Green Building Rating Systems and the Role of the Project Manager

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Green Building Rating Systems and the Role of the Project Manager

DT117/4

B.Sc. in Construction Management

Davis Ciprikis

Supervisor: Sean McCarthy

April 2016
Declaration

I hereby certify that this Thesis which I now submit, for assessment on the program of study leading to the award of Bachelor of Science in Construction Management, is entirely my own work and has not been taken from the work of others, to the extent that such work has been cited and acknowledged within the text of my work.

This Thesis was prepared according to the regulations of the Dublin Institute of Technology and has not been submitted in whole or in part thereof, for an award in any other Institution.

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Davis Ciprikis
22/04/2016
Abstract

Sustainable development has increased significantly over the last 10 years. Construction firms are adopting sustainable practices that come from both, internal and external drivers of the construction industry. In order to assess how sustainable a building is, a green building rating systems have been developed to provide a documented and systematic approach to sustainable construction practices. Amongst these rating systems are the Building Research Establishment Environmental Assessment Methods (BREEAM) introduced in the UK and the Leadership in Energy and Environmental Design (LEED) created in the USA.

It has been noted that the project manager will have an important role to play when implementing green assessment requirements due to his/her significant involvement in project procurement. This research aims to identify the evolving role of project manager and to obtain an understanding of how the project manager deals with current green certifications systems.

In order to achieve the main purpose of this study, literature review and qualitative methods were used to provide findings of the research. Data was collected from eight industry professionals in the field of BREEAM and LEED. Members of the industry highlighted the practical challenges faced while carrying out green building assessment and presented suggestions on how to improve the management process on green projects.

The analysis has developed a recognition of four main reoccurring themes in carrying out green building assessment. They include the importance of early introduction of BREEAM and LEED in the procurement process; the need for project participants to fully understand the assessment process; the need for training on how to deliver sustainable indicators; and the submittal of right information to green building governing bodies.

Finally, the research concludes with recommendations on how management can be improved on green building rating systems. These recommendations include the development of systematic procedures that can reduce contractual risks and improve efficiency on future projects.
Acknowledgements

It would never have become a reality without the help, suggestions and support of so many of my lecturers at the D.I.T. Construction Management Department where I experienced a very inspiring, and friendly work environment.

I would particularly like to thank my supervisor Sean McCarthy who has accompanied and guided the whole process, starting from the first brainstorming to the final thesis. Without his guidance and advice I would be lost in the complex and fascinating topic of green building assessment.

I would like to show my deepest gratitude and appreciation to my grandparents Gunta and Karlis for their wisdom and roots.

Many thanks go to my partner Elisa for her support, patience and encouragement during this research.

I would also like to thank my brother Klavs, my friend Neil Ward and the greatest motivator Eric Thomas for answering all my questions in the field of research and helping me experience this journey of discovery.

But at the end it was the two most important people in the world who inspired me to achieve the impossible. To my mom Vineta, and my dad Vilnis without their patience, support and understanding these past four years would not have been possible.

Thank you.
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Abbreviations

AP - Accredited Professional
BER - Building Energy Rating
BIM – Building Information Technology
BoQ – Bill of Quantities
BRE - Building Research Establishment
BREEAM - Building Research Establishment Environment Assessment Method
CO₂ - Carbon Dioxide
COP - United Nations Conference of Parties
DGNB - Deutsche Gesellschaft für Nachhaltiges Bauen -German Sustainable Building Council
DMS – Document Management Software
EDP – Environmental Product Declaration
EU - European Union
GBRS – Green Building Rating System
GGBS - Ground Granulated Blast furnace Slag
IGBC – Irish Green Building Council
ISO- International Organization for Standardization
JIT – Just In Time
LCA - Life Cycle Assessment
LEED - Leadership in Energy and Environmental Design
m² - Meter Squared
PM – Project Manager
QA – Quality Assurance
SWMP- Site Waste Management Plan
UK - United Kingdom
US – United States
USGBC - United States Green Building Council
Chapter 1: Introduction
Section 1.0: Introduction

The focus of this chapter is to provide a background to the chosen research topic. The author will highlight the aims and objectives of the dissertation and to offer a brief overview of the scope of the research. The chapter will conclude with an outline of subsequent chapters of this thesis.

Section 1.1: Background

Today, the global society is facing a huge challenge – its course and progress has caused the destruction of its one and only home: the Biosphere of planet Earth (Brundtland, 1987). It can be seen that company’s actions on environmental practice get different forms of media attention. As a result, the global society has become conscious of the climate change and are starting to think and act sustanably. This latest trend offers a new competitive advantages to businesses. Sustainability issues are becoming a way of marketing for a company to show their contribution to environment.

The high level of carbon emissions has increased demands for solutions on the current energy crises. As a result, more sustainable practices can be implemented through government legislation or a market driven tools. The most evident definition of sustainable development is by Brundtland (1987) who defines sustainable development as ‘meeting the needs of present without compromising the ability of future generations to meet their own needs’. This definition indicates that there is a greater needs for more sustainable construction in order to reduce the consumption of the natural resources.

A way of achieving a more sustainable construction is through implementation of a green building rating systems (Taylor, 2015). A green building rating system is a method of assessing the environmental goals of a project through the planning and design processes, which are based on a systematic point scoring for all the sustainable tasks that are presented in a project. As a result, great deal of knowledge and coordination skills are placed on project managers for implementing these systems. This dissertation will study the role of project manager on green building rating systems, and the challenges faced by industry professionals on delivering a sustainable project.
Section 1.2: Research Aim

The overall aim of this research is to investigate the evolving role of the project manager and the challenges of delivering Green Building Rating Systems (GBRS).

Section 1.3: Research Objective

- To examine the role of a project manager on green building rating systems.
- To examine the challenges of meeting a complete set of sustainable indicators.
- To determine on-site management challenges in relation to delivering BREEAM and LEED projects.
- To investigate the forms of communication on sustainable project.

Section 1.4: Scope of Research

This study aims to address the main benefits and challenges in the form of examining the relationship between various contractual parties on green building rating systems. Primary and secondary data will be used to gather information and evaluate challenges of BREEAM/LEED and their effectiveness when used on green construction projects. BREEAM and LEED are also known as Green Building Rating Systems (GBRS), which will be used interchangeably during this study. The research begins with the collection of secondary data in the form of literature review with the aim of presenting a comprehensive understanding of green building rating systems. The literature review will aim to investigate project management practices on green building rating systems with the focus on site management challenges. The study will then investigate the forms of communication between the project manager and the project team.

The primary research follows in the form of semi-structured interviews, which will allow the author to gain insight into participant’s experiences of undertaking BREEAM and LEED projects. The data gathered from interviews will then be compared and analysed in order to draw research conclusions and further recommendations.
Section 1.5: Dissertation Content

- **Chapter 1: Introduction**

The dissertation begins by introducing the topic of climate change and how the introduction of green building rating systems can reduce the carbon emissions, as well as potential role of project manager in sustainable construction. This chapter also includes the research aim and objectives that are going to be carried throughout this dissertation.

- **Chapter 2: Literature Review**

This chapter consists of comprehensive review and analysis of the green building rating systems, the role of project manager and the planning involved in carrying out such systems. The literature review then proceeds to examine the forms of training and communication techniques essential for completing the green targets and on-site management. By doing so, this study seeks to offer the reader an insight into sustainable construction and challenges of delivering sustainable indicators.

- **Chapter 3: Research Methodology**

In this chapter the author presents the reader with an insight into research methods that are available when conducting a study of this kind. The chapter further outlines methodology used during the primary and secondary data collection and the reasons for selecting these research methods.

- **Chapter 4: Data Analysis**

In this chapter the author aims to analyse the data gathered through primary research. The interviews of professionals are analysed and the interviewee responses are recorded in Appendices.

- **Chapter 5: Findings**

This chapter will summarise findings from interviews and will compare them to the literature review.

- **Chapter 6: Conclusion**

The final chapter summarises the research by illustrating how the aims and objectives have been met. The aims and objectives are then merged allowing the author to draw conclusions on the role of project manager on green building rating systems. Recommendations are also given to limitation upon the research and areas of further study.
Chapter 2: Literature Review
Section 2.0: Introduction

Davies et al. (2010) report that 40% of total CO$_2$ emissions arise due to construction activities. BREEAM developed a pledge, made in the COP 21 climate intervention in Paris 2015 that 9,000 new buildings with BREEAM certification will be built by 2020, which would reduce the CO$_2$ emission by 900,000 tonnes (Taylor, 2015).

