustainability within the BE. The legislation and initiatives outlined covered a wide range of sustainability impacts on the BE and all pillars of sustainability. Much of the legislation and initiatives were identified in the literature review.

The researcher, by using the term "familiar" sought to establish if the respondent's knowledge was based on a superficial understanding of the legislation, or a level that granted full cognisance with sustainability.



LEGEND FIGURE 5.9	
1	The Climate Change Act (2008)
2	The Environmental Protection Act (1990)
3	Town and Country Planning Act (1990)
4	Environment Act (1995)
5	Waste Frame Work directive (008/98/EC)
6	Environmental Protection (Duty of care) Regulations 1991
7	Hazardous Waste Special Regulations
8	Landfill Tax and aggregates Levy
9	Site Waste Management Plans Regulations
10	Waste and Resources Action Plan (WRAP)
11	The Green guide to Specification
12	The Carbon Reduction Commitment Energy Efficiency Scheme
13	CEN standards on the Sustainability Assessment of Buildings

Figure 5.9 Bar chart illustrating Main Survey question 16 results; modified from Harrop SurveyMonkey®, (2015)

Stakeholders within the BE may have limited awareness as to why they are doing a "thing" but are doing it regardless to comply with legislation. A point argued by Silberman (2015) who states that people comply with the "Law" even

if they do not understand it, for three reasons. Firstly, a duty to comply; secondly concern with breaking the law, and thirdly that they have priorities in life they consider more important than challenging the rules. Arguably another reason for lack of awareness is not simply ignorance of a “thing” but that there is no inclination to understand a “thing”. With the exception of categories 11 and 13 on Figure 5.9, most respondents claimed familiarity with the listed initiatives and legislation. Although initially encouraging, the research question may be better served by understanding the barriers behind the negative answers. This is because it is likely that this legislation impacts on many areas within the professional context of those respondents who said “no”, which asks, “why they are not more aware and “how can that lack of awareness be corrected”.

The most well-known pieces of legislation include the Climate Change Act (2008), the Environmental Protection Act (1990) and the Hazardous waste special regulations. A possible reason (discounting acceptance bias), might be that the Climate Change Act (2008) and the Environmental Protection Act (1990) do not always overtly impact on a company’s bottom line unlike waste management particularly with the levies imposed by the landfill tax.

Figure 5.4 (s5.4.8) illustrates that 88% of respondents indicated that they considered “Adherence to legislation”, was the principal driver. The main survey was unable to determine the respondent’s depth of knowledge of this legislation, or if the 88% had a decent depth of knowledge, or as Silberman (2015) argues, a blind acceptance that the law must be obeyed, even when not fully understood. Regardless, there is consistency in that most cases the majority of respondents were familiar with the listed legislation. A weakness of the question was its purely “closed” format. The interviews through probing will be able to ascertain the interviewee’s depth of knowledge.

5.2.16 Question 17: Could the following known facts relating to the Built Environment be described as "sustainable”?

It was felt that many of the respondents in the pilot did not understand the adverse environmental impacts that the BE is responsible for. This question was designed to outline the environmental impacts caused by the BE industry and included various facts identified in the literature review including Energy from Fossil fuel consumed in construction accounts for half of UK’s emissions of CO_2.

1. Energy from Fossil fuel consumed in construction accounts for half of UK emissions of CO_2
2. More than 400 million tonnes of materials go to the site, 60 million tonnes go to tip because of over-ordering / damages landfill
3. UK Construction sends 36 million tonnes of waste to landfill each year
4. The UK construction industry consumes 6 tonnes of raw materials for every person living in the UK each year
5. 30-40% of Global energy consumption is directed to the construction and operation of the built environment
6. 3 billion tonnes of raw materials annually extracted for global construction materials

The majority of respondents chose “No” for each item, (mean average 73%) indicating that the stated issues were not considered sustainable. Those in the minority who answered “Yes” indicated that they considered that these were sustainable or perhaps not environmentally adverse (mean average 8.5%). However, the survey in this format did not allow the respondent to defend this opinion. A considerable number of respondents answered, “I do not know” (mean average 18.5%). Although it is accepted that bias may have influenced the “Yes” answers, it is hard to understand that applying the “don’t know”, unless “technical jargon bias” was applicable. The researcher, therefore, considers that these respondents may be unaware of the issues and adverse effects outlined in these 7 points. This area will be explored further during the interview.

5.2.17 Question 18: Would you use an interactive IT-based "living" Sustainability resource that promotes sustainability awareness, records and monitors a building (or buildings) impact on the pillars of sustainability throughout its lifetime? A framework that would include within its capabilities the following functions:

The researcher felt that each of the points, none of which are arbitrary, would help promote a lack of awareness to sustainability within the BE, and the part of the SIR framework would start to coalesce from the responses. SIR is an awareness empowerment tool.

According to Iliopoulos (2017), awareness starts with knowledge. Therefore to expand that point, the greater the knowledge, the greater the awareness. Therefore, with awareness, an individual can make sense of themselves and the world around them. The researcher would concur with this and expand on it by saying that awareness of sustainability within the BE, needs to start with being self-aware and understanding how that impacts on one's own professional context.

To be self-aware of one's own BE and its impact on the four pillars, certain things need to be considered and understood. These would include detailed knowledge of the total tonnage, mass, specification and location of all the components that make up the building(s) structure. You would need to understand the nature of materials used for construction, such as the inclusion of toxic or hazardous materials. You would require an awareness of the buildings carbon footprint. From a BE perspective, the researcher would argue that understanding and being aware of these points is a definitive first step to being aware of one' s BE environment from a sustainability perspective. As Iliopoulos (2017), states: "and with awareness, an individual can make sense of themselves and the world around them."

The ten proposed functions of the SIR framework are listed below. The questions allowed for an "open" element follow-on box at the end to allow for additional comments. This is intended for respondents to comment on the ten potential functions and perhaps outline others they might expect.

Results:

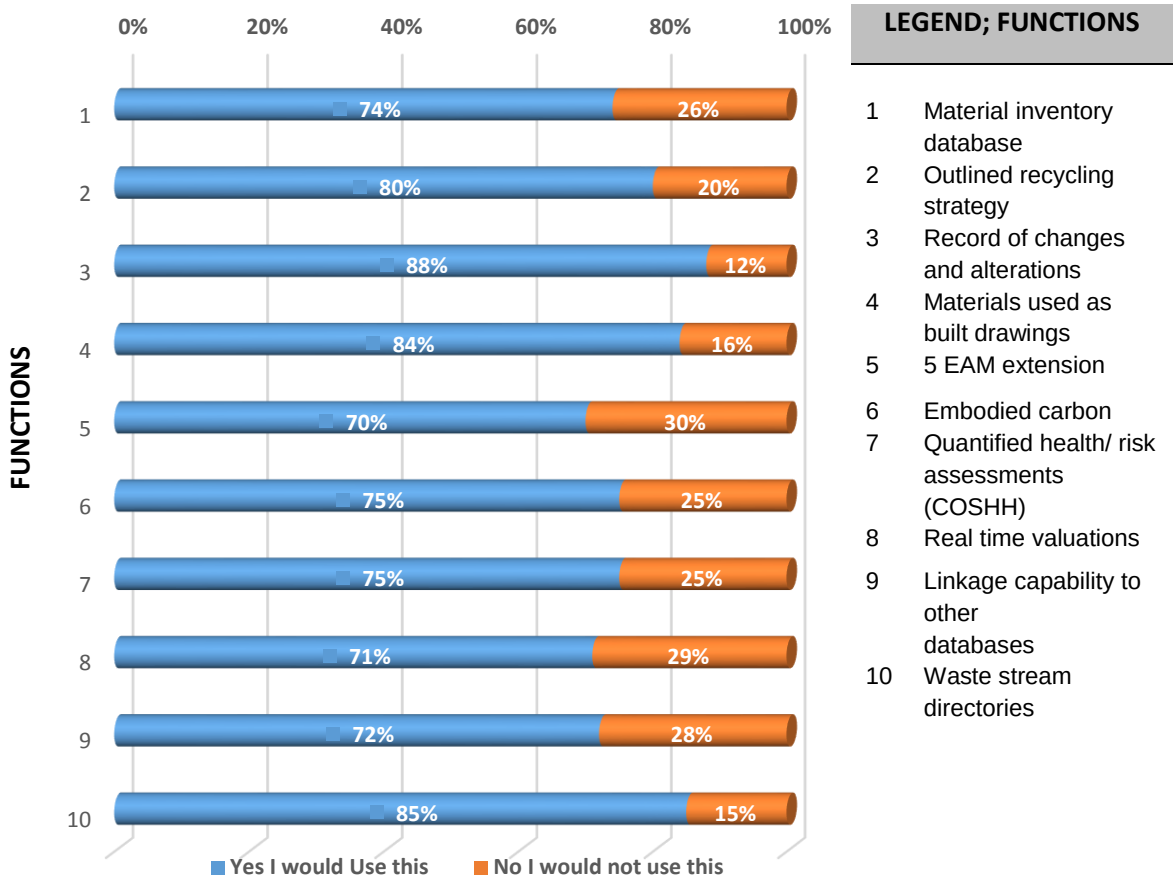


Figure 5.10 Bar chart illustrating Main Survey question 18 results; modified from J Harrop Main survey by Harrop. SurveyMonkey®, (2015)

It should be noted that the mean average of respondents who would use the interactive living database outlined above which would form the skeleton of the SIR, 77.4 %.

A number stated that they would not use the database and cited reasons including specific functions were not applicable to their working environment and that they would not use the function that quantified “real-time valuations” as their building was leased. Another respondent saw no value in quantifying the embodied carbon of their buildings, and there was no statutory requirement to do so.

One respondent offered some conflicting responses, citing the importance of sustainability and agreeing on the benefits of EAM’s stating they had a

comprehensive knowledge of BE legislation which had an impact on sustainability. Their company believed that the facts outlined in question 17 were not sustainable but would not use any of the functions of the database outlined in question 18.

Forty percent of the respondents outlined that the database should be more than simply a site-specific model, with many outlining functions that were already included in several commercially available BIM models. One respondent whose opinion echoed a significant number of respondents stated that there would be far more interest in a model that not only did this but allowed for a broader context of sustainability within the global BE to be accessed because issues including climate change are a global phenomenon and not site or building specific. They also stated that the “causative issues were global”. This point was repeated by several different respondents, whom all suggested that the SIR had a broader application than just being site-specific because the sustainability of the BE was a global issue.

5.3 Semi-Structured Interview (See Appendix A)

5.3.1 Question 1: Which of the following best describes your employment context?

The researcher decided to remove the Planning and Building control sectors from the main interviews, not due to their lack of importance, but principally through the difficulty in arranging these interviews even by telephone and Skype. It was, however, recognised that this sector is influential; though for the SIR, they would seem to have limited influence in promoting sustainability to the stakeholders of the BE in any other way than legislative through acts such as Town and Country Planning Act, the Building Regulations Act, or Technical Standards in Scotland, in effect by stick measures.

The researcher added a new stakeholder category to the main interviews, that being the Health, Safety and Environment (HS&E) manager. Despite the small number that could be interviewed, their opinions were sought as their roles are impacting more on a company’s sustainability processes. If a company has no

dedicated sustainability professional in place already, then it seems likely that these individuals have at least one word in their job title (Environment) that may make them the first choice for delegation of this function by senior managers, (this is certainly the researcher's direct experience). Civil engineers were generally site based, and targeted consulting engineers were a mixture of civil and structural engineering disciplines. It was felt that this represented an adequate selection of BE sectors to discuss the topic as far as possible in face to face interviews and acquire a representative cross-section of opinions.

Stakeholder	% of total Interviewed	
a. Building Contractor	22%	
b. FM	42%	
c. Civil Engineer	8%	
d. Structural Engineer	8%	
e. HS&E Manager	7%	
f. Architect	11%	
g. Specialist Supplier/ Manufacturing	2%	(37 interviewed)

5.3.2 Question 2: How would you categorise your position within your company structure?

The researcher made a concerted effort to approach the lower management levels and tradesman as far as possible. The pilot (including the interviews) and the main survey respondents were mostly from higher levels of management and although in no way were these opinions invalid, it was felt that a broader cross-section was more representative. Particularly as the younger generation were more likely to be lower management. This though was less likely with some of the trades whose opinions were valued because of their experience and perspective, which despite many being decidedly "old school" they were far more practically biased.

The reason for improving the cross section of respondents and interviewees was to determine if the emerging trend of a lack of awareness was commonplace. The SIR's core reason being will be to combat a lack of awareness of sustainability within the BE, therefore made this a necessary step.

Previous responses from the pilots and main surveys have in the main been from the higher levels of management, with poor response rates from the lower management. The relevance of this is that there is value in garnering opinions and assessing relative levels of awareness throughout the entire management structure of an organisation.

The core reason for this is that the lower managers of today are likely to be the higher managers of tomorrow and thereby ultimately dictating policy. Raising awareness of sustainability today in the lower management levels may, therefore, lead to it being established within their corporate mind-set, in the same way, quality assurance is arguably considered to be today by middle and higher management levels within the BE today.

An open question demonstrating the non-pure form paradigm outlined in Chapter 4 asked the interviewee who in the management structure was responsible for corporate sustainability initiatives. One interviewee, a Senior Manager from a multinational company with a multibillion-pound facilities portfolio, stated, “Although there was a person identified in the company they were not very effective in promoting either their position or sustainability’s place in the corporate ethos. Another interviewee, a middle-level manager working for a large “Total FM” company indicated that they were aware that there was an individual in this role, but they had no idea who it was. Other opinions strongly reflected these two points, in addition to this, it seemed that several companies had assigned the sustainability role to their environmental manager, who may not have had training or knowledge of the general contexts of the topic.

Some of the answers suggested the possibly that with many companies’ sustainability is viewed as a primarily environmental issue, which provides an early indication that there is a lack of awareness at a high level within many BE disciplines of sustainability’s context within the BE.

5.3.3 Question 3: To which of the following professional bodies do you belong?

Similarly to question 3 in the main survey, the question was included to discover the level of awareness of interviewees who were members of a professional organisation. If they appeared to have a reduced awareness of sustainability despite these bodies providing access to information, they apparently did not use it. This would indicate deeper barriers that exist and raises questions as to why the information is not being communicated through what should be effective means. It is, therefore, unlikely that a resource such as the SIR would be used unless these barriers can be overcome.

All the professional bodies listed, have committed sustainability agendas such as the Federation of Master Builders' Sustainable Development Charter and the British Institute of Facilities Management who conduct annual surveys specifically regarding sustainability within their discipline. It is perhaps logical, therefore, to assume that anyone who is a member of the company has an empowerment framework to improve their knowledge of sustainability within and without the BE.

Seventy percent of those interviewed were members of a professional body which among the interviewees included the Chartered Institute of Builders (CIOB), the British Institute of Facilities Management (BIFM), the Institute of Environment Management and Assessment (IEMA), the Royal Institute of Chartered Surveyors (RICS), the Royal Institute of British Architects (RIBA), the Institute of Civil Engineers (ICE) and the Institute of Structural Engineers (IStructE)

Probing questions revealed a consistent trend that interviewees who were members of professional bodies were not fully utilising the resources that they offered. Several interviewees echoes the view of an SME's Managing Director, who stated that although he was a member of two professional bodies he rarely had the time to use them for either research or reference; he also stated that he had a stack of the unopened monthly subscription association magazines still in their plastic wrapping. The interviewee was further asked why he had joined a

professional body, if not for the networking and referencing resources. His reply illustrated that membership was primarily a measure to provide customer reassurance and provide validity for pre-qualification questionnaires (PPQ's), needed to progress through to the next stage of a contract tender. Although this interviewee stated that he was aware of the concept of sustainability within the BE, he admitted that his level of knowledge was lacking. The opinions of this interviewee were shared by several other interviewees, and many stated that they accessed their professional institution for advice, reference or networking at most once a month.

Several Interviewees who were small and micro businesses owners indicated that they had no real understanding of the concept of sustainability within the BE. However, they were interested in learning more about it because they heard the term mentioned more in their working contexts. One interviewee, a sole trader, stated, "I hear the word (sustainability) more and more, it sounds like something that customers are expecting to see demonstrated". This latter point was typical of other small traders interviewed such as a Managing Director (MD) of a scaffolding SME employing 40 people; also this interviewee was concerned that the noticeable climate issues could adversely affect his business, as his business was largely externally based.

A point made by at least three interviewees was that they had no idea where to access information on sustainability, particularly as it related to their working context as they were not members of any professional organisations and had the minimal intention of joining one.

Throughout this question, a theme evolved one which the researcher certainly sympathises with, that being a lack of time to access the websites and go looking for the relevant section regarding sustainability. Research of this nature is not hard to do, but it could for example with the researcher's own professional body's websites be made easier especially for the older generation who may be in senior positions and less computer literate that the younger ones. In addition to this, the researcher and probably many of the readers of this thesis will be

guilty of having a stack of unopened professional subscription journals waiting to be read.

5.3.4 Question 4: Does your employer have the following policies? a) Sustainability Policy? b) Environmental Policy?

Question 4 in the main survey asked the same question. The results highlighted that there was confusion between the two policies. Many respondents, for example, considered that these were the same thing, albeit with different designations. The risk of acceptance bias was also a consideration in the survey, a risk that could be better managed in an interview by viewing the policy and probing to ensure that the interviewee knew the difference between the two policies.

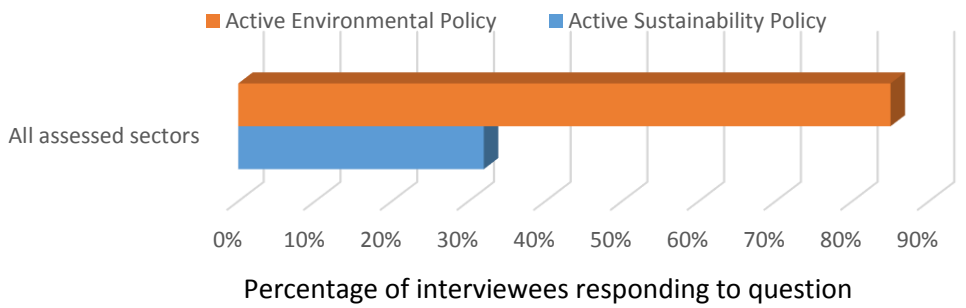


Figure 5.11 Bar chart illustrating Semi-structured Interviews question 4 results; Source Harrop (2016)

The interview format allowed the researcher to physically inspect the documents although it should be noted that a minority of interviewees refused to show the actual policy citing “commercial in confidence” reasons, although it was possible with some of these companies for the researcher to view the document on the company’s website. Probing questions were generally posed asking interviewees what barriers they considered relevant to their organisation if they did not have a sustainability policy. Twenty percent of the interviewees were unaware of the difference between an environmental policy (EP) and a sustainability policy (SP), however, in 50% of those instances, the interviewee’s (which varied from SME’s to multi-nationals) had fully developed EP’s and SP’s in place. Most of the interviewees had limited detailed knowledge of these

documents even though in many cases there were published documents in operation noted on their respective company websites.

Respondents who asked were told the difference between the two policies after they had finished answering the question. According to one interviewee barriers against the implementation of an SP included a lack of time, and according to two others, there was a notable lack of awareness of the concept. Although it was uncertain in all cases whether this was the result of a companywide lack of awareness or just that the higher levels of management (possibly more aware of sustainability integration in the company processes) had not passed on this knowledge sideways or to the lower levels.

An Interviewee who worked for a multinational organisation stated that “the principal context of sustainability, emphasised to him by his management structure was that of company resilience.” He seemed far less aware of any other definitions of the term despite his company having a very comprehensive sustainability policy in place

Many interviewees outlined several barriers against the implementation of an EP and an SP which included a lack of time, a lack of organisational interest and a general lack of awareness of the difference between the two policies. It was evident, however, that there is a genuine interest in sustainability as at least two sole traders and several non-management level employees outlined that they were applying pressure on their employers to recognise sustainability and its relevance in their industry.

5.3.5 Question 5: Would you agree that you are encouraged to (or encourage) the pursuit of sustainability within your professional remit?

This question allowed the researcher to determine the level of sustainability awareness and commitment in the interviewee's employment context and depending on their awareness of sustainability, establish if they would have been aware themselves if they were being encouraged to pursue sustainability within the BE.

Although most of the interviewees were familiar with the high profile visible initiatives such as office waste recycling and energy management (turning off office lighting and computer screens at night), many of the interviewees considered that this was the extent of the encouragement regarding sustainability.

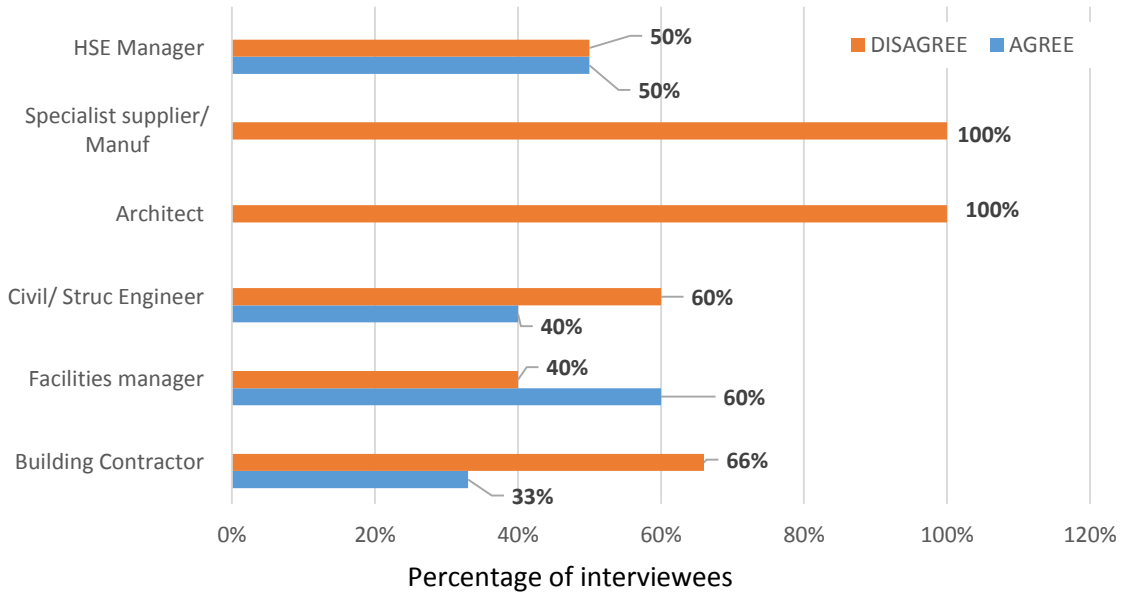


Figure 5.12 Bar chart illustrating Semi-structured Interviews question 5 results; Source Harrop (2016)

Many interviewees whose employers held SPs and EPs disagreed with the surmise that they were encouraged to pursue sustainability within their remit. Although there were different reasons for this:

A Managing Director of an SME with 100 employees stated that the promotion of sustainability within his company was probably his responsibility. However as he did not fully understand the broader concept as related to the BE, he did not consider himself well placed to encourage it in others. When further probed why he had a basic knowledge despite dealing with several BREEAM projects and enquiring clients, he indicated that he had never been inclined to research further because of time restraints and the lack of an easy to use centralised point of reference, as he admitted his level of awareness was perhaps as he put it “shamefully lacking”

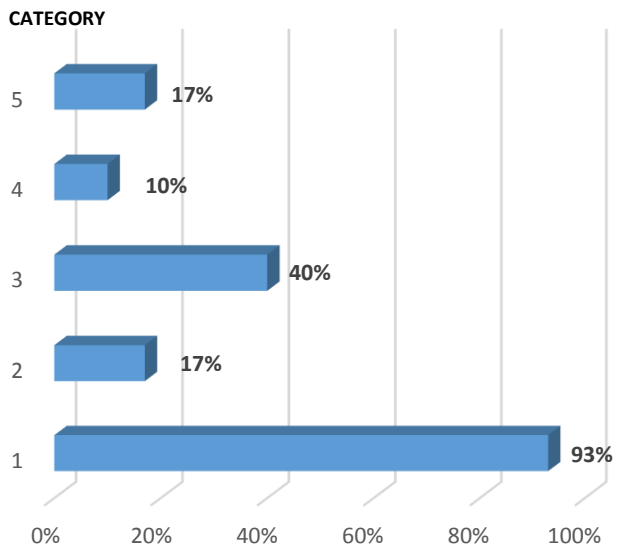
A consistent trend in the results was the lack of encouragement from higher management outlined by several the interviewees, such as “Int no 5” who stated that there was no encouragement to increase awareness of sustainability from higher up in the management structure. One interviewee, a low-level manager in an SME Architectural practice, stated that although there was a very comprehensive sustainability ethos regarding the BE in place, within his company, it was not however promoted or actively audited, and that there was no flow of information regarding its use or its purpose. Several of the interviewees who were interested in the concept relied on trade journals and discussions with suppliers to further their research. One interviewee, a middle manager in a soft FM SME, stated that his client had discussed the concept of sustainability and what they would expect from him in future business dealings.

Another interviewee outlined that this employer had inductions for most things that happened on site including security and health and safety, which included half-day courses on fire picket training and other issues he considered minor. However, he further outlined the word “sustainability” had never been mentioned in any of these courses and inductions. This interviewee and several others complained that they would be more interested if it was easier to find out about the larger issues, and they felt that there was not enough transparency in the company regarding its policies and affiliations. Interviewees who had a knowledge of sustainability and felt they were not included in the company’s direction, mostly considered that it was not worth rocking the boat and becoming proactive.

5.3.6 Question 6: What of the following sustainability-related issues are practised within your company?

This question allowed the researcher to determine how sustainability was practically approached within the interviewee's company and explore their level of awareness of what was done and possibly why. It was found in the main survey that several of the given BE sustainability-related categories (see figure 5.13), were practised in the interviewee's company there was also a concern in the main survey that there was confusion between the categories particularly

categories 2 and 4. An interview format would permit a certain degree of explanation if needed.



LEGEND 5.13:

Category 1:
Waste management and recycling
Category 2:
Long term planning of embodied building materials
Category 3:
Carbon emission management
Category 4:
Specification of sustainable construction materials
Category 5:
Sustainable procurement practices

Figure 5.13 Bar chart illustrating semi-structured interviews question 6 results; Source by Harrop (2016)

The results of this question closely mirrored those recorded in the survey, the priorities were the same albeit the percentages in all respects lower, but the same pattern emerged. That being that waste management and recycling would seem to be the most closely associated task with the general concept of sustainability. Zigmond et al. (2011) argue that it is a common perception to consider sustainability as strictly an environmental issue, certainly a point that echoes throughout this thesis. They cite that many people believe that if they recycle they are sustainable. Also, that many behaviours people commonly associate with sustainability are not enough in themselves to qualify as truly sustainable (Zigmond et al., 2011). The researcher's personal experience reflects this perspective, although waste management has been a part of his experience both personally and professionally it was practiced initially without an awareness of the concept of sustainability within the BE. The word might be considered a rebranding of waste and recycling. This was certainly the researcher's perspective before this research. According to Rimanoczy (2017), sustainability was an uncommon word 12 years ago, which gained new meaning as it became more linked to scientific publications relating to climate

change, this may explain some of the confusion about the definition of the word and what it encapsulates.

Among the contractors interviewed, the reuse of materials within their work context was a well-practiced process; for example, reusing aggregate, crushing concrete for hard core, reusing asphalt for new road surfaces and recycling steel, such as cited by an Interviewee who was a Managing Director of a Building Contractor, an SME with 100 employees. According to this interviewee, this was due primarily to economic reasons rather than sustainability considerations; landfill was expensive and if materials could be re-used some of the savings could be passed onto the client. Most of the building contractors cited the similar reasons, in precis that being the financial reasons over the environmental.

Interviewees from contracting firms such as a groundworks contractor in North Scotland who processes thousands of tonnes of construction and demolition (C&D) waste annually were understandably vocal on this point, because of land-fill costs and its adverse effect on their bottom line. Good waste minimisation practice was generally from the interviewee's perspective a pecuniary measure rather than proactive sustainable practice. However, in the researcher's opinion, it is still a start to promoting awareness, in fact persuading companies that sustainable practice might have an ameliorating effect on the bottom line may be the only way to promote it.

It is recognised that investment costs are arguably one of the most significant barriers as previously outlined. Therefore sustainability initiatives within a commercial context would have to demonstrate earning power. There are numerous companies who can demonstrate that sustainability can generate income and promote business, such as Marks and Spencer, Walmart, Sainsburys, Dupont, Tesco and Unilever to name only a few (Zokaei, 2013), as well as many UK companies who specialise in demonstrating how sustainability need not cost a business but can generate profit.

Carbon emission management was in both the main survey and the semi structured interviews the second most popular issue. According to several

interviewees, initiatives for carbon management are based on energy savings, which include a strategy for the electrification of their cars and Lorries within the next ten years and exclusively using LED lights in their Facilities.

One interviewee outlined that their supply chain was being reappraised to making it more sustainable, inline with the new ISO 14001 requirements, and it required on their part several changes to their supply chain and persuading others to follow suit, a strategy they claimed is working. On that point, several interviewees admitted that their diligence in waste minimisation was attracting interest from clients who were ISO 14001 accredited, and keen to demonstrate that the 2015 update were proactively being incorporated into their ISO 14001.

It should be noted that interviewees from some of the smallest companies approached (sole traders/ microbusinesses) also diligently practised recycling and considered that they should play a part in protecting the environment.

What was certainly found here was that there was a mixture of attitudes, there was informed awareness as to the sustainability-related categories illustrated in Figure 5.13. Several interviewees stated that their companies practised these categories without a thought to the sustainability benefits but mostly for pecuniary advantage. What was striking, however, was that 10% of the interviewees (some from larger companies) had very little knowledge regarding their company's sustainability initiatives. Probing revealed that these interviewees had very little idea what was on their website, they generally cited a lack of time as being the barrier for not researching it more. On this point, the researcher would agree with Ferdig's (2007) statement that sustainability leadership is an emerging consciousness and clearly from these results, the concept is not being promoted by the leadership.

5.3.7 Question 7: Sustainability issues have increased in importance within your profession within the last ten years, do you agree?

In the main survey, 90% indicated that they believed sustainability had increased in importance within the BE in the past ten years. The researcher decided in this instance to test this high-end result in an interview setting to reduce the risk of acceptance bias. This was partly achieved by probing, and establishing both why the interviewee agreed, and the context that made them consider it relevant, such as waste generation or global warming. Those who would answer “no” would be subject to probing questioning to ascertain the reason(s) behind their answer. In précis, to determine the barriers to their lack of awareness. An acknowledged weakness in the question was that the opinions of the younger generation were of interest to the researcher; however 10 years before they may have been in school, yet to start on a career path; in these instances the researcher was interested to know more about their exposure to sustainability be that from domestic, professional or academic sources.

Replicating the results achieved in the main surveys, the interviewees overwhelmingly agreed that sustainability had become more prominent over the past ten years (90% agreement), which would be consistent with the researcher’s experience and the arguments of Rimanoczy (2017), relating to the recent appearance of the word in its newly established context.

At least 20% of the interviewees from all sectors stated that the word was becoming more prevalent in their routine professional and domestic lives.

According to 60% of those interviewed sustainability was frequently mentioned in articles in their professional subscription magazines. Other sources of information included the media and the increasing use of the word sustainability in trade literature, for example, “timber from sustainable sources“, and reduced solvent products such as paint.

Several of the interviewees cited that sustainability was rapidly creeping into their professional lives, and for that reason, it was being taken seriously. One

interviewee repeated a point made earlier, this being that there was increasing interest from clients regarding his company's sustainability position. In increasing frequency sections in pre-qualification questionnaires (PPQs) and invitation to tender (ITT) documentation, had larger sections that were being devoted to sustainability. This point requesting sustainability credentials was mentioned by several of the interviewees. Probing questions revealed that these ITTs were from larger organisations that usually held the ISO 14001 accreditation.

10% of interviewees stated that they did not believe that sustainability had increased in importance. One such interviewee believed that anthropogenic climate change was a myth although he considered that a sustainable reputation was a good idea if it could make his business more profitable. Each of these interviewees was sole traders who did not subscribe to a professional body and had limited interaction with the internet. Further probing questions revealed a significant lack of awareness of the issues linked to sustainability. Their opinions seemed to be influenced by their lack of exposure to any of the drivers discussed in question 9 of the survey (s5.4.8) such as client pressure, or the requirement for a green company image. Except for the interviewee above, their arguments additionally were not based on climate change denier arguments as they did not link sustainability to this issue, and furthermore seemed to have no definitive views on this one way or the other.

The minority of those who were members of professional institutions such as the BIFM stated that websites and subscription magazines had often featured articles relating to sustainability relevant to their sector.

Despite the relative familiarity of the word, it was evident that a significant number of those interviewed were unaware of the link between the need for a globally sustainable regime within the BE, and anthropogenically caused climate change.

In several instances, it was clear that employees and clients were the cause of the topic being pushed in the workplace. The employee's interest having been sparked from modules in courses such as Higher National Certificates (HNC),

that albeit in a limited sense included the term sustainability and outlined its relevance, in addition to client interaction through ITTs and PPQs.

In precis, as outlined in the introduction to this chapter although the word sustainability is well documented, and most people have heard of it, the evidence is increasing in this thesis that it still not readily understood regarding its link to climate change. It is perhaps within this ambiguity that the core of the issue and the answer to the research question can be found. That being that the word is known, but its deeper meaning is dispersed perhaps due to it being ill-defined as argued by Schäfer (2013). It seems possible therefore that Thomas Macaulay's (1800-1859) quote that "Half knowledge is worse than ignorance", may have some validity.

5.3.8 Question 8: What are the "Drivers" that promote the practice of sustainability within your professional remit?

The dictating drivers for the awareness and acceptance of sustainability within the BE are those factors that can make it happen, as discussed in the literature review and Chapter 3. A green company image is becoming increasingly important (Schaltegger and Hörisch, 2015); a point demonstrated in question 9 of the main survey (Figure 5.4). The interview will be the researcher's final opportunity to check the consistency of the trend that has emerged regarding the dominant drivers, these being a green corporate image, client pressure and adherence to legislation. Confirmation of this trend would have a direct influence on the design of the SIR.