In Ireland, contractors currently depend on the client requirements to implement the green building assessments as there is no obligation by the Irish law to have an environmental assessments on a structure. However, there is a compulsory measure to have a Building Energy Rating (BER), which only measures the energy performance of operating the building (Stewart and Corless, 2007). Under the current 2011 Part L of the technical guidance documents, a building is to be planned and constructed as to guarantee the energy performance “in such as to limit the amount of energy required for the operation of the building as is reasonably practicable”. This does not take into account the embodied energy produced during the construction stage (TGD L, 2011, pp. 5).

Research has presented numerous building rating systems that have been developed internationally, however the researcher will focus on the United Kingdom’s ‘Building Research Establishment Environmental Assessment Methods and the United Stated of America’s Leadership in Energy and Environmental Design (Roderick et al., 2009). BREEAM and LEED buildings are not constructed any differently to a building with no certification, but require specified materials and building design with greater attention to the use of the building. The first stage is to appoint a project team that will select an experienced green building Project Manager (PM) during the project’s feasibility period (Robichaud and Anantatmula, 2011).

As a result, Liyin et al. (2006) argue that accreditation will increase the cost of construction, time and resources, and therefore discourages management from tendering for BREEAM/LEED specified projects. In response, Bogenstätter (2000) states that without early involvement of the PM the contractor and architect are at a disadvantage, especially when it comes to incorporating client’s goals into the project’s design, preliminary budget and scheduling.
Section 2.1: An Overview of the Green Building Rating Systems

The main basis of the Green Building Rating Systems (GBRS) is to offer an overall evaluation of the environmental performance of a building by meeting the requirements set out in the documentation (Zhang et al., 2014). Jamie and Mohamed (2013) state that the responsibility of implementing green procurement will lie in project management. Furthermore, Tam et al. (2004) described that project management on a green developments will have to involve further training, extensive document management, communication, early team collaboration and environmental planning. Andrea et al. (2012) argues that the delivery of a construction projects comprises of efficient recourse allocation, monitoring of embodied energy and to reuse and recycle resources through any other means by which natural resources are sustained.

As GBRS is not mandatory, it rests in client to specify the implementation of GBRS, and the level of certification will depend on time and resources available (Schweber, 2013). Further, clients have to know that GBRS will account for increased costs of up to 5 percent on the overall project. Most of the GBRS will take place in design stage as the assessment criteria will have an effect on the points that can or can’t be achieved (Zhang et al., 2014).

Starrs (2010) compares the two rating systems and finds that the main aim of BREEAM is to decrease $CO_2$ emissions caused by energy use in buildings, whereas LEED focuses on reducing annual expenses on energy. Saunders (2008) argues that LEED is suited to climates where mechanical ventilation is commonly used and places where the driving culture prevails. On the other hand, BREEAM is thought to encourage cycling and walking-based transport, as well as more resourceful water consumption. Furthermore, Schwartz and Raslan (2013) presents that BREEAM and LEED are both subdivided into specific environmental categories and sub-categories where each system gives a certain number of credits towards achieving a specific sustainable requirement. Figure 2.0.0 summarizes and compares the main features of each system.
Section 2.1.1: LEED Rating System

Leadership in Energy and Environmental Design was developed by the United States Green Building Council (USGBC) in 1998 (Glavinich, 2008). LEED is a voluntary certification programme, which serves as a guideline and assessment method that clients or organisations can choose to implement. LEED building rating systems encompass a collection of sustainability indicators to assess how the green building is operating (USGBC, 2015). LEED is assessed under 8 different categories which are location and transport, sustainable sites, water efficiency, energy and atmosphere, material resources, indoor environmental quality, innovation, and regional priority (Glavinich, 2008). In order to gain LEED certification the owner has to demonstrate the ability to reduce the building’s ecological footprint and to lower the operation costs using a checklist method which consists of specific criteria. Additionally Glavinich (2008) distinguishes LEED as a documentation planned for improving the way people work in construction, design and operate the building. Multiple design submittals have to be presented during planning and construction to the USGBC, which is the governing body of LEED certification. Wu et al. (2016) explains that LEED is based on 110 credit rating system with certain prerequisites spread over eight categories as can be seen in figure 2.0.1 and 2.0.2.
### Location & Transportation

<table>
<thead>
<tr>
<th>Credit</th>
<th>Description</th>
<th>Score</th>
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<tbody>
<tr>
<td>LTc1</td>
<td>LEED for Neighborhood Development Location</td>
<td>16</td>
</tr>
<tr>
<td>LTc2</td>
<td>Sensitive land protection</td>
<td>1</td>
</tr>
<tr>
<td>LTc3</td>
<td>High priority site</td>
<td>3</td>
</tr>
<tr>
<td>LTc4</td>
<td>Surrounding density and diverse uses</td>
<td>5</td>
</tr>
<tr>
<td>LTc5</td>
<td>Access to quality transit</td>
<td>5</td>
</tr>
<tr>
<td>LTc6</td>
<td>Bicycle facilities</td>
<td>1</td>
</tr>
<tr>
<td>LTc7</td>
<td>Reduced parking footprint</td>
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</tr>
<tr>
<td>LTc8</td>
<td>Green vehicles</td>
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### Sustainable Sites

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</thead>
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<td>Site assessment</td>
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</tr>
<tr>
<td>SSa2</td>
<td>Site development - protect or restore habitat</td>
<td>2</td>
</tr>
<tr>
<td>SSa3</td>
<td>Open space</td>
<td>1</td>
</tr>
<tr>
<td>SSa4</td>
<td>Rainwater Mgmt</td>
<td>3</td>
</tr>
<tr>
<td>SSa5</td>
<td>Heat Island reduction</td>
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<tr>
<td>SSa6</td>
<td>Light pollution reduction</td>
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### Water Efficiency

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<tbody>
<tr>
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<td>Outdoor water use reduction</td>
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</tr>
<tr>
<td>WEp2</td>
<td>Indoor water use reduction</td>
<td></td>
</tr>
<tr>
<td>WEp3</td>
<td>Building-level water metering</td>
<td></td>
</tr>
<tr>
<td>WEc1</td>
<td>Outdoor water use reduction</td>
<td>2</td>
</tr>
<tr>
<td>WEc2</td>
<td>Indoor water use reduction</td>
<td>6</td>
</tr>
<tr>
<td>WEc3</td>
<td>Cooling tower water use</td>
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<tr>
<td>WEc4</td>
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### Energy & Atmosphere

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</tr>
<tr>
<td>EAp2</td>
<td>Minimum energy performance</td>
<td></td>
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<tr>
<td>EAp3</td>
<td>Building-level energy metering</td>
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<tr>
<td>EAp4</td>
<td>Fundamental refrigerant Mgmt</td>
<td></td>
</tr>
<tr>
<td>EAc1</td>
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<td>EAc2</td>
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<td>EAc4</td>
<td>Demand response</td>
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</tr>
<tr>
<td>EAc5</td>
<td>Renewable energy production</td>
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<tr>
<td>EAc6</td>
<td>Enhanced refrigerant Mgmt</td>
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</tr>
<tr>
<td>EAc7</td>
<td>Green power and carbon offsets</td>
<td>2</td>
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Figure 2.0.1 LEED Credit Rating Category 1 (USGBC, 2015)
There are four LEED accreditation levels which are measured in points (Andrea et al., 2012). These are represented in figure 2.0.3 which list the ratings that can be gained in LEED.
As LEED is evolving in today's global market, Andrea et al. (2012) expresses the need for advanced management practices to improve the construction, design and operation of LEED buildings that follow a systematic management approach. This has led to increasing demand for PMs to have a greater understanding of LEED requirements as they play a critical role in the success of the LEED projects. According to Silva and Ruwapura (2009) PM’s have to involve contractors early on, as introduction, documentation, and LEED systems have to be implemented or adjusted to the existing construction practices. The LEED implementation guide, as shown in Figure 2.0.4 is sequentially structured and contains the following hierarchy:

**LEED IMPLEMENTATION GUIDE**

**PROGRAM**
- Owner’s Project Requirements
- Scope Verification
  - Determine the level of commissioning
  - Formulate a green team
  - Understand building specifics
  - Determine level of LEED commitment
- Design Charette
  - Understand OPR and develop goals
  - Sizing LEED action plan
  - Identify unique project issues
  - Register project with USGBC