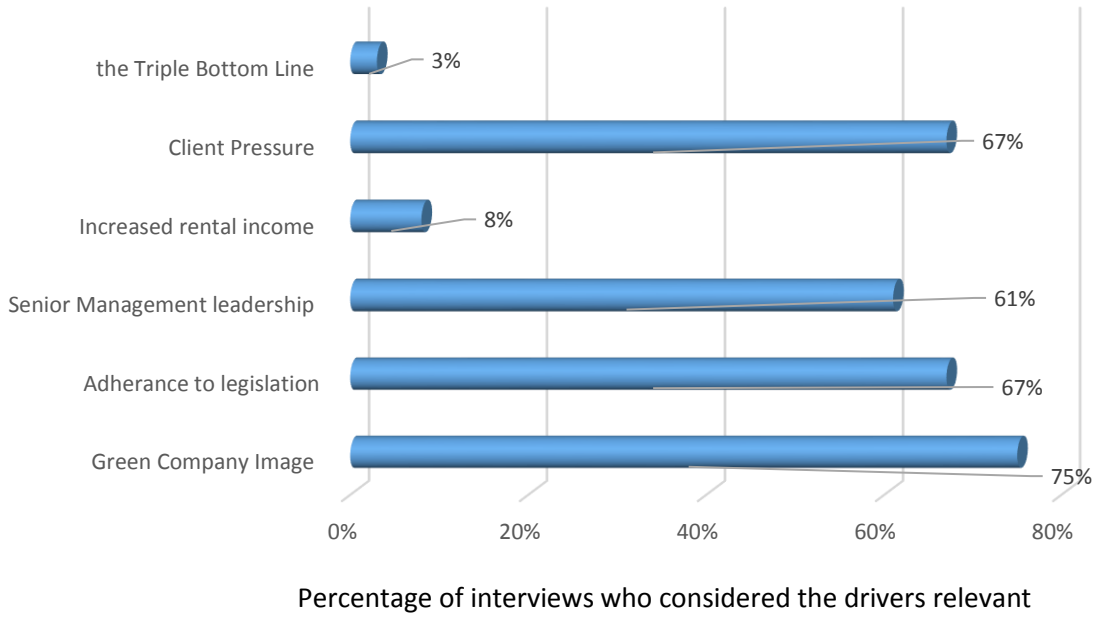


Figure 5.14 Bar chart illustrating Semi-structured Interviews question 8 results; Source Harrop (2016)

Figure 5.14 illustrates the results obtained revealing the most significant drivers in the implementation of sustainability initiatives in the BE. This question was also answered by those who had experienced this first hand and demonstrated successful implementation of sustainability in the workplace. The highest scoring driver (75%, see Figure 5.14) was “green company image”. Probing questions revealed that there were at least two reasons for this. The first being that it was good to be a company that was bucking the trend and appeared to be environmentally virtuous. Secondly, new and existing clients were requesting evidence of sustainable behaviour from their suppliers. One interviewee, an Environmental Manager of an SME in Caithness, stated that the far north of Scotland is witnessing a dramatic increase in renewable energy projects and the spotlight is very firmly shifting to using sustainability minded suppliers. Probing questioning revealed that there were barriers slowing acceptance which she believed was a one-sided belief of the barriers such as high investment costs.

Other interviewees in this region of North Scotland stated that they believed that it was becoming increasingly important to have green company credentials, as clients were starting to expect to see this, particularly when they will have to demonstrate their green supply chain, as required in the 2015 updates of the ISO 14001.

The legislation is an almost inevitable stick “driver” in an increasingly litigation-based society according to one interviewee, who stated that they sometimes did a “thing” because they were forced by legislation to do a “thing”. Sometimes, however, he further argued, once the benefits and relevance are demonstrated then two things can happen, firstly acceptance and then sometimes awareness.

“Client pressure” and “adherence to legislation” were considered equally important in the interviews. The researcher agrees with Myler’s (2016) stance, that client pressure is arguably one of the strongest drivers, particularly in the BE. A reason for this may be the simple fact that much work is won in the BE through the tender process. The phrase “it is a buyers’ market” would seem to apply. The majority of those interviewed considered that without senior management leadership a sustainable regime would not possible within an organisation. There are practical realities that support this latter point, such as, initiatives that are not sanctioned by management in the workplace may not have a realistic chance of success. In companies within the BE that have high workloads the lower levels of the workforce may not have the opportunity, nor the time, to promote sustainability as an unpaid voluntary action. Senior management can offer material help in the form of funding and a range of “carrot” incentives.

All the drivers illustrated in figure 5.14 whatever their ranking are important, as are those that were not outlined in the question. Promoting a driver such as investment achieved through a greater awareness of the perceived benefits may be an effective way of removing the opposing barrier, which in this instance might be lack of training and a reduced incentive to invest risk capital in a concept like sustainability.

5.3.9 Question 9: Please tick the following "Barriers" that you feel hinder the practice of sustainability within your Professional remit.

Barriers preventing sustainability in the BE were discussed in the literature review and were further distilled in Chapter 3. Barriers carry at least equal importance to drivers because a barrier can derail and action or an initiative at the earliest planning stage particularly if it is insurmountable, or perhaps perceived as such. The design of the SIR depends on understanding these variables capitalising on drivers and endeavouring to ensure that no barrier is insurmountable. The most influential barriers identified in the pilot and the main survey were found to be a lack of investment and lack of interest. It was felt to be of importance to confirm these trends because of their influence on SIR's design.

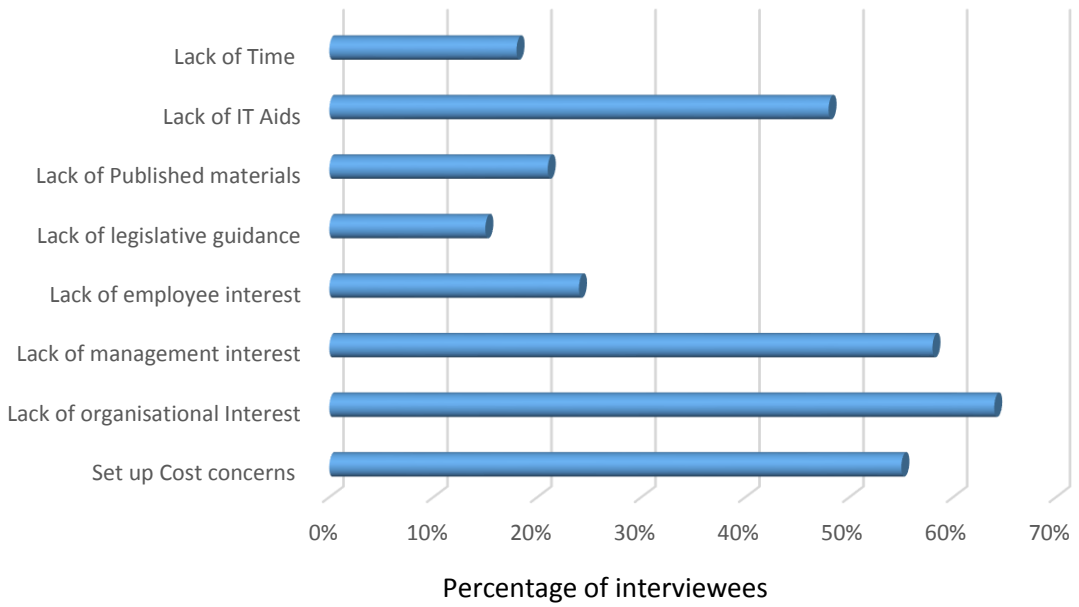


Figure 5.15 Bar chart illustrating Semi-structured Interviews question 9 results; Source Harrop (2016)

The three most important barriers according to the results were a lack of interest from the employer (management and organisation), the costs associated with the integration of sustainability into a company and the ease of access to information about sustainability in context.

Several of the interviewees remarked on the lack of interest from their employers and the company at large. One interviewee reflected the opinions of a larger number who stated that although his employer had sustainability and environmental policies, there was no enforcement or knowledge share regarding them or their relevance to the business. Probing questioning revealed that the lack of organisational and management interest was often found to stem from a lack of knowledge and awareness from the senior management and leadership structures. To reinforce that point, and to outline that sustainability if not understood by senior management nevertheless could not be ignored, two interviewees reported that in their organisations someone had been given a new job title, such as “Sustainability Manager”. This was cited by one interviewee a project manager for an SME with 350 employees. The expectation being according to the interviewee that a box had been ticked and sustainability was now someone else’s mandate, and therefore as he further stated, “someone else’s problem”.

Forced change from “below” was the case in the researcher’s professional context. However, one interviewee stated that all new initiatives have to be fed from the top, particularly in a company with an autocratic management style. The notable difference in the researcher’s context, however, was that his employer has become aware of sustainability and become cognisant of its advantages and its commercial opportunities. A concerning trend as outlined by a mid-level manager in a Consulting Engineering SME was that policies and initiatives existed regarding sustainability within their company. However the management did very little to promote it, so very little information or incentive trickled down to the lower levels, management or workforce.

The point was repeated by a significant number of the interviewees who articulated that they could not rely on their employers as sources of information regarding sustainability within their remit, and they asked where they could find impartial expert advice. One of these interviewees raised the point that several other interviewees also made, that being that they were unaware of a centralised “one stop shop” referencing resource. The interviewee complained

that there was little time to conduct independent research, particularly using hard copy and going to libraries, so he outlined the need for an IT-based resource available on an intranet or the internet. Another interviewee pointed out along with 20% of the other interviewees that the lack of easily accessible information available and points of contact deterred them from “bothering” to conduct any research. During probing questions, the researcher reminded the interviewee that he had previously mentioned that he belonged to a professional institution with known sustainability links to forums and articles. The interviewee stated that he was unhappy with the time it took and complained that he could never find exactly what he wanted, such as sustainable suppliers, links to applicative legislation, funding opportunities and green technology and products. He summed up this point by saying that there was not a “Sustainability biased macro online resource” in the way that internet-based travel website Expedia was an online macro travel resource, a point repeated by several other interviewees. Another interviewee outlined that this was of greater importance because of the growing requirements for transparency regarding the implementation of sustainability in the business, which would seem to be made manifest in the 2015 updates to the ISO 14001. These updates prioritise sustainability within the business which if not implemented then the ISO 14001 (2004) accreditation will no longer be valid as of October 2018, which would remove the accreditation holder from qualifying for many business opportunities, arguably an effective “stick” incentive.

Over half of those interviewed considered that a significant barrier was the cost of the implementation of sustainability within their business. A senior manager from a contracting SME made the point as did several others, this being that he had no idea what the costs were because they had little idea what was involved, there was simply no information that they could use to quantify capital outlays. Questions that this interviewee additionally asked in the interview included, “Whom can I talk to?” and “Are there any consultants who can advise me on how to integrate sustainability into my business?” and “As this is a green initiative can I get financial help from a Government grant?”, The interviewee argued that there was too little information about the topic, he was also

concerned about how a genuine expert could be formally identified. Another interviewee stated, “I need a single point resource where I can find out everything I need to know!” A point reflected by a low-level manager from a different perspective who stated that he had asked questions regarding sustainability within their commercial context but no one in their management structure was prepared or perhaps could answer them with genuine knowledge. This interviewee’s point was that a method of accessing information regarding sustainability without having to refer to her line managers would be something she would use.

Set up costs included those associated with training, academic qualifications, sponsorship and promoting membership for professional body membership such as IEMA and the BIFM.

A recurring trend among employers according to the several interviewees was that joining these professional bodies was contingent on the applicant demonstrating that there would be a tangible benefit to the employer, a difficult thing to do. Although open agreement with Interviewees in an interview setting was inappropriate as outlined in Chapter 4, the researcher would agree with the interviewees on a number of points, such as lack of employer interest, lack of awareness over investment costs, and a lack of readily available reference resources, because they have been relevant in his professional context.

Through the interviews particularly, the researcher found that his professional perspective on these barriers was not unique, offering the possibility that these opinions may be an industry standard.

5.3.10 Question 10: If you have undergone any sustainability training, what form did it take?

Training refers to a systematic approach to learning and development to improve the individual team and organisational effectiveness (Goldstein & Ford, 2002). Aquinis and Kraiger (2009) argue that training activities have a positive impact on the performance of individuals and teams, which include improved attracted, motivation and empowerment.

Question 10 revolves around two issues. Firstly, ascertaining the ethos of the company, the interviewee works for, which may, for example, be demonstrated if they have received funded training, thus demonstrating that the employer has overcome the barrier of investment cost concerns as previously discussed. Secondly, it granted the researcher a perspective of the interviewees themselves, allowing assessment of what they gained from the training, (if any) and had they initiated it. The Interviewees were asked if they had undergone any sustainability training and asked to comment on four given categories, CPD, Seminar/conference, in-house training or external academic.

Probing questions were asked of the majority of the interviewees, which included asking if they had initiated the training or if they had been encouraged to undertake it. The intention behind this was to ascertain the commitment and thirst for knowledge that the interviewee possessed. Of concern in the main survey was that bias affected the answers regarding sustainability training, and it seemed possible that greenwashing may have been at play. A point that will be easier to ascertain in an interview setting.

Of the eight disciplines interviewed only the FMs, Building Contractors and the HSE managers had received any form of sustainability awareness training, formal or otherwise.

The greater percentage of all training (55%) was undertaken independently by the interviewees, at least five who cited that their interest in sustainability within the BE has been growing. In several instances however employers were unwilling to fund this. In this instance, some interviewees circumvented this barrier by undertaking training independently in the form of online courses run by academic institutions. Self-help training was a strong theme throughout the interviews, either the interviewee taking the initiative to find courses online or pressuring employers to send them on courses. In several instances, this included persuading representatives of their supply chains to give presentations extolling the sustainable virtues of their products.

The fact that this is not employer-driven would indicate that as yet it is too early to argue that commercial pressures are strong enough to drive a renaissance in sustainability within the BE.

“In-house” was the next most undertaken form of training. According to one interviewee, a middle manager in a blue-chip company, it was a half day course given by their Environmental Manager who outlined what sustainability was, although not how it applied to their discipline. This was a point repeated by three other interviewees who indicated that the course was given to provide an awareness of the topic as clients were starting to use the term at an increasing rate in contract documentation such as PQQs and ITTs.

Attendance of academic courses was low even with the FM’s and building contractors. Several interviewees said that their companies had sent employees on external academic courses. They admitted however during probing questions, that sustainability in the BE context had been included in the curriculum of HNCs and undergraduate degrees, and then they felt that the course content had been superficial. Only two of the interviewees (both Facilities Managers) stated that some of their employees had been placed on a sustainability course because of the positive impact it had on CVs especially when they were used in tender documentation

The researcher would state that instigating change through promoting awareness of sustainability in his professional context, (an engineering consultancy SME with 80 employees), he has been mostly successful. Although acknowledging that things are still at a very early stage. Even so, the undertaking of the PhD at Cranfield University is evidence of serious intent on the researcher’s employers’ part, even though the researcher instigated the process.

It should be noted that probing revealed that the most cited barrier to training was the cost for the course and the time lost to the employer, particularly regarding academic qualifications and training.

5.3.11 Question 11: Have you heard of the following terms associated with Sustainability?

The pilot had two terms that could be strongly identified with sustainability in its variant of this question, the main survey had nine such terms, and it was decided to increase the number terms in the semi-structured interview to 16. The reason for this was to include terms that the researcher had often come across in the research for this thesis, most of which were discussed in the literature review, and the successive chapters. With the arguable exception of Rachael Carson's Silent Spring (1962), which was included because both the book and its author repeatedly appeared in many different points of reference, which almost always cited Carson (1907-1964) as kickstarting starting the environmental movement as argued by Griswold (2012).

With the possible exception of Carson's Silent Spring (1962) and the Keeling Curve, each of the given terms form a direct part of the story regarding sustainability in the BE. Nonetheless, knowledge of all or indeed any of these terms would the researcher felt demonstrate a degree of awareness of sustainability initiatives and terminology, at least within the BE

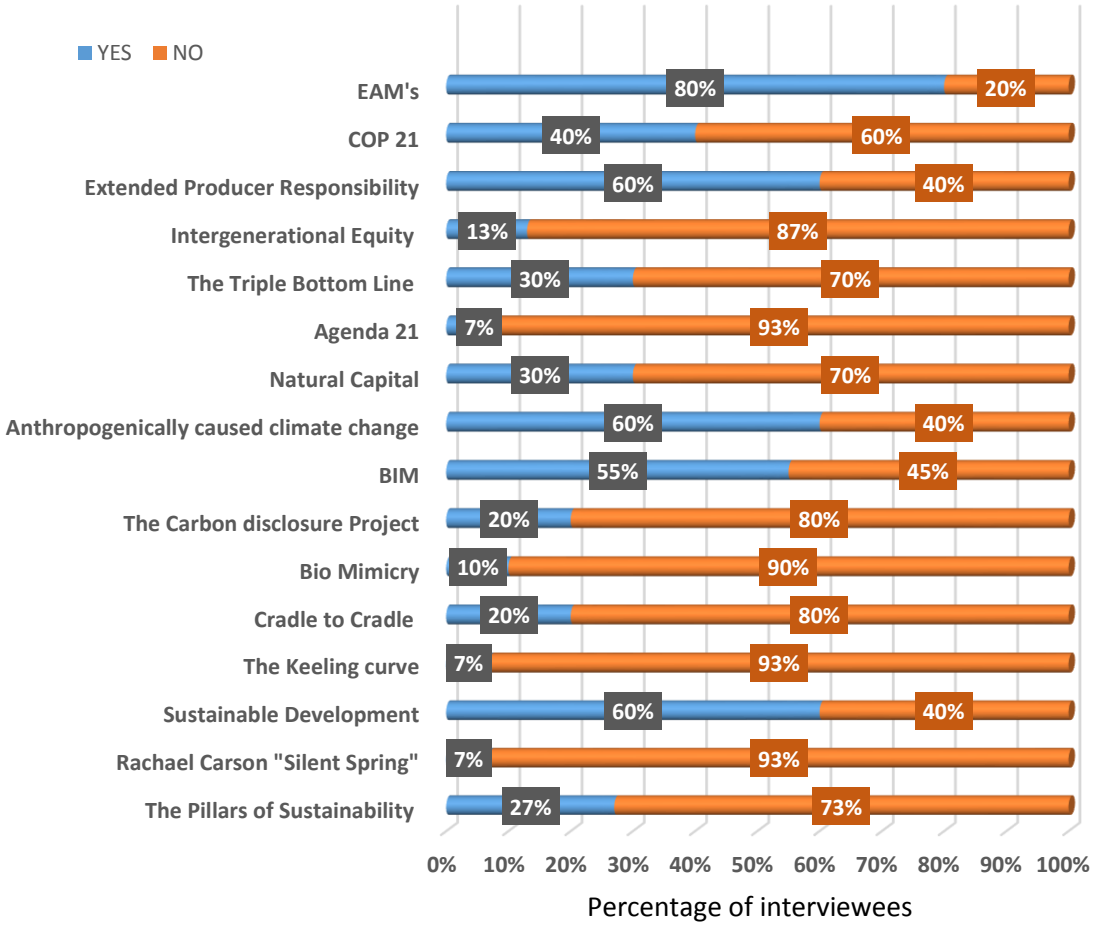


Figure 5.16 Bar chart illustrating Semi-structured Interviews, question 11 results; Source Harrop (2016)

Arguably, it stands to reason that 80% of interviewees had heard of an EAM although it should be noted that the term Environmental Assessment Methodology and its acronym “EAM” were largely unknown to several of these interviewees until BREEAM was cited as an example. Therefore, to a high percentage of interviewees, an accreditation that promotes sustainability within the BE was known of. However as illustrated in Figure 5.16 this does not necessarily translate to an awareness of sustainability as many of the other terms were not known illustrated by the negative responses. The results may indicate that some terms and systems are more familiar than others because they impact more in a working context, or that the interviewees may not equate EAMs with sustainability due to confusion as to what the word sustainability means as argued by Zigmond et al. (2011).

This may reinforce the point frequently outlined by several respondents in the Main Survey that EAMs can often be “lip service” tool, a point also argued as argued by Aspinal et al. (2012).

Sixty percent of interviewees had heard of the term sustainable development, and 50% anthropogenically caused climate change. Most of the interviewees cited that they had heard these terms via the media such as television and the internet. It would seem, however, with the low results from other terms that this did not promote a further interest or encourage further and research. This point was reinforced by the fact that although 27% of interviewees had heard of the pillars of sustainability only a third of them could say what they are, which would seem inconsistent with the numbers who cited that they had received some form of awareness training. Seven percent had heard of Rachael Carson’s “Silent Spring”, although no one had read the book.

Probing questions enabled the researcher to ascertain if the interviewees knew the meaning behind the terms they had given a positive response to. This allowed for a certain degree of cross-checking and reduced the risk of “acceptance bias”. In several instances, however, the actual meaning of the term was at best only partially known. Of interest, however, was that many of those who were familiar and understood the terms had researched them themselves, a point reflected by the numbers as cited in the preceding question that had on their recognisance attended courses and studied the topic.

A trend in this question was that most interviewees had not heard of some of the terms given in the question, (although no interviewee was ignorant of all of them). However, the positive results do not conclusively demonstrate full or even partial awareness of sustainability and its relevance to the BE. The results, however, demonstrated at least two things, firstly that there is interest in sustainability as the answers and discussion with the probing questions demonstrated and secondly, Ferdig’s (2007) opinion that there exists an “emerging conscience” relating to sustainability may not be so far from the truth.

5.3.12 Question 12: If you have used an Environmental Assessment Methodology; BREEAM, LEED, DREAM), would you agree that it had a positive impact on the Four Pillars of Sustainability? (Environmental/Economic/Social and Cultural)

As previously discussed in the literature review & Chapter 3, EAMs are a well-used tool within the BE. According to Ding (2008), they can help stakeholders in the BE understand the interaction between the BE and the environment. However, Aspinal et al. (2012) outlined criticisms levied at EAM's such as the environmental pillar being mostly considered over the others. The researcher felt that the opinions from stakeholders who had experience of EAMs would be of interest, particularly in ascertaining the level of awareness of these methodologies. The main survey results indicated that most respondents believed EAMS had a positive impact on the pillars of sustainability. Most of the main survey respondents referred to the best known and the world's oldest EAM, BREEAM. The researcher felt that it was important to continue this question through to the semi-structured interview so that the respondent could justify their opinion and therefore demonstrate their familiarity of the EAM's, and possibly awareness of the connection between sustainability and an EAM

As illustrated in figure 5.16, 80% of interviewees stated that they had heard of EAM's and approximately 25% of those had been involved in a project that was BREEAM accredited. For the purposes of the supplementary question, these will be considered a new subset of respondents. It should be noted that this research does not comment on the industry-wide real-world effectiveness of the EAM systems regarding achieving a measurable degree of sustainability within the BE or critique and compare them all in detail. The rationale behind this supplementary section was to ascertain the depth of knowledge of the users of the EAM's relating to sustainability within the BE.

Most of those who had used EAM's (mostly BREEAM) were uncertain about its efficacy regarding the promotion of achieving a genuine, sustainable regime within the BE, though it could be argued that relatively few seemed to have an in-depth knowledge of the subject and its supporting issues.

However one interviewee outlined during probing, that the greater part the EAM was considered at worst to be a tick box exercise awarding points to achieve a good rating by the inclusion of elements that are not needed (such as bicycle racks), or items that ticked a box (such as photovoltaic panels, roof-mounted wind turbines and water recycling systems) which in one interviewee's experience failed to work soon after commissioning. At best an EAM could be a tool that effectively promotes sustainability within the BE, this would be contingent on factors such as an awareness of the concept by the user and the will to ensure that the tool played an effective part in a sustainable regime, arguably its original intended use.

A point alluded to by several of the interviewees was that the environmental pillar is the most familiar was the most associated with BREEAM. A number of interviewees who had used EAMS said that the environmental pillar takes centre stage in the BREEAM assessment, although it was conceded that others are catered for such as the social pillar. The bias or perception of it towards the environmental pillar reinforcing the earlier argument made by Zigmond et al. (2011) that sustainability is predominantly an environmental issue.

An interviewee who was familiar with the MoD's DREAM system believed that it did have a positive effect on promoting sustainability within the MoD, for several reasons. Implementation of it was a mandatory requirement so it was used across a greater cross-section of projects than those in the civilian sector such as BREEAM. No interviewees who had used it made any reference to it being a tick box exercise and the corporate image was not considered to be a primary driver because of the nature of the non-public domain of most MoD construction projects.

What does seem apparent, discounting the negative opinions, and relevant to the research question, is that its use does not seem to have generally encouraged the EAM user to become more interested in sustainability. Those who used the MoD's DREAM, however, demonstrated greater awareness and interest in sustainability after using it repeated times.

5.3.13 Question 13: Is your employer/company affiliated to any company with links to sustainability initiatives, such as the United Nations Global Compact and the World Green Building Council?

Some BE-related sustainability organisations were outlined in literature review such as the World Green Building Council and the United Nations global compact along with some others. For a company to be signed up to any of these organisations would either indicate a genuine commitment to sustainability within their sector context or possibly an attempt at greenwashing? What is of interest to the researcher is whether the interviewees are aware or not that their company is a member of an affiliated organisation. Being aware of affiliation is not enough to guarantee an awareness of the company's sustainability ethos, but it may be a good indication. Of equal interest to the Researcher will be those who cite that they "do not know", particularly if their company is a member of one of these organisations.

The results reveal three categories of answers (Yes, No, and I do not know), with some issues that were exposed during probing questions.

Firstly, only 11 % of the total no of interviewees knew that their companies were members of sustainability-related organisations. Each of these was asked to outline who the organisation was and how long their company been affiliated with them. All were clear and confident on this point and demonstrated an awareness of their company's ethos and commitment, all but one of the interviewees said that they were encouraged to be a part of the organisation's sustainability drive.25% said that their company was not affiliated to any such organisation. A number were right about this. However, half of those who said that they were not, was on further investigation proved incorrect, and their company did have affiliations that had sustainability links such as those listed above. It was evident from the other questions posed in the interview that these individuals had a low level of general awareness of sustainability within their remit.

A significant percentage of the interviewees "did not know" if their company was affiliated to an organisation such as those outlined, an answer which

demonstrates a lack of awareness of this issue. The researcher, however, probed deeper to ascertain what barriers if any prevented them from finding out, 33% of these interviewees cited lack of time, 15% cited a lack of perceived relevance to their position and 10% of those asked said that they had not thought about their company's general position regarding this topic. The remainder cited combinations of all the above reasons. The researcher would argue that this question demonstrated a lack of awareness of almost 70% of the interviewees. As previously stated there is an emerging consciousness which could excuse these high numbers. However, the point of the research aim is not to blame those without awareness, but merely to propagate and develop it.

5.3.14 Question 14: Do you agree that the general concept of sustainability is fully understood by your company?

The main survey recorded that 74% of those interviewed believed that their company had a partial understanding of sustainability; only 10% believed that their company had a comprehensive understanding of it. The interviews allowed the researcher to determine, whether the interviewee had an awareness that would enable them to determine this. In other words, if the interviewee has little understanding of the concept themselves, it is unlikely that they will have a sufficient level of knowledge to make a judgement either way. If however, they do possess an understanding of sustainability, within the BE they will be well placed to provide an insight as to the barriers that prevent their company from being fully informed. The question was thus phrased so that the interviewee was not "put on the spot" by being directly asked if they had an understanding themselves. Their responses in the rest of the interview reinforced by thee answer from this question granted the researcher an impression as to the interviewees level of knowledge of the subject, and their companies communication regarding it. It was not possible to interview everyone in the company which obviously would have given the best picture of awareness of sustainability.

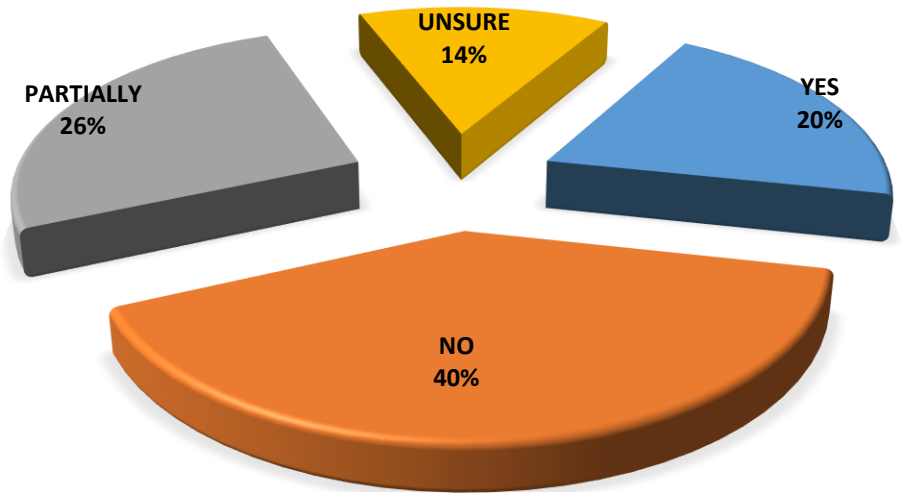


Figure 5.17 Pie chart illustrating Semi-structured Interviews question 14 results; Source Harrop (2016)

According to the results as illustrated in Figure 5.17 40% of interviewees did not believe that their company understood the general concept of sustainability, 26% stated that they felt that their employer partially understood it 14% were unsure and 20% stated that they believed that their company fully understood it.

Probing questions as to the core reasons behind the negative position unearthed the following issues: A large percentage of interviewees reported that elements of sustainable behaviour are practised; such as office material recycling and water conservation. Many of the broader concepts alluded to in their sustainability and environmental policies were often not always universally understood by senior management, as a number freely admitted. An answer that trended during the probing questions was that knowledge of the subject often seemed to be understood and known by a select few, who for reasons unknown to the interviewees did not always disseminate it.

Several interviewees indicated that their employer had a partial knowledge of sustainability although it was evident on probing that there were well documented and easily accessible sustainability and environmental policies in place. It might be noted these individuals generally possessed a poor knowledge of the terms associated with sustainability (see fig 5.17).

What seems to be strongly shown in these results was that in the majority of responses neither the interviewee nor perhaps their associated company had comprehensive knowledge of sustainability within their sector. Alternatively put, there was a lack of awareness.

5.3.15 Question 15: Are you familiar with any of the following legislation and initiatives influencing UK building design and construction?

The researcher decided to keep this question included in the main interview also in the interview because it would be possible to test any “yes” responses with probing questions. For example, how the legislation or initiative impacted on their working context. If the interviewee answered “no” to any of the listed legislation, that impacted on their professional activities (such as the Environment Act (1995), or the Health and Safety at Work act 1974), then the researcher would attempt to ascertain the reason behind this answer and understand any underlying reasons behind this apparent lack of awareness, as well as also ascertain if the interviewee linked this legislation to the broader concept of sustainability. The intent of the question was not to analyse the effectiveness of the legislation or its significance about the research question but to ascertain the stakeholder’s awareness of it.

LEGISLATION/ INITIATIVE	Familiar YES %	Familiar NO%
The Climate change Act 2010	20%	80%
Environmental protection Act	60%	40%
Town and country planning act	63%	37%
Environment Act	63%	37%
Waste Framework Directive	60%	40%
Environmental Protection (Duty of care) Regulations 1991	53%	47%
Hazardous Special waste regulations	42%	58%
Landfill Tax and Aggregates levy	38%	62%
Site waste Management plan Regs	25%	75%
Waste and resources action plan	23%	77%
The Green Guide to specification	17%	83%
The Carbon reduction commitment Energy efficiency scheme	10%	90%
CEN Standards (Sustainability assessment of Buildings)	17%	83%
Mean Average	38%	62%

Table 5.1 Illustrating Semi-structured interview question 15 results; Source Harrop (2015)

At face value, the mean average shown in Table 5.1 would suggest that the majority of those interviewed were not familiar with the legislation that impacts on sustainability and the environment associated with the BE. Admittedly, this legislation though impacting on their daily working lives may not necessarily translate to in-depth knowledge of the legislation or why it was put in place. Legislation that might be more commonplace, however, might include the Town and Country Planning Act (63% were familiar), and the Environmental Protection Act (60% were familiar). It was evident during the interviews that higher levels of management were more aware of the legislation than the lower levels, particularly with waste-based legislation such as the Hazardous Waste Regulations and initiatives like the Green Guide to Specification.

On balance, therefore, it was found that a general lack of familiarity existed with the listed legislation and initiatives, particularly environmental specific legislation such as the Climate Change Act (80% not familiar). The same applied to the Carbon Reduction Commitment Scheme (90% not familiar), and the CEN standard for sustainability in buildings (83% not familiar), all of which it can be said to have a strong sustainability bias.

Overall this demonstrates to the researcher that there exists a lack of awareness of the relevance of the legislation on the part of the interviewees, or instead its relationship with sustainability within the BE. The results also would seem to reinforce Silberman's (2015) argument that legislation is blindly obeyed, and the researcher would add, even when it is not understood. As already illustrated in the literature review there is no overarching umbrella sustainability legislation within the BE, like the Health and Safety at Work act 1974 called be considered an umbrella Act for Industrial Health and Safety. As previously illustrated, legislation can be a significant driver for promoting sustainability within the BE; arguably it is not so effective if it is not fully understood and implemented.

5.3.16 Question 16: Are you aware of some of the following adverse environmental facts related to the BE industry?

This question was included in the Main Survey, and it has to be admitted was almost entirely qualitative in its approach. It was included again in the interview as the researcher wished to determine first-hand, the reactions of the interviewees when several known published facts were outlined, initially outlined in the literature review

a. Energy from Fossil fuel consumed in the construction and operation of buildings accounts for approximately half of the UK's emissions of Carbon dioxide
b. Around 10% of UK emissions a are associated with the manufacture and transport of construction materials and the construction process
c. More than 400 million tonnes of materials get delivered to site in the UK each year of these 60 million tonnes go straight to the tip due to over ordering damage due to poor storage or because of inappropriate ordering
d. The UK Construction industry sends 36 million tonnes of waste to landfill each year
e. The construction industry in the UK consumes in the region of 6 tonnes of raw materials for every person living in the United Kingdom

f. 30 – 40% of Global energy consumption is directed to the construction and operation of the BE
g. 3 billion tonnes of raw material extraction, (the equivalent mass of a 2.0 m high brick wall encircling the Earth 390 times
h. Construction is responsible for 20% of global water usage

Except for one interviewee, who believed that the figures were groundless and had doubts concerning the issue of climate change and pollution, most of the other interviewees expressed shock and then curiosity as to the causes of these issues; the latter occurring in most of the responses. From all of the questions, this was the one that the researcher had to maintain a higher level of control over the length of the discussion. This question generated the most significant level of interest and debate. Although an emotive one, the scale of pollution and raw resource usage by the BE is significant and has unquestionably hurt the planet (Goertemiller, 2015), and this was not appreciated to all of the interviewees.

One interviewee had worked within the BE for 50 years and was completely unaware of the broader implications that his activities had on the environment. It was inevitable with a number of the interviewees, that the discussion led on to the consequences of climate change, such as unusual weather patterns, which at the time were having significant impacts in the UK, with flooding in the Somerset levels and the Thames river flooding.

It was evident that there was a distinct of lack of awareness of the adverse environmental effects of climate change and its direct relationship with the BE, for which it could be argued that all the stakeholders could take a share of the blame, this point had generally not occurred to any of the interviewees.

5.3.17 Question 17: Do you know of any recent major projects related to the BE that prioritised sustainability issues?

This question further allowed the researcher to ascertain the interviewee's real-world awareness of sustainability within the BE, by asking if they were aware of any high-profile BE projects that had promoted sustainability to high levels. One project that had global attention was the London Olympic venue, which was featured in several professional journals such as the BIFM's FM world and the national press. Failure to cite this as an example of sustainability (particularly in this case for a Facility Manager) would offer the researcher a final chance to confirm that a lack of awareness exists in the BE regarding sustainability. Probing questions were asked to ascertain why this lack of awareness existed, bearing in mind the number of methods through which this knowledge can spread, such as professional publications the internet, social media and the news media.

Very few responded to this question positively, those who did all referred projects including the London Olympic venue and the Tate Modern, although very few could cite many facts concerning them. Two interviewees referred to a project that was local to their workplace, a supermarket that had been built according to well-publicised sustainability credentials and awarded a BREEAM rating. Those interviewees who did not know of any examples were unable to offer reasons for this other than citing lack of time and interest, however all these interviewees were interested to hear about these projects and in four instances although they originally discussed projects which did have sustainability credentials but did not associate these with this at the time. These projects included three bioremediation projects for cleaning up hydrocarbon contaminated soil.

An interviewee who discussed their bio-remediation experience was asked to justify why they considered this to be sustainable. The reply included a reduction of soil replacement saving approximately 300 tonnes of material extraction, which would have required reinstating with virgin materials. Less work was required removing the need for digging planet, and associated fuel

use issues and no waste had to be paid for which would have attracted significant disposal costs.

5.3.18 Question 18: Would you use an interactive "living" single point Sustainability resource, available to all stakeholders within your company, that promotes awareness of sustainability within the BE?