**DESIGN**
- Schematic Design
  - LEED workshop and meetings
  - Develop an initial design basis of design
  - Develop conceptual design
  - Value management
  - Constructability analysis
- Design Development
  - LEED workshop and meetings
  - Energy modeling
  - Value management
  - Constructability analysis
  - Finalize basis of design
  - Construction waste management plan

**CONSTRUCTION**
- Mobilization
  - LEED kick-off meeting
  - Documentation
  - Site monitoring
  - Material monitoring
  - Indoor air quality monitoring
  - Static testing
- Construction Documents
  - LEED workshop and meetings
  - Value management
  - Constructability analysis
  - Develop a commissioning plan
  - Design review
  - Develop specifications
  - Execute commissioning plan
  - Review the subcontractors’ submittals

**POST-CONSTRUCTION**
- Acceptance and Close-out
- Final LEED Submittals
- Lessons Learned Workshop
- Startup, Checkout, and Functional Testing

*Figure 2.0.4: LEED implementation guide* (Bayraktar and Owens, 2010)

Throughout the design and construction phases, an external LEED consultant known as LEED Accredited Professional (AP) will be employed to gather LEED credit documentation and to inspect how the project is complying with the specific guidelines set out by USGBC. This documentation will then be submitted for a review to the USGBC. Not every credit within the rating system will apply to the project as external factors such as public transport may not be in certain proximity of the site, therefore no credits can be earned on that factor. The number of credits earned by the project will however determine the level of LEED certification (Zezhou et al., 2016).
Section 2.1.2: BREEAM Rating System

Increasing demand for ‘green’ construction emerged from Kyoto Protocol, due to their commitment to reduce the $CO_2$ emissions, building sector started to look at existing and new development and how they can be improved (Li et al., 2013). As a result of the Kyoto protocol legislative and fiscals requirements were introduced in the UK. One such requirement emerged through growth of BREEAM, which is a non-government organisation tool established in 1990. Furthermore, Schweber (2013) states that BREEAM was adopted by the UK as a mandatory requirement in 2000 for all public procurement through tender requirement (Archives, 2008).

The primary aim of BREEAM is to measure the embodied energy of the building and to reduce the energy consumption while improving the wellbeing of the occupants (Ding, 2008). The evaluations on buildings are carried out by licensed BREEAM assessors who assesses the building with similar procedures as LEED rating system (Cole and Valdebenito, 2013). BREEAM measures the sustainability through 10 categories extending from energy to water usage this is further represented in figure 2.0.5 (Schweber, 2013). These categories focus on the most important ecological factors, combining low impact design performance and carbon emissions reduction. Within every category certain amount of credits are targeted to reach the overall BREEAM certificate (BREEAM, 2015). As a result, Schweber (2013) states that BREEAM allows the client to evaluate, reflect and measure the performance of their building
on sustainability, and BREEAM certification will promote added market value. Furthermore BREEAM aims to provide recognition of the buildings’ sustainability and acts as a driver to stimulate demand for sustainable buildings.

Section 2.2: Project Management Process

The PM’s objective is to understand LEED/BREEAM requirements in order to achieve the assessment criteria and to deliver the project within budget and on time. PMs are generally first to meet the project brief and information regarding specifications, therefore their level of familiarity with the assessment criteria will influence certain aspects of the traditional management approaches (Robichaud and Anantatmul., 2011). Furthermore Andrea et al. (2012) states that PMs will have to adjust their management role in order to adapt to the GBRS criteria. As a result, Wu and Low (2010) finds that project manager is responsible for earning 20 percent of the credits on GBRS projects. PM’s failure to achieve necessary credits could result in litigation, conflict, delays, financial losses and reduced competitive advantage (Andrea et al., 2012).

Schweber (2013) emphasizes that the credits most visible are the ones which seem to create additional work. PM’s involvement on GBRS project can be summarised in extensive documentation, communication and reporting. As a result, Robichaud and Anantatmul (2011) identifies that the PM’s early involvement is essential on GBRS project otherwise contractors and architects will be at a disadvantage particularly when it comes to integrating the client’s goals into the early design, preliminary budget and schedule estimates. At the design stage, PM can contribute their knowledge by advising on environmentally responsible construction activities, performance goals and build ability.

Furthermore, Robichaud and Anantatmula (2011) explain that the PM’s responsibility lies in the planning of meetings for the construction team to ensure they have a clear awareness of the project’s objectives and programmes, along with other inputs that will help to generate the credits in other sections. These opening meetings will lay basis for launching a shared team environment (Robichaud and Anantatmula 2011). In addition to facilitate the meetings, the PM is responsible for the maintenance of GBRS documents, ensuring that GBRS requirements are achieved and monitoring the implemented measures of assessment criteria (Bayraktar and Owens, 2010). Figure 2.0.6 represents PM’s involvement in the project from feasibility stage.
Construction projects generally contain large design teams and each person has their own function to perform in the GBRS process. The challenge with this is to ensure that each person knows exactly what is expected from them and when their work is required. Furthermore, this will ensure the project is on track to achieve the required rating (Miles, 2014). Robichaud and Anantatmula (2011) suggest that the PM will have to provide for more advanced communication systems than for traditional projects, as improved communication will be required for specified documentation, prerequisites and other requirements. These communication systems will have to be discussed in early planning meetings as it is of major importance to the success of the project. Tam et al. (2004) suggest the use of collaborative management software in order to assist the PM on keeping credit scores and schedules.

Zezhou et al. (2016) indicate that cost is one of the most important factors affecting PM decisions on green projects. Furthermore, Robichaud and Anantatmula (2011) supports that most of attention in GBRS projects focuses on its ‘positive environmental impacts’, but costs are the greatest restraint to building green. As a result, the PM finds it challenging to balance between environmental performance and cost. In order to earn higher profits environmental management is often forgotten (McCoskey and Maddock, 1994). According to Zhang et al. (2014) a PM can incur an increase of 1-5 percent to the projects total cost depending on the size of the project and the PM’s previous experience on GBRS. The additional costs required are for investment on sustainable construction technology and staff training (Shen and Tam, 2013).
2002). Conventional procurement practices in construction emphasise that organisations tend to focus more on short-term profitability (Walker and Brammer, 2007). Even though initial costs of GBRS are greater than conventional projects, USGBC (2015) shows that long term cost in maintenance and operation can recover those expenses and open new market opportunities. BREEAM/LEED buildings are expected to reduce operational costs by 8-9 percent annually (USGBC, 2015). Schwarts and Raslan (2013) state that certified buildings increase in value of 11 percent compared to buildings with no certification.
Section 2.3: Providing Effective Communication

The key challenge to deliver a financially successful project lies in communication and coordination across all parties involved (Nitithamyong and Skibniewski, 2004). Projects seeking GBRS certification can be more complicated than conventional projects, consequently communication can be improved if all trades work together under one system as opposed to the traditional primary communication methods (Robichaud and Anantatmula, 2011). The primary means of communication include meetings, e-mails, web sites and letters and are proven to be limited. Furthermore, they can delay collaboration between different parties involved (Andrea et al., 2012). Figure 2.0.7 represents traditional communication approach compared to one DMS or BIM can offer.

In order to achieve effective communication on GBRS project, Andrea et al. (2012) recommend adopting a Document Management Software (DMS) system to record the projects progress and to provide an online platform where documentation can be uploaded for the certification process. The DMS system aims to aid all team members to collaborate on an online software package where file sharing, messaging and up-to-date information is managed (Cabeza et al., 2014). Zhanga’s et al. (2015) report shows that adopting DMS can improve the coordination of works by insuring an open evidence of who has accessed the system and who has met on-time document delivery and other information.

![Diagram](image)

**Figure 2.0.7: Representation of communications methods in construction** (Hore, 2006)
However, implementing an effective DMS system requires training sessions on how to operate the system, which costs time and resources. Nitithamyong and Skibniewski et al. (2006) state that by implementing DMS on projects can:

- Save time by reducing errors occurring under paperwork.
- Add and store submitted documents from all parties for reference and review by BREEAM/LEED assessors.
- Scan paper forms and store invoices.
- Share live up-to-date documents.
- Create accessibility and editing of files from tablet or mobile devices.
- Add comments to receive information required.