The results and numerous comments from Question 18 of the main survey questionnaire, encouraged the researcher to change the focus of the SIR from a tool directed to a particular site/project /company to one that had a more macro view and thus could promote the concept of sustainability throughout the BE to all stakeholders at all levels, everywhere. The additional suite of non-site-specific points was drawn from points noted and discussed in previous chapters such as the Keeling Curve; sustainability minded NGO.s, relevant legislation, reference resources and sustainable supply chains. The semi-structured interview increased the list of functions to allow for this general approach of increasing awareness of sustainability not only within the BE but with a far more comprehensive global perspective. In precis, the results from this question alongside question 18 in the main survey will provide the foundation data for the early specification of the SIR models initial design

Non-Site-Specific Functions:

a. Database of all known causative issues of climate change with particular relevance to the BE
b. Links to related websites with real-time world relevant facts related to sustainability within the BE and its global position, such as the Keeling Curve, population stats, media and news feeds.
c. Included links to organisations for like mind example the World Green building Council.
d. Provided live links to NGO’s and professional companies promoting sustainability globally
e. Comprehensive list of all likeminded suppliers in the United Kingdom and beyond so that an informed choice could be given to the systems operator to act sustainably or not.

f. Easy access links to legislative resources
g. Links to UK wide training resources, such as companies offering CPD, academic courses and those academic institutions with reputations for promoting sustainability.

Site Specific Functions (BIM Associated Functions):

h. The capability of being a fully detailed material inventory database.
i. Provided strategies for the physical materials that form the building/buildings and infrastructure
j. Provided an accurate record of all changes and alterations throughout the facilities lifetime
k. Detailed all materials used (for example in a construction project), quantities and specifications and "as built" drawings
l. Functioned as an extension to the initial environmental impact assessment of the building throughout its lifetime, allowing, for example, the provision of accurate data for Extended Producer Responsibility liabilities
m. Routinely calculated the embodied carbon within the building fabric
n. Assessed quantified and managed potential health hazards from chemical components of building materials and finishes (i.e. Asbestos and lead)
o. Provided real-time valuations of the Built environment (Rebuild costs, insurance valuations
p. Be capable of linking with other databases to provide a macro assessment of embedded materials from an unlimited number of buildings
q. Database of all known waste streams relevant to the known components

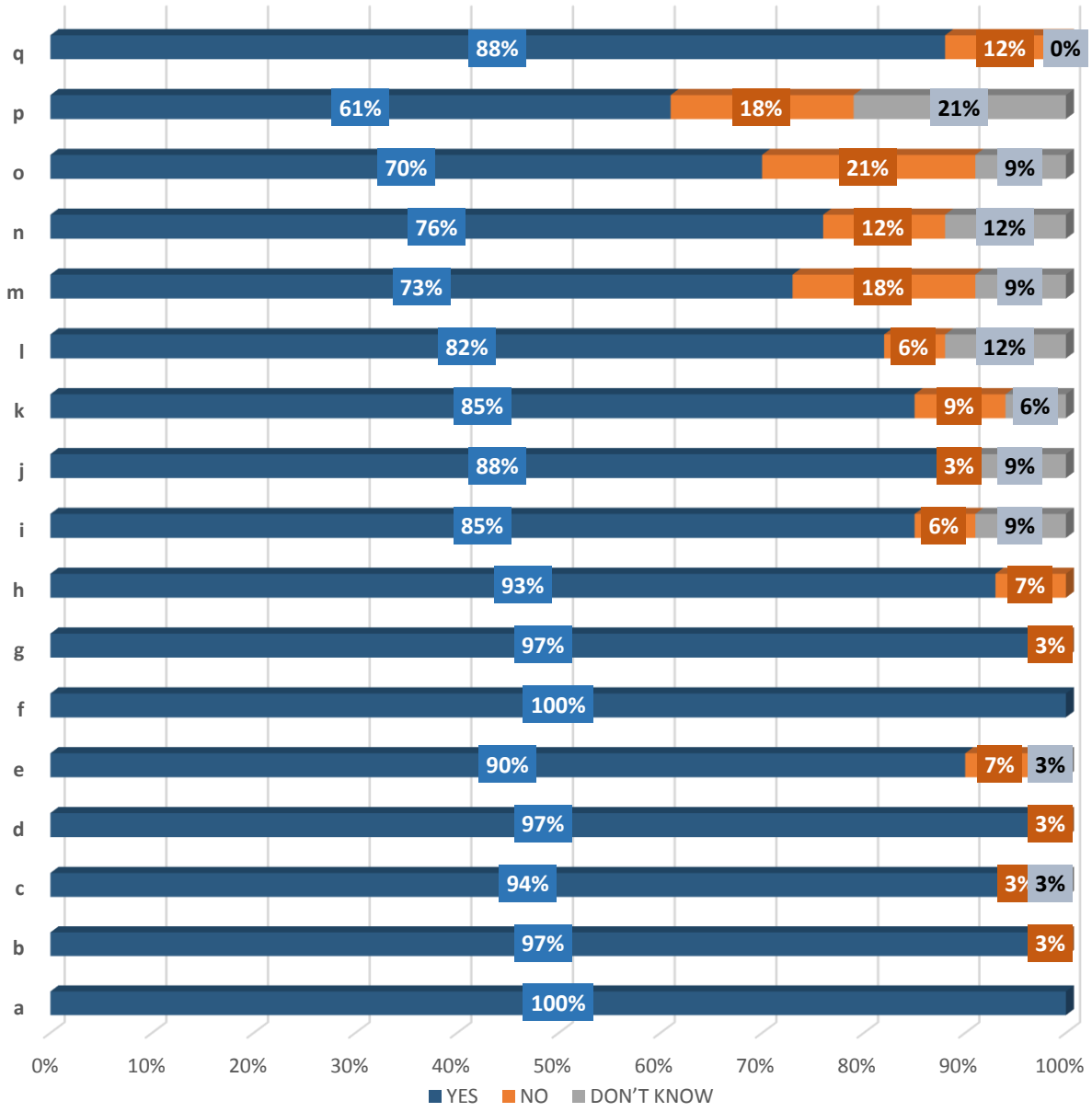


Figure 5.18 Bar chart illustrating Semi-structured Interview question 18 results; Source Harrop (2016)

All categories scored high positive results from respondents who stated that they would use a resource that offered these functions; a mean average of 88% was achieved. Most of the interviewees would use a system with the listed functions.

It should be noted from the results illustrated in 5.18 that the non-site-specific answers scored consistently higher "YES" results than the site-specific ones, indicating that the wider macro perspective capabilities the SIR would be the

better-used functions. This is consistent with many opinions from interviewees as previously outlined who were interested in understanding the bigger picture as these functions offer a wider view of the real world. These macro issues included the thought leaders, issues that impact on sustainability both within and without the BE and the causative issues of climate change, in short sustainability from a holistic viewpoint.

Probing questions during the interviews revealed positive responses to the following questions:

Q1 If such a system as the SIR existed would the interviewee believe it would be universally used?

Most Interviewees believed that the SIR would certainly be used. One interviewee, a senior manager for a 250 plus employee multi-national company, stated that he believed that an awareness support system such as the SIR would be something that they would unquestionably use. He further stated that the non-site-specific function would probably be more readily used than the site based one, although he certainly saw the value particularly as a cheaper more accessible form of BIM. Most other interviewees agreed with this view, with others stating that the BIM functions would link into sustainability and give smaller companies a chance to demonstrate their sustainability ethos without having to purchase a BIM system.

Ten percent of the interviewees had concerns over SIR being a “fad” and used briefly and not then looked at again, Only one interviewee, believed that the system would not be used by either himself or anyone within his firm, due to lack of time, and, and lack of relevance to their business. Most interviewees believed that the framework would retain interest for its message and links to current micro and macro issues impacting on sustainability such as global warming. If the SIR was a current living resource, it could well be frequently referenced according to one interviewee, a corporate senior HSE manager for a blue-chip engineering multi-national company (40,000 + employees).

Several the interviewees, however, indicated that there would be several issues to facilitate the SIR's use being accepted, such as being cheap to acquire, needing very little if any training, kept current and that reference to it in work times was permitted and even encouraged.

Q2 Is sustainability and its numerous associations generally discussed within the working context and without, for example, pollution climate change?

Several interviewees indicated that as standalone subject sustainability was only rarely discussed. However, elements of it were, for example, climate change, social injustice, third world issues and pollution. The link between sustainability and the BE was largely not considered amongst the interviewees. This point was best outlined by an SME FM (Soft FM) who said that she had been talking extensively about climate change over lunch and tea breaks concerning recent flooding in the UK. She indicated however that the causative reasons were not part of the discussions, and conceded that this would have been an interesting continuation of these discussions, she stated, "The thought never occurred, as regards the how's and whys, which if you think about it is the most important bit".

Q3 Would they assign someone dedicated to its maintenance and upkeep?

According to several interviewees, maintaining a system such as the SIR could be time-consuming; a worrying issue. BIM, for example, requires a dedicated input operator; the SIR would, therefore, benefit from being largely maintenance free by the subscribers.

There was an issue regarding time, for some of the smaller companies represented by the interviewees, as they were concerned about the time it would take employees away from their jobs. They did not want the SIR to be, as one interviewee put it "the next solitaire". It was additionally hoped by many of the interviewees that the SIR would be updated by a third party and therefore a subscribed service as opposed to software, such as a pre-loaded DVD or CD. If

this were the case, maintenance would simply be a matter of keeping up with a subscription. A small number of interviewees considered that a hard copy resource would be a useful format for the SIR system, despite its inability to be current between editions (it should be noted that these individuals were of an older demographic).

The secondary list of functions with potential BIM applications, however, would certainly need site input. Interviewees outlined that if BIM did not cover this or if they did not have it, this could be a subscribed service undertaken by a specialist, and in that instance according to an interviewee who was, a mid-level engineering manager from a manufacturer, he stated that a system like SIR would have to justify its costs.

Q4 Would you encourage and promote its use with either carrot or stick measures?

This question was mainly directed to the senior managers and CEO's who were interviewed as they would be more likely to direct policy and be able to institute initiatives. "A CEO of a light engineering SME with 150 employees stated that they would use "carrot" measures rather than "stick" ones if possible, such as the SIR being installed on their PC system. They would also consider having pop quizzes on current events with material rewards; he stated that "employees responded very well to material rewards". Online awareness mini-courses with examinations might form part of their employee award recognition program.

An interviewee who is an environmental manager with a consultant engineering SME (75+employees) believed that the system would have great merit particularly, if it could produce auditable records indicating that it had been used, and therefore be used to support PQQ's, tender submissions and perhaps and be used to demonstrate ISO 14001 2015 update compliance.

Stick measures as discussed with an interviewee who is a Royal Navy base Commanding Officer might include sustainability being part of the sites main induction process, which like Health and Safety is a continual learning process.

Q5 How would the interviewee prefer to access such a system as the SIR?

1. An “app” on a smartphone or a computer
2. A website, or section on a company’s intranet
   (85% would prefer to use these two methods)
3. Hardcopy updatable manual (9% would prefer to use this method)
4. Other (Site fitted television screens) (6% would prefer to use this method)

It is perhaps not surprising in these times that the preferred method of the system being accessible is via an app or direct to a website. The majority of the interviewees overwhelmingly reported this. Those who favoured hard copy information were generally from the older interviewees.

As mentioned a number of the functions particularly H-Q (Figure 5.18) may be available in commercial Building Information Modelling (BIM) Systems, These systems are becoming more accessible and cheaper to acquire. However, any overlap between SIR and a BIM system is not a concern for the researcher for several reasons. Firstly, not every stakeholder within the BE has access to a BIM. As discussed in the literature review BIM tends to be specific to a specific BE application such as a new build project, existing facility (ies) or project specific.

Although, it seems very likely that sustainability will be serviced to a greater degree with future BIM systems (Sheth and Malsane 2014).

5.4 Project Duration Word Association

As outlined in Chapter 4 a project duration word association test which took place over the entire research term”. This was a discrete controlled association test (Neilson & Ingwerson, 1999). Due to the sheer numbers (1203 interviewees) who were subjected to the test Individual respondents will not be cited. Although was an enjoyable diversion for the researcher, the founding reason behind this exercise was to ascertain what the primary associations within the BE was for the word “sustainability, as argued by Zigmond et al. (2011) there is a very strong environmental association. In so doing the

researcher felt that a representative feel of a lack of awareness of sustainability as a concept with 4 pillars would be garnered.

The answers were placed into four categories to show what the immediate response to the word was.

These were:

Category 1 Environmental (Waste recycling, waste dumping deforestation, pollution, climate change)

Category 2 Economic (Profit, business resilience)

Category 3 Social Environmental considerations (Human-centred issues, such as starvation, water scarcity, disease)

Category 4 Cultural (Maintaining national identities, traditions)

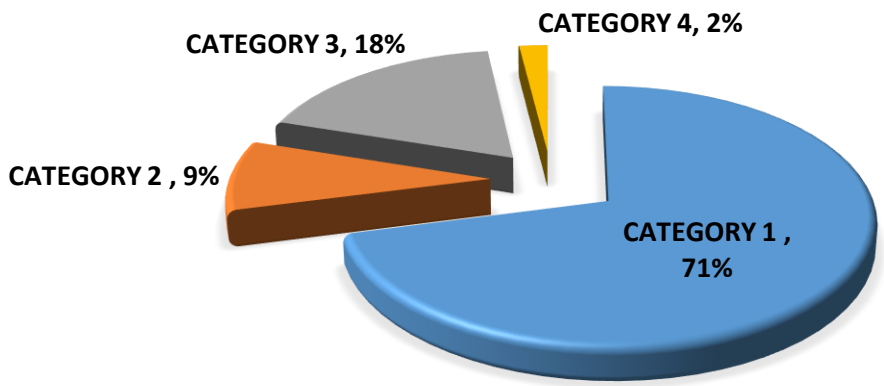


Figure 5.19 Pie chart illustrating Project Duration Word Association exercise results; Source Harrop (2017)

According to Zigmond et al. (2011), the perception of sustainability is that it is a purely environmental issue, a point indeed demonstrated in the word association test, which additionally demonstrated to the researcher that sustainability as a construct of four pillars was not well understood. A further

confirmation after the pilot and the main survey that there exists a lack of awareness of sustainability within the BE by many of its stakeholders.

5.5 Chapter Summary

The main surveys and the semi-structured interviews were dedicated to answering the research question and defining the foundations of the research aim.

There was, it should be noted a great deal of consistency between the responses from the main survey (MS) and the semi-structured interviews (SSIs); This consistency applied to almost all the questions, such as identification of the barriers and the drivers, and the perceptions of the interviewees concerning their employers' attitude to sustainability. Both MS and SSI surveys noted confusion as to what the term sustainability meant. To many, it seemed to be a rebranding of the word "environmental". There was evidence in both MS and SSIs that sustainability was being limited by many to mean recycling and waste management, a point demonstrated in the word association exercise because these elements were the most recognised facets of sustainable behaviour. Both MS and SSI surveys demonstrated that there was a perceived lack of communication between managers and subordinates (and vice versa) regarding company sustainability initiatives (if they existed)

So both elements of the main survey (MS & SSI) demonstrated a number of consistent issues such as: confusion over the term sustainability; a perceived general lack of information; a lack of inter-company communication concerning sustainability initiatives; and a lack of detailed knowledge of the legislative drivers that impact on sustainability or the adverse environmental effects that the BE generates, as stated by Goertemiller (2015).

What is evident aside from a strong inescapable trend that there is a significant lack of awareness of sustainability within the BE, a point also strongly argued by Shaika (2015), is that there is also curiosity, a willingness to learn and a genuine thirst for knowledge about sustainability, what it is and why it is relevant. There is in precis a general lack of awareness despite the information

and activity that is continually evolving to support a sustainable regime within the BE. The SIR is the research aim and at a practical level a tool to promote sustainability within the BE, to all of its stakeholders irrespective of who they are or where they are.

Ullah et al. (2013) state that if people's perception, knowledge, awareness and attitude towards environmental issues are high, then the environmental literacy rate is also high, in which case this will lead to a positive change in behaviour. This latter point summarises the researcher's fundamental argument in answering the research question. That being that a genuinely sustainable regime within the BE can be achieved but only through collaborative effort, which means that every stakeholder in the BE in every trade and profession everywhere must act accordingly. A positive shift in mind-sets may only be possible through improving environmental literacy, and that can only be achieved by understanding the issues at play and how they can be resolved; in short, by gaining awareness. The question, therefore, remains "how this can be achieved". Perhaps it is a simple answer, and one that always connects a lack of comprehension to a state of total erudition, that being education, awareness and from that, knowledge. What is required, however, is a tool to achieve it.

6 SIR, THE SUSTAINABLE INFRASTRUCTURE RESOURCE

6.1 Introduction

The preceding chapters demonstrated that a lack of awareness to sustainability exists within the BE. The researcher considers this to be the overarching barrier to the research question:

”Can an effective inter-generational sustainable regime become a reality within the Built Environment?”

In the researcher’s view, this is wholly contingent on every stakeholder in the entire global BE sector gaining an awareness of sustainability, as well as through knowledge making, and informed and committed decisions can this be achieved. The initial challenge is to ensure all stakeholders in the BE are aware of the awareness support system, the Sustainable Infrastructure Resource (SIR).

6.2 Proving the Need for the SIR

Shaika, (2015) argues that there are barriers to sustainable construction, the most prominent of which is a lack of awareness. This point was directed to the BE by Bungwon et al. (2016) who argue that a lack of awareness exists within stakeholders in the BE to sustainability, and without this, sustainable building could be hindered due to ignorance and a collective lack of understanding (Hakkinen, 2011).

The lack of awareness as to what sustainability is and means within the BE is outlined and argued in the preceding chapters. It is therefore important to coalesce the factors that have been discussed throughout this thesis and describe how they justify the SIR’s existence and dictate both its form and function.

Evidence for the core tenant of this thesis is found in all but Chapter 4 the methodology which identifies the methods chosen to address the Research question.

6.2.1 Chapter 2

The literature review outlined there are many organisations including Governments, NGOs, SME's, micro businesses and thought leaders who globally promote sustainability within and without the BE, and therefore it would be logical to assume that awareness is pervasive. In the BE these numerous organisations are very proactive in promoting awareness of sustainability within the BE such as the Chartered Institute of Builders whose Carbon Action 2050 toolkit is designed to promote awareness by guiding the BE sector. The Royal Institute of British Architects whose, 2013 revised Plan of Work, includes sustainability consideration in all of its stages and the British Institute of Facilities managers who have conducted surveys regarding sustainability in the BE for the past 11 years. It stands to reason that these entities continue to promote sustainability awareness because they feel that it is a never-ending mission.

A living example was outlined in the literature review of Easter Island, albeit in a localised context of what happens to an environment when there is a lack of awareness of living sustainably, in precis, a disaster. On the other hand, an example of collective sustainable action was illustrated in the literature review with the construction of an entire city called Greensburg in the United States, rebuilt according to sustainable principles, after an F5 tornado decimated it in 2007.

A lack of awareness appears to be a universal constant that continually leaps from these pages. The literature review bought into question the level awareness of the health effects of construction materials, such as solvents, polymers materials antithetical to nature, even toxic natural materials such as asbestos. Was it through a lack of awareness that great post-modernist architect Frank Lloyd Wright lived with his family in a building of his design which he knew was riddled with Asbestos, the adverse effects of which were understood at the time.

As outlined earlier the BE is a massive producer of greenhouse gases and waste, two points that provoked the Research Question. If this can be changed,

it can only be achieved by a collaborative effort, one in which every stakeholder within the BE, through all its lifecycles, has a part to play. Sustainability, therefore, requires to be taught and be part of the BE's core business strategy.

The literature review outlined several micro, and macro BE related initiatives with notable sustainability credentials, such as the London Olympic Venue, the Restore shop, and the cradle to cradle business models of organisations such as Polyflor and Interface. The immense amount of International European and UK legislation that positively impacts on the pillars of sustainability were outlined in precis in the literature review. It is arguable that there would be greater emphasis and awareness of sustainability if there were a single umbrella act like the Health and Safety at Work Act 1974 (HASAWA 74), that was explicitly directed to the BE. It would almost certainly give day to day immediate relevance to it as the HASAWA 74 does to health and safety today, instead of the topic being dispersed amongst a myriad of international and UK statute law, which it could be said almost hides sustainability in plain sight.

Importantly this chapter discussed the population dynamic and the BE related issues, such as a population that has doubled since 1960 to 7.6 billion (2018), and the immense increase in urbanisation being undertaken as you read this. Both of these factors suggest that we are at a point where sustainability has to be a grounded part of the expanding BE because it is expanding to an unprecedented degree.

6.2.2 Chapter 3

This chapter discussed several barriers and drivers which both hinder and promote sustainable practice within the BE, all of which were included in the main survey. It was found from the respondents and those interviewed in the semi-structured interviews all the barriers examined in this chapter had a common denominator, one that seemed to bind and influence them all, being a simple lack of awareness and knowledge. With sufficient awareness and understanding, it is hard to see how any barrier is truly insurmountable. The barrier of “investment” can be removed once it is understood that there is a positive economic argument for sustainable building as argued by Soulti, (2006), and as demonstrated by organisations such as “Restore” and “Polyflor” as discussed. A lack of organisational and management interest can be dissolved once it is understood that sustainable practice is in the best interests of the company’s survival, a point that would be appreciated by the profit centred. The lack of employee interest would also be included as younger employees (i.e. Millennials) tend to prefer to work for companies that are ethical and has a positive impact on the world (Jenkin, 2015). Added to which there are quantifiable benefits to working in green buildings such as improvements in health, wellbeing, productivity and self-reported absenteeism (Singh, Syal, Grady, & Korkmaz, 2010). Other barriers discussed in Chapter 3 such as a lack of subject matter experts, available information, inclination and even available time to pursue this in the working environment could be positively affected if there exists a state of genuinely informed awareness of the need for a sustainable regime within the BE. So the researcher would argue that a lack of awareness can be considered a binding barrier, and once removed through education and training could remove these occluding barriers.

6.2.3 Chapter 5

Chapter 5 demonstrated that there exists a lack of awareness of sustainability within the BE, which became apparent from the survey results the semi-structured interviews, and the word association exercise conducted over the period of research. The lack of awareness was repeatedly demonstrated throughout the main survey. For instance, there was generally a great deal of confusion in both the pilot and the main survey relating to the differences between an environmental policy and a sustainability policy. This is argued by Schafer (2013) where they are commonly confused. Additionally, the strong associations between sustainability and the environment often cause a misconception that sustainability is strictly an environmental issue (Zigmond et al., 2011). The latter point was illustrated in the pilot, the main survey and the word association exercise where sustainability was most strongly identified with waste recycling and carbon management (both perceived as environmental issues), both of which are regulated by legislation. As Silberman (2015), argues legislation can be adhered to even when it is not understood. According to Revell and Blackburn (2005), many studies have shown that regulation is the primary driver of environmental reform amongst SMEs. However, reasons provided by respondents and the interviewees for this, included a lack of training and a lack of information dissemination.

The main survey revealed that many of the respondents and interviewees believed that they were not proactively encouraged to pursue sustainability in the workplace, Information regarding this was not always disseminated, and a frequently recurring criticism was that companies pursued sustainability for pecuniary benefits only, which is also argued by Berns et al. (2009). Although most respondents believed that their companies were addressing sustainability, they did not consider that they were acting to integrate it within the company by passing on knowledge or encouraging training. Several respondents and interviewees cited that the organisation knew that specific processes had links to sustainable action in the BE such as a BREEAM assessment, which had to be undertaken, however it was not fully understood beyond financial and possibly marketing reasons, as to why it had to be done. Therefore, companies

and employers did not promote sustainability, nor did they encourage knowledge through training, all of which almost inevitably created a state where awareness of it was lacking

The surveys and interviews revealed that although training had been given this was in the form of “Continued Professional Development” (CPD) and in-house seminars. However the researcher would argue based on the comments made by the interviewees that there was a lack of continuity in training as the course contents of a half-day seminar were often quickly forgotten. Additionally, the CPD courses were generally company representatives expounding the environmental benefits of their products and systems, thus accentuating the environmental bias as argued by Zigmond et al. (2011). A lack of regular directed education and awareness programmes within the companies of the interviews and respondents was evident, barriers for this distilled from the methodology centred on a combination of a finance and time-related reasons. Ironically according to Butler and Keaveney, (2014), education and training are the best tools to counter these barriers.

Many of the respondents and interviewees did not believe that their companies had a high level of knowledge to sustainability, although it was accepted that this question had a weakness that being the respondent and the interviewee may not have possessed a sufficient level of knowledge on which to base that assertion. The question for that reason also had strength, because if the question was answered in the negative, either the company or the respondent/interviewee had a lack of awareness of sustainability in the BE, possibly both.

In both the surveys and semi-structured interviews, a lack of awareness of several general terms associated with sustainability were demonstrated, such as “sustainable development”. The list of words and terms was increased in the interview, and although it is accepted that technical jargon bias may have affected the responses, the researcher felt nonetheless that terms such as “cradle to cradle”, “Agenda 21” and the “pillars of sustainability” would have been known even with limited awareness of sustainability. A great deal of

interest was displayed mainly in the semi-structured interviews about these terms, and what their real-world macro associations were.

Many interviewees and respondents were unable to cite recent well-known BE related projects that showcased sustainability, including notable ones like the London Olympic Venue, which was arguably the largest project of the kind ever undertaken in the UK. This project was included in most of the major professional institution's subscription magazines expounding its sustainability credentials, not to mention other forms of exposure such as television documentaries, and internet-based videos. Barriers that were cited for lack of knowledge of these projects included time, the fact that information concerning these issues was not centralised or convenient to access. Although the researcher would argue against these latter points, it should be remembered that although 30 years ago research was largely undertaken in libraries the internet seems to have created a generation whose expectation of information access is instant. The researcher would surmise that this point alone is what has created the internet “one-stop shop” giants such as E-Bay, Amazon and Expedia. It also outlines specific core operational requirements for the design of the SIR

The notable lack of awareness was demonstrated by many respondents and interviewees when they were unaware of the adverse effects that the BE has on the environment and its significant contribution to anthropogenically generated CO_2. Given the arguments (Zigmond et al., 2011), that sustainability and environmental issues are often confused, there was, even so, a significant lack of appreciation of the mostly environmental issues that were listed in the questions.

Those who reacted positively to the final question in the main survey and the interviews indicated that if an awareness framework existed, it would need to be something readily accessible using current technology. The mean average of those who would use the SIR as demonstrated in the results of the main survey was 77% and 87% for the questionnaires and the interviews respectively.

Many of the respondents and interviewees stated that the SIR would have greater relevance if it had a macro perspective, not merely a site-specific one. The SIR as previously mentioned would need to exist in an electronic format which would improve access and therefore continual use. The fact that it could be used as a one-stop shop for a wide variety of information including supply chains and training information was also an attractive feature, improving the chances for office-based usage.

A lack of awareness of sustainability within the BE exists. To successfully promote it may well have a cascade effect of removing what might be considered by many if not all the barriers illustrated in table 3.1 Chapter 3

The issues discussed above are far from exhaustive, and it is anticipated that there will be other barriers that the SIR can counter and drivers it can further promote that have not been discussed in this thesis, there will additionally be barriers in the use of the SIR itself which will be further discussed in this chapter.

6.3 The Research Aim and a Sense of Awareness

The aim is to develop the Sustainable Infrastructure Resource (SIR). A framework with a principal aim to promote a sustainable regime within the BE.

As Shaika, (2015) argued there are barriers to sustainable construction, the most prominent of which is a lack of awareness. To counter that one must consider what tools can be used to remove this significant barrier.

Claeys (2014) argues that to achieve a globally sustainable regime we need an awareness based collective action, the cause of our ecological and civilizational crises is between our ears, and what is needed is a deeper shift of consciousness. The researcher unquestionably agrees on this collective action ethos and would further argue that achieving a global awareness of sustainability in the BE is contingent on it. A tool is therefore required, one that can in one form or another be accessible to every stakeholder in the BE, of all ages everywhere, imparting knowledge, encouraging networking, in short, an awareness support system.

The SIR will remove or reduce the barrier of a lack of understanding and the need for change by removing the two influencing factors which according to by Kurt Lewins (1890-1947) are a lack of awareness and a lack of communication

The SIR model will be a tool designed to promote sustainability within the BE anywhere there is a BE and someone who looks after it. The SIR will need to be flexible and available over a variety of mediums including electronic and hardcopy and be able to not only overcome the barriers that could threaten its own existence but also be a tool that overcomes the barriers that affect the promotion of sustainability within the BE, itself, many of which have been previously discussed.

6.4 SIR's Primary Functions

The following SIR functions include those distilled from the main survey and in particular from the interviewees' responses who were able to expand on their answers and opinions. The functions are listed as "macro" which offer a global high-level perspective prioritising wide scale awareness empowerment, and "micro" site-based which may be considered functions that could be included in current Building Information Modelling systems already available on the market.

6.4.1 Macro Functions

1. Definitions of what sustainability is, its history, its relevance and application to the BE, in a global context. Database of known causative issues of climate change. Many respondents and interviewees, particularly younger, expressed an interest in understanding the broader picture of sustainability in the BE. An awareness of the macro picture should, it is hoped, lead to an ever growing interest in developing knowledge, and ultimately a sustainability driven mind-set.
2. The SIR would contain a database of informed stakeholders in and out of the BE, with a global capability of networking, permitting information and idea exchange, in effect bringing all stakeholders together on a level platform irrespective of who and where they are.

3. Web-based links to websites that impact and raise knowledge of sustainability issues, impacting on the four pillars of sustainability such as the Keeling curve and population statistics.
4. Links to NGOs, for example, the World Green Building Council, the United Nations Global Compact, The Carbon Disclosure Project. Many Professional institutions promote sustainability within the BE such as the BIFM, RICS, CIOB, RIBA and IEMA. Provision of live links to NGOs promoting sustainability globally, such as MIT Sloan and the IISD Green Verge, including details of conferences and seminars.
5. Free membership to all those who sign up to the SIR, in effect creating a sustainability dedicated social media resource for anyone of any industrial sector, irrespective of qualification or experience to become a member of a broader community and encouraged to share experiences of implementing sustainability within their sectors. In effect creating a global community of like-minds.
6. Lists of all sustainable suppliers in the United Kingdom and globally so that an informed choice could be provided to the stakeholder relating to product choice, company travel and supply chains.
7. A directory of current legislation relevant to sustainability within the BE and horizon scanning to consider how future legislation will impact on a company's operations, allowing for a degree of business resilience for strategic planning.
8. Comprehensive reports and accounts of conferences and initiatives that have impacted on sustainability within the BE such as Agenda 21, Johannesburg 2002, and COP 21.
9. Provided links to academic institutions through the UK who have courses that impact on sustainability within the BE.
10. Links to professional organisations that can consult on sustainability and free resources providing templates for sustainability policies and associated advice.
11. Provided links to organisations worldwide that have their methods for promoting sustainability within the BE so that a state of global awareness

might be achieved, with networking for an active sustainable-minded community.

12. Include a full material inventory database capability, acting as a voluntary measure and possibly be included in a macro database allowing for studies to be carried out relating to the volumes of embodied materials, for example, carbon capture information.
13. Links to live news and other mass media feed including social media that impact sustainability within the BE.
14. A database of all known adverse materials and chemical compounds found within the BE with links to an organisation who already pioneer this field such as PHAROS project. Voluntary inventories might be submitted detailing lead and asbestos quantities which might afford a picture of these materials within the UK's BE.
15. A macro application of the following point (no 16), a macro material inventory database such a feature would have the capability through a common medium such as the web-based SIR to create an international inventory, a transparent account of where materials are and what their sustainability-related loadings are, including toxic and dangerous materials such as lead-based finishes and asbestos. Therefore, in effect creating a global material inventory. Such a worldwide database might allow for research to be carried out ascertaining the logical and economic use of materials at the end of their current use, permitting an element of future generational planning based on existing materials that can be reused or upcycled.

6.4.2 Micro functions Site based functions

16. Include a full material inventory database capability, which would catalogue every component in every facility; there would be several advantages to this from a sustainability perspective such as having an awareness of the embodied carbon and embodied energy loadings for which a site owner or stakeholder is responsible for.

17. Links and advice on recycling and reuse strategies, including possible exchange and mart type functions for re-using materials about to be discarded by others around the country and immediate locality.
18. Contained all information about the building(s) as-built drawings, specifications.
19. Access to an embodied carbon calculator to allow FM to assess their carbon liability.

6.5 The SIR's Form

There are several options to the SIR's form, and how it can be accessed such as a web-based resource site, updatable CD/DVD/ USB data stick and printed material (hard copy).

6.5.1 Web-based

For the first time in human history, there exists a medium that can be accessed in every corner of the planet and that approximately 48% of the world's population has direct access, the internet (internetlivestats, 2018). According to Internetlivestats (2018) this was only 20% ten years ago. Access to the internet is increasing where it is and information can be accessed anywhere with a WIFI signal. The inescapable point is that the internet may be the most efficient and cost-effective way of promoting awareness to sustainability.

As outlined 48% (ibid) of the world's population have direct access to the internet, which can be accessed on a PC, a laptop, a tablet or a mobile phone. The most logical form for the SIR would be a bespoke created website available under subscription and eventually with the intention of making it free, financed by donation in the manner of the Wikipedia online resource.

6.5.2 Updatable CD/DVD/ USB data stick

The researcher was unable to ascertain how many of those who do not have access to the internet may still have access to a computer; it is suspected that this may be in great numbers in parts of the world where the internet can be expensive or simply not possible to access.

For these organisations, a certain amount of data can be provided in the form of a DVD, a micro SD card, or a USB resource. Although obviously information would have to be given differently as internet links may not be possible. This form of the SIR would still contain an immense amount of data, as USB data stick at the time of this thesis publication can have 250GB memory capacities, according to techdocs (2018), a 250GB memory stick can hold 250 copies of the entire Encyclopaedia Britannica. USBs are small portable and easy to post anywhere in the world. The same principle would apply to either DVD or CDs. However, the USB stick is arguably an easier item to post and can hold a greater storage capacity.

6.6 Overcoming SIR's Barriers and Developing SIR's Drivers

Every action performed by any living being can be determined by drivers and barriers (as outlined in Chapter 3), the implementation of sustainability in the BE is similarly affected.

For a resource such as the SIR to be effective, it needs to complement the drivers and counter the barriers not only those discussed in Chapter 3, and further investigated in Chapter 5, but also those that would influence its survivability.

6.6.1 Barriers and Driver influencing the SIR

RELEVANT BARRIERS	RELEVANT DRIVERS
• Concerns over set up costs • Lack of organisational interest • Lack of management interest • Lack of interest from employees • Lack of legislative guidance • Lack of published materials • Lack of IT Aids • Accessibility	• Company Green image • Adherence to legislation • Senior management leadership • Client pressure

Table 6.1 Illustrating Barriers and Drivers influencing the implementation of sustainability within the BE; (Harrop, 2018)

6.6.2 Barriers

Set up Costs

Investment costs as demonstrated in the pilot and the main surveys was consistently one of the two most significant barriers identified by the respondents and the interviewees.

Although as discussed there is the potential that full awareness and knowledge can effectively remove the barriers that have been discussed in this thesis and further demonstrated in the survey. That said, awareness has to be gained, which is the core reason for the creation of the SIR. So it would be necessary for the system to be attractive to organisations and management alike. Which it should be mentioned was the other high priority barrier that was encountered in the surveys. To overcome the barrier SIR would need to be an economical or free resource that would have demonstrable benefits to the organisation. The latter would be achievable by using the SIR and becoming a subscriber; this would demonstrate that learning about sustainability is a part of the working culture and the company ethos. It would be possible to log the hours that each employee spent on the system. The SIR would have a graded tier system acknowledging the levels of awareness and knowledge gained.