As shown previously, the PM is responsible for the organisation of kick-off meetings, which benefits the communication among the project parties (Robichaud and Anantatmula, 2011). Bayraktar and Owens (2010) further recommend the following strategies to consider during kick-off meetings:

- Make sure that all parties involved with the construction process have recognised all construction related credits in the action plan.
- Discuss training of subcontractors if necessary.
- Identify the function and standards expected from subcontractors.
- Review the construction-waste management plan.
- Manage site visit with all subcontractors to discuss BREEAM/LEED as a team.

Subsequently Bayraktar an Owens (2010) concluded that the PM will have to dedicate a minimum of four hours a week to manage GBRS documents. As a result, contractors tend to employ external LEED consultants who are responsible for collecting, analysing and processing LEED documentation.
Section 2.4: Planning and Scheduling

During the planning and scheduling process PMs must consider the impact of green criteria on the overall schedule of construction works (Glavinich, 2008). Wu and Low (2010) stated that most of PM time involves planning and organising the schedule of works. Furthermore, Riley and Cotsgrave (2013) state, that PM will usually develop a work breakdown structure to see what part of GBRS will impact the project. Work breakdown structure aims to separate the project into sequential stages, an example being the ‘RIBA Plan of work’ (Royal Institute of British Architects, 2013). When the plan of work is complete, the PM must further develop a specific BREEAM/LEED action plan that is to be implemented in scheduling of works and document submittal to the green building councils (Bayraktar and Owens, 2010). The plan of works must be explained to all parties, this can be done at pre-commencement meetings where all parties have to work together during projects feasibility and programming stage in order for PM to accomplish smooth construction schedule (Robichaud and Anantatmula, 2011). Furthermore, these meetings will allow the actors to have an understanding of what aspects of GBRS are their responsibility (Andrea et al., 2012).

Liyin et al. (2006) explain that planning for BREEAM and LEED will effect existing performance levels. Therefore, PMs has to identify the credits to be achieved early in the planning stage as failure to meet these requirements can set back the project schedule and increase the costs of construction (Bayraktar and Owens, 2010). In order to achieve the BREEAM/LEED requirements on a project PM will have to meet objectives set on site development, energy efficiency and water efficiency (Bayraktar and Owens, 2010). Furthermore, Liyin et al. (2006) state that the PM will have to develop key environmental performance indicators in order to establish objectives and targets for the assessment criteria.

According to Bayraktar and Owens (2010) the following factors need to be identified prior to developing an action plan in relation to BREEAM/LEED:

1. The availability of environmentally friendly material.
2. The development of construction waste management plan.
3. The amount of experienced green subcontractors and their training.
4. Local restrictions on water, energy and other requirement criteria.
5. Minimization of embodied energy.
6. Cross team interaction and Communication.
Furthermore, almost all the innovation credits will require PM’s involvement (Li et al., 2013). Glavinich (2008) indicates that most of the PM’s time on BREEAM/LEED projects is spent in BREEAM/LEED credit documentation and submittals. As a result, (Andrea et al., 2012) states that an inexperienced PM who is new to BREEAM/LEED generally presents incomplete contract documentation that makes the process long and time consuming. Therefore, Glavinich (2008, pp. 58) states that it is important for all parties to recognise “which submittals are required, when they are due, what their format should be, and their review and approval processes”. Ding (2008) expressed that most of the documentation required to produce by PM is in relation to materials and waste. Figure 2.0.8 represents all the credits that can be achieved by PM.

Documents that are required and that need to be submitted will be issued by the Building Research Establishment (BRE) and United States Green Building Council (USGBC). The documentation will be specific and precise. Such documentation can show how much carbon is embedded in concrete and the carbon emissions released while delivering the materials to the site. IF the PM is unable to gather the documentation required, an external consultant Accredited Professional (AP) can be hired to facilitate the documentation process who provides templates and other equivalent tools to make the process easier (Andrea et al., 2012).

<table>
<thead>
<tr>
<th>Major impact</th>
<th>Moderate impact</th>
<th>Value-added opportunity</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSap1: construction activity pollution prevention</td>
<td>SSc3: brownfield redevelopment</td>
<td>Innovation and design (ID)</td>
</tr>
<tr>
<td>SSsc5: site development</td>
<td>SSc6: storm water design</td>
<td></td>
</tr>
<tr>
<td>EAp1: fundamental commissioning</td>
<td>WEc2: innovative wastewater technologies</td>
<td></td>
</tr>
<tr>
<td>EAc3: enhanced commissioning</td>
<td>WEc3: water use reduction</td>
<td></td>
</tr>
<tr>
<td>MRe2: const. waste management</td>
<td>MRe1: building reuse</td>
<td></td>
</tr>
<tr>
<td>MRe3: material reuse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MRe4: recycle content</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MRe5: regional materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MRe6: rapidly renewable materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MRe7: certified wood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EEq3: const. IAQ management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EEq4: low-emitting materials</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Figure 2.0.8: Impact categories of LEED credits on PM (Li et al., 2013)*
Section 2.5: Training and Subsequent Meetings

Two recurring themes of the literature on GBRS focus on the project manager’s knowledge on the assessment criteria and training required for all of the actors involved in the project (Robichaud and Anantatmula, 2011). Wu and Low (2010) record that often not enough training is given to staff on what the overall project is trying to achieve, which may produce potential difficulties to motivate contractors in achieving GBRS objectives. Robichaud and Anantatmula (2011) state that workers have lower level of motivation when the employees are not fully aware of the green project process.

Both BREEAM and LEED offer training courses on becoming an AP that aims to train construction professionals to understand the GBRS process (Bruce et al., 2009). As a result, USGBC (2016) states that AP demonstrates an understanding of the accreditation process. The AP’s role is to provide the design team with professional advice on the environmental assessment methods (Robichaud and Anantatmula, 2011). Furthermore the AP will schedule activities, set priorities, determine the credits that can be accomplished and communicate the issues with the project team (Bruce et al., 2009). It becomes the AP’s duty to gather GBRS credit documentation and to submit assessment reports to the BER and USGBC governing bodies. In most projects the tender documents specify that the PM will have to provide their own AP consultant in order to carry out all of the accreditation process (IGBC, 2016). Additionally Andrea et al. (2012) state that AP consultant is not there to carry out all of the tasks for PM but to advise and help with the GBRS process.

Wu and Low (2010) state, that instead of relying solely on GBRS for individual projects, PM’s should be able to adapt to an International Organization for Standardization (ISO) where technical and nontechnical aspects of project management are balanced. As a result, the ISO 14,000 was developed as a system for organizations to promote environmental performance (Liyin et al., 2006). The main components of ISO 14’000 management system cover ‘waste recycling, increasing employee involvement and communication throughout the organisation, increasing communication between project parties, constantly reviewing programmes and motivating continual improvements’ with other principals that are represented in figure 2.0.9 giving a framework for implementing environmental management system (Zhang et al., 2014). Furthermore, Liyin et al. (2006) states that BREEM shares the standards of ISO 14’000 and can make the process more cost effective as both are similar. Yates (2014) criticised ISO 14’000 as it is a long certification process that takes years to become certified.
Figure 2.0.9: The framework for implementing environmental management system (Liyin et al., 2006)
Section 2.6: Project Management and Sustainable Construction

Ofori (2000, pp. 196) defines sustainable construction as “creating constructed items using best-practice clean and resource efficient techniques from the extraction of the raw materials to the demolition and disposal of its components”. Once the construction begins the PM will have to implement the BREEAM and LEED requirements on contractors and subcontractors (Faratti et al., 2012).

According to Li et al. (2013) subcontractors do most of the procurement and are the key for earning or loosing points on the project. Glavinich (2008) defines subcontracting as a party that is engaged by a contractor to provide workforce, equipment, services and materials necessary to carry out a particular section of the work. Sarkisa et al. (2012) state that contractors favour to employ the same subcontractors, regardless of the construction project and will depend on subcontractor’s performance in achieving credits. As a result, the PM can also accept the liability for the work of subcontractors (Sarkisa et al., 2012).

Li et al. (2013) established that subcontractor training, communication and tendering documents are the key considerations for a successful project. These communication issues can be magnified when combined with the unique functions associated with green project delivery (Robichaud and Anantatmula, 2011). Glavinich (2008) argues that the PM must inform subcontractors about their responsibilities on a BREEAM or LEED project pre-commencement meetings in order for them to know what is expected.