Lack of organisational and management Interest

These two barriers may have commonalities about using a system such as the SIR. As a barrier, this might be rendered less of an issue depending on the organisational reason for lack of interest. As demonstrated in the main survey these included set up costs and time needed to access it. As mentioned the SIR is intended to be a free or cheap resource. Its use can be easily monitored and in so doing the employer can demonstrate that their employees are “sustainability aware”, something that clients are expecting to see on pre-qualification questionnaires and invitation to tender documents.

Lack of interest from employees

Even if this applied to an employee, a green corporate image as a driver is encouraged and may be rewarded with incentive schemes such promotions, pay rises, or employee of the month awards. Proof of accessing and understanding information might be recorded on staff records to allow the employer to prove that their staff have an awareness of sustainability within the company. This also, as mentioned above, could have been used in PQQs and ITTs, ably demonstrating to prospective clients that there is a culture of sustainability within their organisation. At this time it is difficult for a company to comprehensively prove that it has not only an ethos of sustainable behaviour but that all of its employees share this mindset.

It might be fair to say that if an employee had reason to believe that they might be rewarded in some way for accessing an awareness support system like the SIR, it would probably happen.

Lack of legislative guidance

Access to the SIR for those with an internet connection would provide easily accessible data on all legislation relevant to sustainability within the BE and whatever might be required. In instances where the resource would be loaded on a portable device such as a USB, then current details relative to the country's legislative framework could be loaded on to a medium such as a USB data stick.

Lack of published materials / Lack of IT aids

These two barriers would automatically become obsolete as soon as the SIR was accessed. With a subscription to a system like the SIR, the number of references to published materials, either first or second hand could be prodigious, even if limited to stand alone mediums like a USB stick. Arguably the majority of published information on sustainability can be found on the internet; this is undoubtedly the researcher's experience.

6.6.3 Drivers

Company Green Image / Client Pressure

According to the survey results in Chapter 5, a green company image trended as a significant driver. This may be for some reasons: kudos because it is the right thing to do, or perhaps more likely to do with an image that will attract investment and business from other organisations appreciating the value of this in their supply chain. It may be simply following their company directives in employing sustainably minded suppliers. Either way, a system such as the SIR could allow an auditable demonstration to clients that their staff are sustainably aware and use sustainable supply chains. The pilot "procurement variant" semi-structured interview recorded that 64% of procurement interviewees would purchase from ethically sourced suppliers, which includes companies with sustainable credentials. It should be noted that procurement departments are often responsible for contract letting.

Senior Management Leadership

In a sustainably minded organisation, it would be expected that senior managers would condone and encourage sustainable behaviours and mindsets among their employees. As indicated this might be supplemented by carrot schemes, including promotion, pay raises and bonuses. Senior managers can influence policies and initiatives. With their genuine and enthusiastic back up it would be hard to see how a system like the SIR would not frequently be accessed.

6.7 SIR's Secondary Functions

6.7.1 The Built Environment; Physical Form

The awareness empowerment function is certainly the most dominant function of the SIR, particularly as a lack of awareness was identified in the results chapter as being a principal barrier to the promotion of sustainability within the BE. However, there might be a range of secondary uses for the SIR, which may well have real-world applications.

Function H on figure 5.18 (*The capability of being a fully detailed material inventory database*) might have several real-world commercially attractive applications that may not be immediately obvious. Although a capability of most BIM systems, a resource such as the SIR might manage collated information from organisations willing to release it. On any site, there is an enormous quantity of material that forms the BE. Most sites do not have easy access to such information because of the work required to assess the drawings and make estimates based on as-built drawings. The researcher undertook an exercise at the MoD site he works on originally as part of this research. Assessing 6,433 “as built” drawings took a little over 3,000 hours which enabled the researcher to formulate tables that provided details of the facilities component inventory for a site with several dozen buildings ranging from 20 – 5,000 m^2 and a large variety of construction methodologies. This data could have some real-world uses, including part of the client’s package requirements within the CDM regulations or to hand over documents to new buyers illustrating, for example, hazardous materials to a contractor before work being is carried out in an area. The potential list of uses is considerable.

6.7.2 The Chemical Cocktail

Many may think that the approximately 100,000 manmade chemicals that exist have been tested and proclaimed as safe, this is not the case (Estabrook et al., 1996). Estabrook et al. (1996) further argue that we are in fact “flying blind” and that recent studies undertaken in their research, indicate that we, in fact, know very little about the impacts on the environment and human health that these chemicals and pesticides pose. They argue that we tend to think in “linear” terms and that we look to cause and effect links from single chemical agents and not about the potential effect of combinations. They cite for example that a plasticiser used in vinyl flooring (diethyl hexyl phthalate), in combination with the common solvent trichloroethylene is a far more powerful toxicant than these chemicals alone. The SIR would be a resource permitting easy access to all information available to research this such as the PHAROS resource. Estabrook et al. (1996) were not the first to voice this concern, which might be attributed to Rachael Carson (1907-1964).

6.7.3 The Phoenix Factor

Through long-term strategic planning, knowledge of available resources can provide work and security to local people. A detailed material inventory, even for a single building can have great use as previously outlined. A town or a city, however, offers a different scale of advantages. New industries and opportunities can be built from the old. On decommissioning, the small MoD site where the researcher works will yield thousands of tonnes of high-grade steel as well as thousands of tonnes of recyclable concrete. These materials could easily be a potential starting stock for a smelting or processing business, or the structural bones for new industrial infrastructure.

6.7.4 Self-Generating Responsibility

Organised religion, big business and government all use frameworks of individual disempowerment to ensure a passive and responsive population base (Corvus, 2007). Corvus's (2007) argument may be a valid one, that being, increased social security legislation has created a "nanny state" and removed a sense of self-responsibility, self-reliance and created a loss of the work ethic. Whether true or not, it seems apparent that the SIR would be a framework of personal empowerment from knowledge and networking. The primary intention in its development is that its operation and maintenance would elicit a sense of responsibility from its users.

6.7.5 Disaster Assessment

On the 22nd February 2010, a magnitude 6.3 (Ml) earthquake hit the Canterbury area of New Zealand's South Island. The worst affected area was New Zealand's second most populated city, Christchurch. The incident killed 181 people. Although global warming did not cause this, it did highlight the need for an organised and strategic response to help people and to assess the damaged BE. In the short term that would include repairing damaged buildings and finding accommodation for the displaced; and new office facilities to keep the local economy going in challenging circumstances. As outlined in Chapter 5, the surveys and interviews identified that FM as a profession seemed to have

the greatest awareness of sustainability within the BE and a broad base of functions to maintain and service it:

"One of the most immediate concerns in the days and weeks after the earthquake was temporary accommodation and inevitably the spotlight fell on facilities management (FM) departments to make this happen"(source FM World, 2015)

In the absence of a BIM system, it might be asked how a framework like the SIR could have helped with the immediate relief of human suffering?. Firstly the material inventory would have been relevant to each, and thus provide the capability of planning to reuse the materials responsibly and sustainably. Secondly, such a framework would record the presence, quantities and type of hazardous materials, for example, whether Asbestos was Chrysotile (white) or more harmful types Crocidolite (blue) or Amosite (brown). With this data rescue and demolition teams would have a better understanding of the materials they might encounter. In the case of 9/11, it is estimated that 2,000 tonnes of pulverised Asbestos (Povtak, 2013) were airborne. The physical effects are just starting to become apparent and the worse according to Povtak (2013) is yet to come, a point reinforced by Barasch, (2017) who cites that victims of 9/11 such as rescue workers, police and people in the locality at the time of the attack are developing cancer at an alarming rate

6.7.6 Future and Intergenerational Planning

Future planning usually requires an appreciation of available resources. If at a theoretical future point in time, a universal SIR database existed listing all the components in every building on the planet, then the possibilities of material planning and re-use could reduce raw material extraction to an immense degree. Where materials are scarce but opportunities for the industry were plentiful then materials to build plants or towns would be needed. A macro SIR could catalogue chronologically available materials including locality and specification. It is known that some nuclear sites, for example, are starting or are in the process of decommissioning, and this will release potentially millions of tonnes of "waste" building materials. Had this framework existed at the time

of construction, a strategy for the potential future use of the components or the facilities could have been strategised. Although this may never be a function of the SIR and may well be incorporated in some form of “macro BIM” database, having this level of information on the world BE material inventory might nonetheless, have a litany of potential uses, not the least being an immensely powerful tool in promoting sustainability within the BE.

7 CONCLUSIONS

7.1 Introduction to the Chapter

The research question examined, “Can an effective intergenerational sustainable regime become a reality within the Built Environment?” In Chapter 6 the researcher stated that this can be achieved but only with the collaborative efforts of all stakeholders within the BE.

The outcome of this research is the development of the SIR, where in Chapter 5 its form and function were justified, all, which were developed as a result, from the methodology and methods. This chapter will provide an overall conclusion to the thesis and insight where the research can be taken further.

7.2 Summary and Conclusions

The research question centres on sustainability within the BE. As outlined in Chapter 1, sustainability is comprised of four pillars (see figure 1.1): Social, Economic, Environmental and Cultural. The research question examined if an effective intergenerational sustainable regime can become a reality within the Built Environment”. In particular, whether resultant CO_2 emissions could be significantly lowered in the BE through sustainability.

Although CO_2 emissions are an important aspect of this research, achieving the four pillars of sustainability are critical if the BE is to become sustainable in the long term.

The reduction of BE-related CO_2 emissions does, however, remain an important target, and as Juniper (2013) argues, no economic activity can occur without the environment to support it. In other words, if the environment is destroyed and becomes hostile to supporting life, then it will become increasingly difficult to support human activity. Regardless of this statement, human economic activity is already being affected by sea level rise for example on small low-lying islands. In the longer term, this is likely to affect many of the planets most significant financial centres including London, New York, Tokyo, and Hong Kong (Bawden, 2015)

The urgency of achieving sustainability within the BE becomes more apparent each year. In August 2016, global atmospheric CO_2 levels breached 400 ppm, where it was stated that such levels would frequently be recorded (Kahn, 2016). Further to this, Kahn (2016) stated that the planet had reached the 1.5C (2.7F) warming threshold, a key metric in the 2015 Paris climate agreement.

The SIR as described in the preceding chapter is a multi-function tool that will raise awareness, educate, and, impart knowledge, thereby having a positive effect on promoting a sustainable regime within the BE. As previously outlined, this must be done as a collaborative effort. Once the SIR is active and becomes a part of every stakeholder's professional life, the researcher believes its use will increase, and drivers such as the increasing importance of sustainability within the BE, and companies not wanting to be left behind for either voluntary or regulatory reasons will aid this growth. Also, it is anticipated that the stakeholders through custodial ownership and a sense of personal and professional responsibility will aid the growth of the SIR with the overall aim of raising awareness with the BE.

The researcher would argue that sustainability in the BE is akin to a road trip from John O' Groats to Lands End. The infrastructure is in place to facilitate a safe trip from point to point, but the route may be unknown, the general direction perhaps but no more. So a tool is needed one that seamlessly shows you the way en-route and in real time, such as a satellite navigation system. The SIR would provide the same function, to raise awareness and provide the user with every detail of the journey en-route.

From the research undertaken the researcher considers based on the conclusions drawn from these chapters that in an industry which has moved closer to sustainability within the BE if global awareness was achieved, it is very likely that a sustainable regime within the BE would be achieved. If this were so, then perhaps the issues raised throughout the thesis would be mitigated.

Within the BE and its associated sectors there exists a substantial and formidable framework of knowledge, tools, experience and purpose, which undoubtedly have a positive effect on the promotion of sustainability within the BE today. That is not to say the barriers are preventing the successful and comprehensive implementation of sustainability have been scaled. The researcher argues that one key barrier exists as identified through the literature review, surveys, and interviews that there is a lack of universal awareness of sustainability. A barrier that seemingly reduces the effectiveness of the BE's achievements in creating a sustainable regime.

This global lack of awareness started to reverse as outlined in the literature review during the last few decades, where world events catalysed the "environmental movement". However, it could be argued that the BE did not react as to these events quickly. This perhaps is not surprising as the BE is generally a traditional industry, with strong directing trends, such as traditional trades, traditional methods and mind-sets, where change is often resisted.

The thesis illustrated examples of real-world implementation and awareness of sustainability within the BE. Elements to promote sustainability are embedded within existing legislation and seems likely to be woven further into future statute law. Sustainability flourishes in the minds of thought leaders such as Walter Stahel, Amory Lovins and so many more. It exists, as outlined in this thesis, in the actions of NGO's multinationals, SMEs and ordinary people undertaking their own initiatives. The BE is a major player in today's global environment, where there may be no other industry that has had a greater adverse impact/effect on the planet, or an industry that can help reverse impacts/effects.

This thesis has argued that an effective and growing sustainability ethos exists within the BE, but it is not fully appreciated and understood, its stakeholders are largely unaware of it. In which case, all those who are aware or partially aware have a responsibility to promote the benefits. As Edmund Burke (1729-1797) said, "No one could make a greater mistake than he who did nothing because he could do only a little"

The research demonstrates that a vital component in achieving a genuinely sustainable regime is to achieve a state of complete awareness with every stakeholder everywhere. As outlined in the literature review, the BE started as a sustainable entity with vernacular architecture. It is now the responsibility of the global industry to sustain the environment, and although it is hard to imagine the industry returning to a completely sustainable regime, there remains room for improvement and adoption.

Sustainability encompasses the continuation of what we are doing but in applying this differently from a different perspective. Humanity has a right to social and technological evolution. It would be possible to become a sustainable society overnight if we relinquished technology, fossil fuel use, and the endless list of comforts that are enjoyed as part of modern society. However, this will not happen so it is about adapting what we have and how we can apply the use of such products and processes differently to identify the benefits and reduce the impacts.

The BE is common in every country on the planet and every civilisation that has ever been, but to make it truly sustainable is a challenge, unlike anything it has ever faced. The BE and its myriad of supporting industries have, in the researcher's opinion, a clear duty to ensure that stakeholders are fully aware of what sustainability is, how it can be incorporated and the long-term consequences if it is not achieved.

7.3 Further Research

Further to this research, the researcher intends to research the legislative framework in depth and the application and viability of major primary legislation covering the pillars of sustainability related to the BE. More importantly, the researcher proposes to undertake a trial study of the SIR model, which will require initially the creation of a dynamic database. This will identify if the tool can raise awareness of sustainability in the BE and where additional steps and processes will be required to ensure validity, reliability and use.

Further to this work, the researcher proposes to expand the issues identified in the thesis, namely the lack of awareness, targeting countries that are likely to have an expansion of urbanisation particularly those discussed in the literature review. Initially, the researcher will focus on China, which has had a significant shift in urban dwelling population numbers since 1980 and is one of the world's highest producers of GHG's.

The researcher would argue that education is the just the beginning of wisdom, not the end, a point relevant to any level of academic study. As previously mentioned, the academic outcome of this research is less important than promoting the subject matter and attempting to make a material difference to GHG emissions caused by the BE.

So far, the researcher has altered the perception of BE-related sustainability issues in the immediate SME environment of those surveyed and interviewed; the intention is to continue influencing all those within this expanding sphere of influence.

The completion of this thesis, therefore, represents the end of the beginning, the start of the journey for the researcher and eventually others, to aggressively and proactively promote sustainability within the BE, a journey it is hoped that will continue until at least an end is in sight.

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APPENDIX A Main Survey and Main Interview Templates

A 1 Main Survey Template

J N HARROP PhD SUSTAINABILITY SURVEY (FINAL)

1 / 1 100%

*** 1. Which of the following best describes your employment context? (You may tick more than one), numeric boxes indicate employee numbers in your company.**

	1-10	11-50	51-250	251+
Building Contractor	☐	☐	☐	☐
Consulting Engineer	☐	☐	☐	☐
Facilities management (Hard and Soft)	☐	☐	☐	☐
Civil engineering	☐	☐	☐	☐
Structural engineering	☐	☐	☐	☐
Supplier	☐	☐	☐	☐
Architect	☐	☐	☐	☐
Planning	☐	☐	☐	☐
Building Control	☐	☐	☐	☐
Manufacturing	☐	☐	☐	☐
Steelwork Fabrication	☐	☐	☐	☐

Specialist supplier / Other (please specify)

*** 2. Please categorise the position you hold within your company structure,**

	Please tick appropriate box
Senior Management	○
Middle Management	○
Lower Management	○

	Please tick appropriate box
Other	◯

Other (please specify)

3. Which of the following institutions do you belong to (You may tick more than one)

	Please Tick
Chartered Institute of Builders	◯
Federation of Master Builders	◯
British Institute of Facility Managers	◯
Royal Institute of British Architects	◯
Royal Incorporation of Architects in Scotland	◯
Royal Town Planning Institute	◯
Chartered Institute of Waste Management	◯
Royal Institute of Chartered Surveyors	◯
Institute of Civil Engineers	◯
Institute of Structural Engineers	◯
The Chartered Institute of Purchasing and Supply	◯
The Chartered Institute of Waste Management	◯
NONE OF THE ABOVE	◯

Other (please specify)

*** 4. Does your employer have the following policies ? (Please tick)**

◯ Sustainability Policy

◯ Enviromental Policy

◯ Both

◯ None of the above

5. How long has your company's Sustainability Policy been active ?

Please tick appropriate box

Under a year	◯
1 - 5 years	◯
6 - 10 years	◯
11 years +	◯
We do not operate one.	◯

If you do not have a Sustainability policy in place please indicate why not..

*** 6. Are you are encouraged to actively pursue sustainability within your professional remit.**

☐ Yes ☐ No ☐ Unsure

If unsure or you answered "No", could you please outline justify your answer.