Riley and Cotsgrave (2013) list strategies associated with the tender process as:

- Contract administration.
- Procurement.
- Materials delivery and storage.
- Construction process and procedures.
- Start up and commissioning.
- Material, equipment and system documentation.

Furthermore, Syal et al. (2007) states that the PM will require implementation of training sessions in order to provide guidance towards employee contribution on BREEAM or LEED credits. Riley and Cotsgrave (2013) recommend that the training can be delivered in conjunction with toolbox safety talks, weekly meetings or employ a GBRS consultant for training workshops.
At the beginning of the construction stage the PM must implement a waste audit for all of the subcontractors. This audit can allow recording and documenting of all the construction activities that will serve as GBRS documentation and credit attainment (Bayraktar and Ownes, 2010). In addition Riley and Cotsgrave (2013) state that subcontractors must accept their responsibilities regarding record keeping and documentation of the materials and equipment that they install.

Literature from Zhang et al. (2014) state that as much as 80 percent of waste generated from construction is reusable or recyclable, which generates responsibility on the PM as GBRS offer credits on waste reduction. According to Wu et al. (2016) the project can gain up to 10 percent of LEED and 8 percent BREEAM credits towards reducing waste on construction. To minimise waste the PM will have to plan and schedule with greater efficiency, therefore taking up more of the PM’s time (Wu and Low, 2010). Furthermore, BREEAM and LEED have developed a checklist system to assist on what material standards can be used on the building (Wu et al., 2016).

Both BREEAM and LEED promote the implementation of the four R’s, ‘Reduce, Reuse, Recycle and Repair’ (Wu et al., 2016). In order to achieve the four R’s the PM must develop a Site Waste Management Plan (SWMP) before the construction begins. The SWMP provides a structured planning process, which can assist in forecasting the type and amount of waste that will be generated in the project and provide guidelines for improved recourse efficiency (Glavinich, 2008). Additionally, Preece et al. (2011) states that monitoring and reporting must be in place for BREEAM and LEED documentation. A reference to SWMP can be seen in figure 2.10 which outlines the main project stages and actions in order to achieve an effective SWMP.
Another restriction on green scheduling is site disturbance and storage of materials, therefore just-in-time (JIT) deliveries concept allows for less storage space on site and accident prevention (Wu and Low, 2010). Glavinich (2008) argues that JIT deliveries can affect the scheduling and can restrict certain activities. As a result, offsite construction is promoted as it allows for quality control and improved speed of construction (Yates, 2014).

**Table 2.10: Proposed outline of SWMP**

<table>
<thead>
<tr>
<th>Project Stage</th>
<th>SWMP Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Set Up</td>
<td>• Enter project details</td>
</tr>
<tr>
<td>Concept Design</td>
<td>• Record waste prevention actions</td>
</tr>
<tr>
<td>Detail Design</td>
<td>• Forecast waste</td>
</tr>
<tr>
<td></td>
<td>• Record waste reduction actions</td>
</tr>
<tr>
<td>Pre Construction</td>
<td>• Specify waste carriers</td>
</tr>
<tr>
<td></td>
<td>• Plan waste destinations</td>
</tr>
<tr>
<td></td>
<td>• Record waste management and recovery actions</td>
</tr>
<tr>
<td>Construction</td>
<td>• Enter actual waste arisings, reduction, recovery and management activities.</td>
</tr>
<tr>
<td></td>
<td>• Carry out training, monitoring and recording</td>
</tr>
<tr>
<td>Post Construction</td>
<td>• Compare actual against forecast waste management activities</td>
</tr>
<tr>
<td></td>
<td>• Assess performance based on KPIs</td>
</tr>
<tr>
<td></td>
<td>• Suggest improvement for next project</td>
</tr>
</tbody>
</table>
Chapter 3: Research Design and Methodology
Section 3.0: Introduction

This chapter presents an evaluation of the different types of research strategies that exist, with the intention to select a strategy that is suited to the aims and objectives of this dissertation. Naoum (2007, pp. 2) defines research as a “careful search or inquiry; endeavour to discover new or collate old facts etc. by scientific study of a subject; course of critical investigation”. The author aims to attain adequate knowledge in the area of the project management and other industry professional roles that have worked on GBRS projects in order to establish the main challenges of delivering complete set of sustainable indicators. In order to achieve the research aim the following research topics have to be taken into account in order to establish the method of use in this research, namely communication, training, documentation, planning and scheduling, and project management and improvements. Naoum lists the different stages of research in figure 3.1.

Naoum (2007 pp. 37) notes that there are three different categories of research methods; Quantitative, Qualitative and Mixed Methods. The author will examine these categories and explain the methods chosen and the rationale behind choosing them.

Figure 3.1: Various stages in composition of dissertation
Section 3.1: Research Design and Strategy

In order to carry out an investigation into BREEAM and LEED, a research problem had to be identified to give a direction and to achieve the aims and objectives of this research. A relatively small amount of literature has been published on the project management practices on GBRS projects. This has led to an investigation of the difficulties project management is faced while delivering a BREEAM/LEED project.

Once the research problem is defined and full investigation in literature is completed, then research limits can be developed and research design conducted. Research design provides structure on how the aims are going to be accomplished and how the objectives are going to be achieved (Naoum, 2007 pp.63). This study uses qualitative research method as to validate the data based on secondary research (Greetham, 2009 pp. 180). The qualitative research method allows the author to look for patterns of relationships among groups and to analyse the construction industry as a whole, whilst quantitative research looks at one strand in the organization (Farrell, 2011 pp. 103). The Following sections will discuss secondary research and primary research.

Section: 3.1.1: Secondary Research

Naoum (2007pp. 23) describes secondary research as gathering reports of previous authors and critically analysing contributions and similarities made by the writers. Secondary research was gathered by reviewing literature regarding BREEAM and LEED using relevant electronic journals, academic reports, published books, websites, government publications and conference papers. The literature review was constructed in a structured sequence to allow each element to be evaluated and analysed in order to focus on the most appropriate points regarding the research objectives.

Secondary research helped to identify the planning methods that can be adopted in order to carry out projects with BREEAM and LEED requirements. The Information gathered from literature review focused on various actors in GBRS projects with a primary focus on PM. Furthermore, the literature review highlighted the potential difficulties in relation to understanding the assessment criteria and the challenges in gathering the correct information in order to gain GBRS certification.
Given that every construction project has its own characteristics, the author used findings from the literature review to develop a research strategy in order to conduct primary research.

**Figure 3.2: Stages of research process**

Greetham (2009 pp. 205) states that primary research allows to investigate research questions so that the answers can be personalised to the validation of research aims and objectives.

### Section 3.1.2: Primary Research

Primary research is the most precise source of information as it is looking at original unpublished research (Noam, 2007 pp. 20). Primary research looks at real life events and how data can be collected. Primary research can take the form of surveys, interviews and case studies. It usually takes place after the secondary research has been gathered and analysed. Farrell (2011) states that the key concept of primary research is to get out and investigate your study. The primary research methods can take the form of personal interviews or case studies that are aimed to obtain first-hand experiences in the GBRS field.
Section 3.2: Qualitative research

Farrell (2011 pp. 101) described qualitative research as data that aims to get insight into how respondents see and view the world. Furthermore, Naoum (2007 pp. 87) states that qualitative research is subjective to the respondents with the attention towards descriptions, meanings and experiences. By selecting qualitative method two categories are presented for the use in data analysis, namely exploratory and attitudinal. The exploratory research method puts emphasis on current situations, exploring alternatives and discovering new insights in the subject matter (Zikmund, 1997). Whereas, attitudinal method are used to analyse the opinions, views and perceptions of respondents towards particular point in their field of work (Naoum 2007 pp. 47). However, relevant insight in the subject matter is concluded with the understandings of human attitudes and behavior towards the research problem. The researcher selects the exploratory research method to conduct analysis. Figure 3.3 compares quantitative and qualitative methods to allow author to develop the basis for carrying out research.

<table>
<thead>
<tr>
<th></th>
<th>Quantitative</th>
<th>Qualitative</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Role</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fact-finding based on evidence or records</td>
<td>Attitude measurement based on opinions, views and perceptions measurement</td>
</tr>
<tr>
<td>2</td>
<td>Relationship between researcher and subject</td>
<td>Distant</td>
</tr>
<tr>
<td>3</td>
<td>Scope of findings</td>
<td>Nomothetic</td>
</tr>
<tr>
<td>4</td>
<td>Relationship between theory/concepts and research</td>
<td>Testing/confirmation</td>
</tr>
<tr>
<td>5</td>
<td>Nature of data</td>
<td>Hard and reliable</td>
</tr>
</tbody>
</table>

Figure 3.3: Comparison of Quantitative and Qualitative research (Nachmias, 1996)
Section 3.3 Quantitative research

Anderson and Poole (2009, pp. 78) define quantitative research as “typified by experimental studies in science-based disciplines where findings are usually expressed in numerical form”. Naoum (2007, pp. 57) presents two main arguments when quantitative research should be adapted:

- When facts about a concept, question or attribute want to be discovered.
- When factual evidence is required to discover the relationship between these facts in order to test a particular theory.

The author will not be using quantitative research to develop hypothesis, as the current study involves in-depth personal experiences from where elaboration and the individuals unique experience is essential for developing an opinion on the current green building practice. For these reasons the author deemed that this approach would not achieve the dissertation’s objectives and therefore quantitative research was not undertaken.

Section 3.4: Chosen Research Method

Having completed a thorough analysis of the research methodology, qualitative analysis was chosen. The qualitative research method is conducted using semi-structured interviews aimed at industry professionals who have experience of GBRS. The author aims to conduct interviews with project managers, quantity surveyors, architects, mechanical and electrical engineers, sustainability managers, and BREEAM and LEED accredited professionals.
Section 3.5: Qualitative research – Semi structured interviews

Nachmias and Nachmais (1996, pp. 83) define interviews as a face-to-face interpersonal role situation in which an interviewer asks respondents questions designed to elicit answers pertinent to the research hypotheses.

After deciding on the research design the author adapted semi-structured interview techniques as part of the data collection. The purpose of the interviews is to collect industry perspective in order to understand green systems in more detail. The target group would consist of industry experts who have experience working on BREEAM and LEED projects. For this Thesis, semi-structured interviews were carried out in order to further explore the dissertation aim. The interviews were adapted to each respondent slightly in order to achieve a balanced view and opinion. Merton and Kendal (1946) as cited in Naoum (2007) state that semi-structured interviews have four distinguished characteristics:

1. The respondents are involved in the area of which is being researched.
2. No analysis are made prior to the interview.
3. The process is centred on an interview guide which specifies topics related to the research.
4. It focuses on the experience of the respondents regarding the subject matter.

As stated previously, the first stage of research process was to conduct semi-structured interviews with a project manager, project quantity surveyor, mechanical and electrical engineer, project sustainability manager and BREEAM and LEED assessor. These interviews consist of list of closed questions and open ended questions to allow the respondents to elaborate on their experience. Such measures are taken to allow more in-depth interviews.

When designing the questions a four-step process was used:
- Determine the type of questions that correspond to literature review.
- Categorise the questions in line with the objectives.
- Pilot test the questions.
- Keep the questions in a logical order.

In order to limit the questions to the dissertation objectives, 8 questions were designed to be both short and comprehensive. The questions are designed to allow the respondents to explain their experiences with the potential challenges when working on GBRS specified project.
Section 3.6: Research Limitations

Limitations refers to restrictions in the study that the researcher has no control over, and delimitations as the limits that have been imposed deliberately on the study (Rudestam and Newton, 2001). The limitations imposed on this study are on the other green rating systems such as DGNB, which is due to the fact that only BREEAM and LEED assessment systems have been carried out in Ireland. Respondents selected for this study had to have worked on BREEAM and LEED projects, therefore certain classes within the industry were not contacted.

The main limitations on research design are the industry panel that responded to e-mails. Although the main body of thesis is focused on project management other professions had to be included as not enough project managers responded. There were no books published solely on project management role on BREEAM and LEED projects, therefore other sources such as green project practices and guides had to be used in order to examine the main aspects of sustainable construction. Also, limited articles have been published specifically focusing on project management.

The author is aware that the findings of this research are limited to people who have carried out GBRS in Ireland, especially project managers. The sample population is rather small in the case of the semi-structured interviews. This was highlighted earlier but one feels it must be acknowledged again. The small sample size means the numbers involved are small in relation to the entire population. However, some generalisation must be made when dealing with research of this nature.
Chapter 4: Data Analysis
Section 4.0: Introduction

This chapter presents, findings and analysis of the semi-structured interviews carried out in this dissertation. Interview transcripts are provided in Appendices.

After conducting a full literature review it became clear that BREEAM and LEED are perceived in various different ways depending on the industry professional. Existing literature was encountered by limited amount of practical evidence into the problems and difficulties faced on GBRS projects. The absence of research on project management was particularly apparent from individuals working on green building rating systems.

It was the researcher’s objective for this section to use interviews to examine the roles of individuals and accomplish the following thesis objectives:

1. To examine the role of a project manager on green building rating systems
2. To examine the challenges for meeting a complete set of sustainable indicators.
3. To investigate the forms of communication on sustainable project.
4. To examine the most time-consuming aspects of working on BREEAM/LEED projects.
Section 4.1: Interviewee Profile

Question 1 - what is your profession?

The researcher commenced all interviews with an introductory question about participant’s professional background and the corresponding role they have in the organisation. The aim of this question is to commence the interviews with simple question.

- Participant A: Project Manager at PJ Hegarty & Sons
- Participant B: Project Manager at Sisk
- Participant C: Chartered quantity surveyor at Bruce Shaw
- Participant D: Director and Sustainability Engineer (LEED accredited professional) at O’Connor Sutton Cronin
- Participant E: Senior environmental and sustainability professional (BREEAM and LEED accredited professional) Mott MacDonald
- Participant F: Energy & Sustainability Consultant (BREEAM accredited professional) at Easlár
- Participant G: Architect at Grangegorman Development Agency
- Participant H: Environmental Manager (LEED green associate) at Ecocem
Section 4.2: Participant Background to GBRS

Question 2 - In what way is your role or work affected by BREEAM or LEED?

This question was chosen to demonstrate each participants experience regarding green building rating systems and to see how BREEAM or LEED has changed their working practices. Participant A, who is a project manager, states that they had never worked on LEED project before and that implementing LEED acquires 20-30 percent added workload. Furthermore, participant A explains that the additional work regarding PM practice lies in understanding the LEED requirements, greater management of subcontractors, making weekly environmental walks and gathering documentation.

Participant B was the project manager on first BREEAM project developed by Sisk in Armagh. Furthermore participant B was the BREEAM coordinator on the site. The PM’s work involved the management of works on site and coordination of BREEAM information such as gathering of documentation for the submittal to the BREEAM AP. Another task for the PM was getting the contractors to understand the BREEAM requirements and how they must comply with the set objectives.

Participant C, work involves pricing the bill of quantities, such task involved the €169 million project of Guinness brewery where BREEAM and LEED were specified as a contractual requirement. Participant C, states that GBRS are a new element that the company must upskill on a higher level, furthermore, clients are continuously looking for information on the additional costs associated with the implementation of BREEAM or LEED on a project. As a result, participant C has to negotiate cost on the design stage and to agree on costs with the contractor.

Both participants D and F are BREEAM and LEED assessor and are involved as external consultants on BREEAM and LEED projects. Furthermore, D and F are involved in providing advice, document management to clients and project teams and help to determine what credits are achievable on GBRS. Other aspects of their work involve presentations on GBRS to industry professionals on the assessment process. As a result, D and F have developed in-house BREEAM and LEED manuals that summarises the documentation in non-technical English for each BREEAM and LEED participant.
Similar to participant D and F, participant E is a sustainability consultant whose key role is to carry out assessments on LEED and BREEAM projects, reviewing documentation and monitoring the achieved credits, which are submitted to the final approval by the USGBC or the BRE.

Participant G, responded that they had no previous knowledge of BREEAM prior to project and that BREEAM did not impact their working practices other than producing documentation for their internal BREEAM consultant.