7. From the following list please tick the applicable Sustainability issues which are practiced within your company.

☐ Waste management / recycling

☐ Long term planning of embodied building materials.

☐ Carbon emission management

☐ Specification of Sustainable construction materials

☐ Sustainable procurement practices

☐ None of the above

If you leave a box unticked could you please provide a very brief reason why this issue is not practiced within your professional remit .

8. The importance of Sustainability has increased in your profession within the last 10 years, do you agree?

- [ ] Yes
- [ ] No
- [ ] I had not noticed

9. Please tick the "Drivers" that promote the practice of sustainability within your company.

- [ ] 1. Company"green" image
- [ ] 2. Adherance with legislation / codes of practice
- [ ] 3. Senior Management leadership
- [ ] 4. Increased rental income from "green" buildings
- [ ] 5. Client pressure (ie evidence required in commercial tenders)
- [ ] 6. The triple bottom line
- [ ] 7. Competitiveness
- [ ] None of the above

If you feel these can be ranked in order of importance ,please use the reference number by the "Driver" and enter them in the below box(most important first).

10. Please tick the "Barriers" that you feel hinder sustainability within your company.

- [ ] 1. Investment costs (Loss to company profits)
- [ ] 2. Lack of organisational interest
- [ ] 3. Lack of Customer interest
- [ ] 4. Lack of management interest
- [ ] 5. Lack of interest from employees
- [ ] 6. Lack of Legislative guidance
- [ ] 7. Lack of easily available published information.
- [ ] 8. Lack of easily applicable "I.T" aids
- [ ] 9. We are interested but do not have the time.
- [ ] 10.There are no qualified subject matter experts we can consult within the company
- [ ] 11.We really do not care about sustainability issues.
- [ ] None of the above

If you feel these can be ranked in order of importance ,please use the reference number by the "Barrier".and enter them in the below box(most important first).

11. Have you undergone any related Sustainability training ?.(Please tick following list)

You may tick more than one box

CPD style course	○
Seminar / conference attendance	○
In house training	○
External Academic qualification.	○
No training undertaken	○

Please indicate any reasons why you have not undergone any training ie Cost, Unaware of courses, no incentive ,no management interest etc

12. Are you familiar with the following terms ?

	Yes	No	Unsure
The Four Pillars of Sustainability	☐	☐	☐
Closed Loop manufacturing	☐	☐	☐
Cradle to cradle	☐	☐	☐
Natural Capital	☐	☐	☐
Agenda 21	☐	☐	☐
Intergenerational Equity	☐	☐	☐
Sustainable development	☐	☐	☐
Extended producer responsibility	☐	☐	☐
Environmental assessment methodologies (EAM) i.e. BREEAM, DREAM, LEED	☐	☐	☐

If you answered "Yes" to the EAM Please outline which you have used.

13. Would you agree that Environmental assessment methodologies (ie BREEAM , LEED, DREAM),have a positive impact on the following Four pillars of Sustainability.

	I agree	I disagree	I have not used an Environmental assesment methodology.
Environmental Considerations (Efficient re use of materials / Ecological considerations/ renewable energy)	○	○	○
Economic. (Material Prosperity / Employment / Education / Fair trade)	○	○	○
	○	○	○

	I agree	I disagree	I have not used an Environmental assesment methodology.
Social (Human Rights / Health and Safety)	◯	◯	◯
Cultural (Well being / creativity / identity and diversity)	◯	◯	◯

If you disagree could you please state why you have this opinion.

14. Is your company / employer involved / allied / subscribed to any organisation with links to Sustainable initiatives for example.The World Green Building Council etc

- ☐ Yes
- ☐ No
- ☐ I don't know

If Applicable, please list the organisations your employer / company are linked with.

15. To what extent do you think that the general concept of Sustainability is fully understood by your company?

☐ Fully ☐ Partially ☐ Unsure ☐ Not at all

16. Are you familiar with any of the following legislation and initiatives influencing UK building design and construction?

	Yes	No
The Climate Change Act 2010	☐	☐

	Yes	No
Environmental Protection Act 1990	☐	☐
Town and Country Planning Act 1990	☐	☐
Environment Act 1995	☐	☐
Waste Framework Directive (2008/98/EC)[	☐	☐
Environmental Protection (Duty of Care) Regulations 1991	☐	☐
Hazardous/Special Waste Regulations	☐	☐
Landfill Tax and Aggregates Levy	☐	☐
Site Waste Management Plans Regulations (SWMP)	☐	☐
Waste and Resources Action Program (WRAP)	☐	☐
The Green guide to Specification	☐	☐
The Carbon Reduction commitment Energy Efficiency Scheme	☐	☐
CEN standards on the sustainability assessment of buildings	☐	☐

17. Could the following known facts relating to the Built Environment be described as "Sustainable"?

	Yes	No	I don't know
Energy from Fossil fuel consumed in the construction and operation of buildings accounts for approximately half of the UKs emissions of Carbon dioxide.	☐	☐	☐
Around 10% of UK emissions are associated with the manufacture and transport of construction materials and the construction process.	☐	☐	☐
More than 400 million tonnes of materials get delivered to site in the UK each year of these 60 million tonnes go straight to the tip due to over ordering or damage due to poor storage or because of inappropriate ordering.	☐	☐	☐
The UK Construction industry sends 36 million tonnes of waste to landfill each year.	☐	☐	☐
The construction industry in the UK consumes in the region of 6 tonnes of raw materials for every person living in the United Kingdom.	☐	☐	☐
30 – 40% of Global energy consumption is directed to construction and operation of the Built environment.	☐	☐	☐

	Yes	No	I don't know
3 billion tonnes of raw material annually extracted for global construction materials (the equivalent mass of a 2.0 m high brickwall encircling the Earth 390 times).	☐	☐	☐
Construction is responsible for 20% of global water useage.	☐	☐	☐

*** 18. Would you use an interactive "living" Sustainability database that would record and monitor a building (or buildings) impact on the four pillars of Sustainability through its lifetime? Please tick those functions below which would be useful in an interactive tool:-**

	Yes I would use this.	No I would not.
Capability of being a fully detailed and evolving material inventory database	☐	☐
Outlined future recycling / upcycling strategies for the physical materials that form the building / buildings and infrastructure.	☐	☐
Provided an accurate record of all changes and alterations throughout the facilities lifetime.	☐	☐
Detailed all materials used (for example in a construction project),quantities, specifications and "as built" drawings.	☐	☐
Functioned as an extension to the initial environmental impact assessment of the building through its lifetime, allowing for example the provision of accurate data for Extended Producer Responsibility liability	☐	☐
Routinely calculated the embodied carbon within the building fabric allowing for changes , repairs maintenance work.	☐	☐
Assessed quantified and managed potential health hazards from chemical components of building materials (chemical combinations known to be dangerous), finishes (ie Asbestos and lead) and contamination issues eg hydrocarbon or radiological.	☐	☐
Provided real time valuations of the Built environment (Rebuild costs, insurance valuations)	☐	☐
Be capable of linking with other databases to provide a macro assessment of embedded materials from an unlimited number of buildings.	☐	☐
Database of all known waste streams relevant to the known components listed within the database.	☐	☐

DO YOU USE SUCH A SYSTEM , if so please outline.

Done

A 1.1 Semi Structured Interview Template

SUSTAINABILITY INTERVIEW MAIN SURVEY

Name **Company** **Date**

1. WHICH OF THE FOLLOWING BEST DESCRIBES YOUR EMPLOYMENT CONTEXT?

a. Building Contractor
b. FM HARD SOFT TOTAL?
c. Civil Engineer
d. Structural Engineer
e. Supplier
f. Architect
g. Planning
h. Building Control
i. Manufacturing
j. Specialist Supplier

Turnover

Company Numbers

NOTES

2. HOW WOULD YOU CATEGORIZE YOUR POSITION WITHIN YOUR COMPANY STRUCTURE

Senior Management
Middle Management
Lower Management (Prioritise)

NOTES
Q : In the management structure who is responsible for corporate sustainability initiatives

3. TO WHICH OF THE FOLLOWING PROFESSIONAL BODIES DO YOU BELONG

Chartered Institute of Builders
Federation of Master Builders
British Institute of Facility Managers
Institute of Structural Engineers
Royal Institute of British Architects
Royal Incorporation of Architects in Scotland
Royal Town Planning Institute
Royal Institute of Chartered Surveyors
Institute of Civil Engineers
Chartered institute of Builders
The Chartered Institute of Purchasing and Supply

NOTES

Relevance of Question, if there is a lack of awareness , why m all these institutes, feature sustainability on websites /magazines etc

4. DOES YOUR EMPLOYER HAVE THE FOLLOWING POLICIES

1, Sustainability Policy

2. Environmental Policy

NOTES

YES / Examine sustainability policy, report on contents / how long has it been active
Did anything prompt the SP (IE Legislation, management initiative?)

NO Ask what barriers, if no policies are evident

Unsure , Ask why they are unsure , uninterested ? excluded?

1

SUSTAINABILITY INTERVIEW MAIN SURVEY

Name **Company** **Date**

5 HOW LONG HAS YOUR COMPANYS SUSTAINABILITY POLICY BEEN ACTIVE
Under 1 year /1-5 years /6-10 years /11 years plus / We don't have one.

6. DO YOU AGREE THAT YOU ARE ENCOURAGED TO ACTIVELY PURSUE SUSTAINABILITY WITHIN YOUR PROFESSIONAL REMIT.

Notes

7. WHAT OF THE FOLLOWING ISSUES ARE PRACTICED WITHIN YOUR COMPANY

a) Waste management
b) Long term planning of embodied building materials
c) Carbon emission management
d) Specification of sustainable construction materials
e) Sustainable procurement practices
f) None of the above

NOTES

8. SUSTAINABILITY ISSUES HAVE INCREASED IN IMPORTANCE WITHIN YOUR PROFESSION WITHIN THE LAST 10 YEARS, DO YOU AGREE?

If "agree", why do they think it has Media legislation, talk, internet, Global warming, weather pattern changes 2014 flooding

9. WHAT ARE THE "DRIVERS" THAT PROMOTE THE PRACTICE OF SUSTAINABILITY WITHIN YOUR PROFESSIONAL REMIT.

a) Company Green image
b) Adherence with legislation)
c) Senior management leadership
d) Increased rental income
e) Client pressure
f) The triple bottom line
g) Competitiveness
h) Any other?

NOTES PROBE ANSWERS

10. PLEASE TICK THE FOLLOWING "BARRIERS" THAT YOU FEEL HINDER THE PRACTICE OF SUSTAINABILITY WITHIN YOUR PROFESSIONAL REMIT.

a) Concerns over set up costs
b) Lack of organisational interest
c) Lack of management interest
d) Lack of interest from employees
e) Lack of legislative guidance
f) Lack of published materials
g) Lack of IT aids
h) Don't have the time
i) Non of the above

NOTES PROBE ANSWERS

11. IF YOU HAVE UNDERGONE ANY SUSTAINABILITY TRAINING, WHAT FORM DID IT TAKE?.

SUSTAINABILITY INTERVIEW MAIN SURVEY

Name **Company** **Date**

a) CPD style course
b) Seminar / Conference attendance
c) In house training
d) External Academic qualification.

NOTES

12 **HAVE YOU HEARD OF THE FOLLOWING TERMS ASSOCIATED WITH SUSTAINABILITY ?**
(YES ,NO)

a) The Pillars of Sustainability
b) Rachael Carson's Silent Spring
c) Sustainable Development
d) The Keeling Curve
e) Cradle to cradle
f) Biomimicry
g) The Carbon Disclosure Project
h) BIM
i) Anthropogenically caused Climate change
j) Natural Capital
k) Agenda 21
l) Triple bottom line
m) Intergenerational Equity
n) Extended producer responsibility
o) COP 21(Venue Paris December 2015)
p) Environmental assessment methodologies (EAM)
i.e. BREEAM, DREAM, LEED (If yes go on to Q12 otherwise skip to Q13)

No training undertaken
Why? , What are the barriers Costs?/ Time ?

NOTES
Probing questions:-

a) What are the pillars
b) What is SD / why is it here

How did they hear of these terms.
Are you interested in Sust in other areas of your life?

13. **IF YOU HAVE USED AN ENVIRONMENTAL ASSESSMENT METHODOLOGY (EAM) (IE BREEAM, LEED, DREAM),WOULD YOU AGREE THAT IT HAD A POSITIVE IMPACT IN THE FOUR PILLARS OF SUSTAINABILITY (ENVIRONMENTAL/ECONOMIC/SOCIAL AND CULTURAL)**

a) Environmental Considerations
Efficient use of materials /Ecological considerations /renewable energy
b) Economic
(Material prosperity/employment/Education/Fair trade)
c) Social (Human rights/ H&S)
d) Cultural (Well being/creativity/Identity and diversity)

NOTES OUTLINE ANY COMMENTS FROM RESPONDENTS WHO DISAGREE

14 **IS YOUR COMPANY/EMPLOYER AFFILIATED TO ANY ORGANISATION WITH LINKS TO SUSTAINABLE INITIATIVES FOR EXAMPLE THE UNITED NATIONS GLOBAL COMPACT, THE WORLD GREEN BUILDING COUNCIL ETC**

YES
NO
DON'T KNOW

Probe Q. Why does interviewee not know? ,ask if they are included in their Sustainability agenda ?

NOTES
List any other organisations

SUSTAINABILITY INTERVIEW MAIN SURVEY

Name **Company** **Date**

15 DO YOU AGREE THAT THE GENERAL CONCEPT OF SUSTAINABILITY IS FULLY UNDERSTOOD BY YOUR COMPANY?

NOTES YES NO UNSURE (If latter two Why is this?)
Probe Ascertain the depth of Knowledge if Interviewee states that they are familiar with it, do they use within Working context

16 ARE YOU FAMILIAR WITH ANY OF THE FOLLOWING LEGISLATION AND INITIATIVES INFLUENCING UK BUILDING DESIGN AND CONSTRUCTION

a) Environmental protection Act
b) Town and country planning act
c) Environment Act
d) Waste Framework Directive
e) Environmental Protection (Duty of care) Regulations 1991
f) Hazardous Special waste regulations
g) Landfill Tax and Aggregates levy
h) Site waste Management plan Regs
i) Waste and resources Action Plan
j) The Green Guide to specification
k) The Carbon reduction commitment Energy efficiency scheme
l) CEN Standards (Sust assessment of Buildings)
m) The climate change act 2010

NOTES

17 ARE YOU AWARE OF SOME OF THE FOLLOWING ADVERSE ENVIRONMENTAL FACTS RELATED TO OUR INDUSTRY

a) Energy from Fossil fuel consumed in the construction and operation of buildings accounts for approximately half of the UKs emissions of Carbon dioxide
b) Around 10% of UK emissions a are associated with the manufacture and transport of construction materials and the construction process
c) More than 400 million tonnes of materials get delivered to site in the UK each year of these 60 million tonnes go straight to the tip due to over ordering damage due to poor storage or because of inappropriate ordering
d) 3 billion tonnes of raw material extraction,
e) Construction is responsible for 20% of global water usage.

NOTES /REACTION?

18 DO YOU KNOW ANY LARGE SCALE CONSTRUCTION PROJECTS THAT HAVE BEEN UNDERTAKE IN THE PAST 5 YEARS WHICH PRIORITISED SUSTAINABILITY INITIATIVE

London Olympic Venue, good answer and one that was featured in all trade and professional magazines. (If no probe, if trade Professional magazines are read?)

SUSTAINABILITY INTERVIEW MAIN SURVEY

Name **Company** **Date**

19 Would you use an interactive "living" single point Sustainability resource, available to all stakeholders within your organisation to understand sustainability within the BE, the micro and macro issues impacting on it relative to their professional remit and the wider context promoting awareness and self-responsibility?
In précis a comprehensive resource that would make the user fully informed about the current state of sustainability initiatives within the built environment and provide all the information needed to enable them to promote self-awareness and understand its relevance, through training courses, experience and linking to like minds globally.
A resource that could include within its capabilities the following functions:-

a) Database of all known causative issues of climate change with particular relevance to the BE
b) Links to related websites with real time world relevant facts related to sustainability within the BE and its global position, such as the Keeling Curve, population stats, media and news feeds.
c) Included links to organisations for like mind example the World Green building Council
d) Provided live links to NGO's and professional organisations promoting sustainability globally
e) Comprehensive list of all likeminded suppliers in the United Kingdom and beyond so that an informed choice could be given to the systems operator to act in a sustainable way or not.
f) Easy access links to legislative resources
g) Links to UK wide training resources, such as organisations offering CPD, academic courses and those academic institutions with reputations promoting sustainability.

BIM associated functions

h) Capability of being a fully detailed material inventory database.
i) Provided strategies for the physical materials that form the building / buildings and infrastructure
j) Provided an accurate record of all changes and alterations throughout the facilities lifetime
k) Detailed all materials used (for example in a construction project), quantities and specifications and "as built" drawings
l) Functioned as an extension to the initial environmental impact assessment of the building throughout its lifetime, allowing for example the provision of accurate data for Extended Producer Responsibility liabilities
m) Routinely calculated the embodied carbon within the building fabric
n) Assessed quantified and managed potential health hazards from chemical components of building materials and finishes (ie Asbestos and lead)
o) Provided real time valuations of the Built environment (Rebuild costs, insurance valuations
p) Be capable of linking with other databases to provide a macro assessment of embedded materials from an unlimited number of buildings
q) Database of all known waste streams relevant to the known components.

GENERAL SUPPLEMENTARY "OPEN" QUESTIONS.

Would you promote sustainability within your organisation, workshops / roadshows

If such a system as the SIF existed would the interviewee believe it would be Universally used?

Is sustainability and its litany of associations discussed generally within the working) context and without, for example pollution climate change.

Would it be administered?, is there enough belief yet to undertake this for the reason it needs to be undertaken

Would the interviewee encourage / reward access of this information (Quizzes with prizes etc)
How would the interviewee prefer to access such a system?

a) APP on computer/Tablet./Phone
b) Hard Copy updatable information
c) Website