Participant H is a LEED green associate at Ecocem who distributes and promotes Ground Granulated Blast Slag (GGBS), which is an add mixture to concrete. Participant H has previous experience of 15 projects where BREEAM or LEED was specified. Participant H role involves communicating with contractors and giving presentations on benefits of using GGBS in achieving BREEAM and LEED credits. As a result, participant H provides the documentation to contractors for the project to gain 15 credits in the LEED certification. Such documentation includes product origins and how it was extracted from raw materials and how the product is transported to the construction site.
Section 4.3: Challenges on Carrying out GBRS

Question 3 - Are there any BREEAM or LEED requirements that have presented difficulty in achieving the project?

From a project management perspective (Participant A) the difficult aspects of LEED is in producing the right documentation as part of certain elements within the project. Other challenging aspects involve the company’s adaptation to a new element of work regarding LEED certification, as it takes up more time and understanding.

Participant B, does not find any major difficulties and states that once a project has a good BREEAM assessor there should be no difficulties in attaining the certification. Participant B finds that one challenging aspect in implementing BREEAM is making sure contractors comply with BREEAM document submittal.

The difficult aspect faced by project quantity surveyor (participant C) was to evaluate the design of the project and to price the BoQ. Furthermore, participant C states that certain design elements were too costly, therefore they had to be mitigated for less costly alternatives. Such example presented was photovoltaics panels, that were not feasible to the overall project, therefore had to be left out. As a result, some credits are lost when pricing the project.

Participant D, finds that most difficult aspect of GBRS is information gathering and communication as most firms do not realise how critical they are to the certification of the project. Furthermore, participant D and F find that difficulties can arise if GBRS are implemented too late in the planning process as certain LEED credits are lost or would be too expensive to amend, that could have been gained in the design stage of the project.

Participant G, states that the most difficult aspect of BREEAM certification on Grangegorman project was management of the documentation as it was a slow process and that no one in the project team had previous knowledge about the BREEAM assessment. This lead from potential ‘outstanding’ rating to a ‘very good’ rating.

In comparison to participant G, participant D has developed their own company’s manual system that summarises the documentation relevant to each participant. Additionally participant F and participant D stated that the most difficult aspect in green building rating systems can be specific criteria on achieving the points, as the descriptions are narrow and sometimes impossible to achieve.
Section 4.4: GBRS On-Site Measure

Question 4 - Is there more supervision required at the construction stage for BREEAM or LEED specified projects?

Yes, according to a project manager (participant A), the designs consultants would specify at the tender stage that they have to appoint a LEED consultant so that there is one point of contact for the LEED process. The LEED consultant would hold workshops for subcontractors and would be involved in project meetings and monitoring everyone’s compliance with the LEED process. Participant A, states that their role is to make everyone aware. The PM tasks would include carrying out weekly environmental checks, submittal of LEED documentation, monitoring of waste logs and making photographic evidence, which leads to the monthly report.

Participant B, states that the same amount supervision is required in traditional projects without certification. Participant B further states that most important aspects of the certification process is to understand what is involved in the certification system and to make sure that suppliers/contractors are compliant with BREEAM throughout the process.

Form the project quantity surveyors point of view (participant C), there would be an assigned person to manage the assessment process leading to higher supervision element. Some of the tasks of the assigned person would include documentation control and documentation upload, administration and clean site policies.

From environmental consultant’s point of view (Participant E), more supervision is required as there is a great deal of information tracking. Participant E recommends to have a dedicated person on site (AP) so that the contractor does not have to spend most of their time documenting GBRS process and tracking of credits. Furthermore, participant E states that if monitoring of certification compliance is left to the site manager, it can often be forgotten as they are more concerned of completing the physical build than to track documentation.

Participant H explains that the consultant will do most of the monitoring and may find it hard to communicate with the contractor on-site, as often contractors are under pressure of completing the project, therefore documentation can be pushed to the side.

This question was not presented to participants D, F and G as the interview questions were not finalised.
Section 4.5: Identify Unique Project Issues

Question 5 - What was the most time consuming aspect of implementing BREEAM or LEED on projects?

Project managers (Participant A) finds documentation as the most time consuming aspect on the LEED project. Participant A states that subcontractors that have not worked on LEED project before may need additional training, which takes up time and resources.

Participant B finds that the timely aspect of a BREEAM was understanding the certification systems and complying with the required documentation. Another part of BREEAM project that took up more time than anticipated was technical builders guide that presented difficulties at the end of the project as the project manager did not know that it was originally part of their work package.

On the other hand, quantity surveyor (participant C) finds that the most time consuming aspect was finding out the precise budget for specific aspects of the project as certain credits such as energy models, building fabric and building control system can become too expensive although initially being part of the design. This led to changing certain aspects of the design to suit the budget but still to gain highest award in both certification systems.

Participant D states that in 2009 the most time consuming aspect of LEED was getting the design team up to speed on the system as ‘nobody cared, at the time’. Participant D explains that people are more aware of LEED now but it still takes time to distribute the information to project parties and make sure that everybody understood what they are doing regarding LEED. Participant D elaborates that the most important aspect of LEED is to produce the right information the first time as it can take up time to send documents back and forward until the contractors have complied with LEED criteria. Furthermore participant D states LEED can be time consuming if the main contractor does not fully understand the accreditation system.

Participant G responds, that documentation gathering takes up most of the time on BREEAM specified project. Furthermore G explains that if there were more people that would deal with BREEAM documentation it would be an easier and faster process.

Similar to participant D and G, participant F and E states that the most time consuming aspect is gathering the evidence from the design team/client/contractor. The evidence has to be exact or it will not pass QA processes from BRE or USGBC. This can be time consuming and
involves a lot of back and forth between assessor and design team particularly if the team has no previous experience of LEED or BREEAM system.

Participant E adds that it can take time to understand LEED Ashrae standards, which are the US quality standards for construction, they are not commonly used in Ireland and may require additional understanding.
Section 4.6: Communication and Information Exchange

Question 6 - How do you think that communication and information exchange could be improved on BREEAM or LEED projects?

According to participant A, it is important to have a good LEED AP that has a good systematic documentation system. Participant A meets the LEED AP every two weeks regarding certification compliance, which leads to monthly reports. Additionally, it is better that all documentation filters through one person only as information can go missing through chain of actors that have to submit documentation.

Participant B finds that there were no issues regarding communication. Furthermore, participant B recommends that BREEAM could be simplified for the subcontractors in non-technical English as some requirement interpretations can be difficult to understand.

Participant D and G promote the use of ‘SharePoint’ and ‘A-site’ which are an online collaboration servers where information regarding project can be managed. It works by project teams uploading relevant documentation. Participant D finds that ‘A-site’ does not work proficiently, therefore they have developed in-house document management procedure for all their clients. Additionally, participant D and G hold presentations/workshops on BREEAM/LEED and participate in regular team meetings.

Participant E explains that they have an in-house system for managing LEED and BREEAM documentation. On a previous BREEAM project participant E has used ‘Tracker Plus’ and ‘IS Tap’ which are online management tools for team collaborations. Additionally LEED has an online platform whereby the project actors can access and review the assessment progress. Furthermore, participant E states that project manager has to ensure that sustainability is always on the agenda throughout the design team meetings and throughout the construction stage.

Participant C extends that they have dedicate a section in the project meetings towards BREEAM and LEED as it has become part of every meeting agenda.

BREEAM AP (participant F) recommends the use of file sharing systems, which would make BREEAM more of web enabled system where the evidence for each credit could be uploaded.

Participant H states that there needs to be a training courses available in addition to what it is right now on LEED assessments. Participant H proposes that there needs be a forum or a society where GBRS actors could get together and discuss BREEAM and LEED more openly.
Section 4.7: Training

**Question 7 - Has there been training sessions implemented for staff on educating them about BREEAM or LEED specific credits that they have to obtain?**

Participant A comments that they had a workshop solely on contractor credits. Furthermore, participant A would organise workshops with sub-contractors educating them on LEED. Each workshop has to be tailored to the specific sub-contractor. As a result, participant A would be involved in kick-off meetings before the start of a project and also during the project in order to refresh what documents are required and to obtain any additional information.

Participant B stated that they had only one, full day meeting on BREEAM prior to starting on construction site that was held by BREEAM AP, explaining how the system works and credits that concern PM.

The quantity surveying firm (participant C) have had few training sessions and find that they have understood of what is required from their practice. Participant C tends to use previous projects as example for GBRS and has developed an in-house database on the specific credits they have to achieve. The firm finds that training is an ongoing process as they learn from experience of GBRS specified projects.

Participant D recognises the importance of training and they would regularly give presentations to different project teams. Participant D presentations involve a simple outline, on the GBRS process in non-technical English so everybody understands it. Furthermore if people are still struggling with LEED, they would meet each party individually and present specific part related to their scope of works.

Participant E tends to hold workshops as part of their scope of works. At a pre-assessment workshop they would gather the whole project team and discuss the specific requirements that are to be involved when designing the building. The purpose of this workshop is to make the people understand the different aspects of the system. Furthermore, they would share the experience gained from previous projects and where the most likely difficulties are to arise.

Similar to participant D and E, Participant F adds that anyone can attend specific courses run by Building Research Establishment (BRE) for further development and understanding the BREEAM system, that are held through webinars.
Participant G relies on external bodies such as consultants to give presentations and hold meetings. Participant G assumes that it is up to subcontractors to have information and training regarding the accreditation process.

Participant H holds regular presentations on LEED/BREEAM systems as part of continuing professional development to architectural and engineering firms.
Section 4.8: Management Review

Question 8 - Are there any suggestions on how management can be improved on BREEAM or LEED projects?

According to the project manager (participant A) the company will look to gain LEED green associate training for some of the main staff. Another investment will be to create their own internal LEED framework as it is being specified on every new building that is coming up in Dublin. The internal framework will be used at the start of a project and would be the starting point from the contractor’s point of view.

Participant B states that it is important to have a good BREEAM assessor as for the information to pass through one person only as it can be difficult to manage people’s compliance with the documentation. Another suggestion is to have a meeting with the project team and to discuss every credit that can be achieved in the project and also for everybody to realise their goal towards BREEAM accreditation.

Participant C suggests that certain interpretations in LEED specifications are not clear, therefore it is difficult to distinguish if some products can or cannot be used. Participant C further explains that LEED projects work of Ashrae American standards and that it needs to be adopted to Irish construction industry.

Participant D states that companies need to develop procedures on how to integrate LEED from the start of a project as it will save time and it will assist firms in strategic planning. As a result, participant D concludes that it is important to make everyone aware of what LEED is and what needs to be done on a project. The most important aspect in LEED is that PM understand how a project is planned before they can be a good manager of the LEED process.

Participant E suggests that one person needs to own the process (manage the process). Furthermore, BREEAM and LEED need to be on the agenda in meetings. Participant E explains that if people don’t discuss BREEAM over a long time it tends to be forgotten.

Participant H states that green building rating systems need to be discussed more openly. Participant H suggests that IGBC should gain more knowledge on the systems and hold more events on educating people on the assessment systems. This question was not presented to participants F, and G as the interview questions were not finalised.
Chapter 5: Research Findings
Section 5.0: Introduction

The following chapter discusses the key points raised in the literature review and the key findings acknowledged from the industry panel. This chapter also presents other issues of significance in terms of green building rating system practices not examined in the literature review but highlighted by the interviewees. The information gathered provides the researcher with an indication on the evolving role of the manager in green building construction. The author will conclude by offering his own analysis on the overall BREEAM and LEED assessment regarding the research.

Section 5.1: Project Management Responsibilities on GBRS

The general consensus is that the most important aspect of the PM on GBRS is to fully understand the green building assessment process. Furthermore the PM must be involved in the project kick-off meeting during which all credit requirements regarding GBRS will be discussed. It is the PM’s responsibility to implement and manage contractors in order for them to comply with the GBRS documentation process. Generally the PM would hold workshops for the contractors/suppliers whereby presenting GBRS and what is required from each contractor. The workshop on GBRS should be carried out in non-technical English as to fully explain each contractor’s roles towards the GBRS accreditation system. Additionally, the PM would hold weekly meetings where GBRS is always on agenda, this makes sure that contractors are compliant with GBRS throughout the construction process. The PM is expected to gather the GBRS documentation from all of the contractors/suppliers for submission to the AP consultant.

Other PM tasks involve planning and scheduling activities with a greater attention on green requirement process. The author finds that the PM generally develops a personalised project manual on how to go about GBRS specified projects in order to assist in future planning of such projects.
Section 5.2: Green Specifications and Documentation

From the gathered secondary research and qualitative research the most difficult and time consuming aspects of BREEAM and LEED accreditation is to produce the right documentation, in order to achieve projected credits. Such documentation involves gathering of information on the source of the product, how it is transported to the construction site, to produce weekly environmental checks, to monitor waste logs and to make photographic evidence. This research finds that contractors that have not worked on GBRS before tend to submit inaccurate or incomplete evidence to USGBC or BER. Furthermore, information submitted by PM must be as per GBRS guidelines or it will not pass the QA process which leads to time delays caused by sending documents back and forward until the project team complies with the precise standard. There are several recommendations put forward by interviewees on how to improve the management of documentation. Such recommendations are:

- The development of internal systematic BREEAM/LEED documentation manual and templates summarising the exact information required.
- To have one person manage the BREEAM/LEED process so that information and documentation filters through one person only.
- The use of file sharing systems such as DMS which would make BREEAM/LEED a more of web enabled system where the evidence for each credit can be uploaded.

Section 5.3: Management Structure and Responsibility

Research analysis present that green building assessment methods tend to employ external BREEAM/LEED consultants. The consultant’s role is to manage the GBRS process. The AP determines what credits can be obtained compared to the design of the project and the budget allocated to GBRS and is responsible for collecting and uploading the achieved credit documentation to USGBC or BER. Furthermore, AP consultants tend to hold meetings where they present the GBRS manual. It is evident that AP produces and distributes templates on the documentation format to be used, which are presented in user friendly English. The author finds that if GBRS is introduced after the design is finalised, then certain credits can be lost due to noncompliance at the design stage.
Section 5.4: Training Opportunities

The author finds that one of the most important aspect of BREEAM/LEED is to understand the process and to make sure that suppliers/contractors are compliant with BREEAM throughout the process. The qualitative research reveals that training sessions are presented at the start of projects where AP give presentations/workshops to the project team on the rating system and credits that each party must obtain. These workshops cover the process of GBRS assessment, as well as the documentation each person must supply to the consultant, and the credits to be achieved. As a result, PM would discuss GBRS in all project meetings in relation to project progress and compliance.

Further suggestions on training have been analysed as:

- Management staff gaining BREEAM or LEED accredited professional training.
- Creating companies internal BREEAM or LEED framework.
- Holding regular presentations/workshops for project teams.

Section 5.5: Sustainable Construction Site Management

As mentioned in section 2.8 GBRS contain extensive documentation. In relation to site management, greater monitoring is required to document the site disturbance and pollution prevention. Contractors have direct impact on 17 sub categories regarding the site management. The author interprets that the most difficult and time consuming aspect of on-site management is the SWMP, as subcontractors often try to cut corners if effective monitoring is not in place. Site management requires greater planning and scheduling as the assessment limits the site storage space and promotes just in time deliveries. It is estimated that GBRS will require up to 20 percent of PM’s time to complete the project.
Section 5.6: Summary of Research Findings

The analysis of the research identified the evolving role construction practitioners working on GBRS and the specific skills used to reduce the risks and uncertainties for the duration of the build. The findings also incorporated the literature so it could be compared against the findings. In addition the author found that understanding the accreditation systems prior to tendering for a project are fundamental in enabling the high level of collaboration between different parties in projects.

While the literature review gave a strong introduction to GBRS and identified many of its features, both positive and otherwise, the author finds that there is a lack of awareness in the current construction market of systems such as BREEAM and LEED. The interviews highlighted the importance of training, communication and planning and how the combination of all three can reduce cost by implementing internal frameworks and the development of documentation templates.
Chapter 6: Conclusion and Recommendations
Section 6.0: Introduction

This chapter summarises the main results from the data provided throughout this dissertation. The author reviews and compares material researched in the literature review against what occurs in real life situations and analyses what he considers to be the current practice. It will present an evaluation of the aim and objectives of the research and form a conclusion. Furthermore, this chapter looks at the limitations and recommendations for this research. The chapter concludes with suggestions on further research proposals on this topic.

Section 6.1: Aim of the Research

The primary aim of this dissertation was to investigate the evolving role of Project Manager and challenges of delivering Green Building Rating Systems. This was achieved through an extensive research on the surrounding literature and analysing industry professional’s experience regarding the research topic.

Section 6.2: Research Objectives

The aim of this research was presented through the following objectives:

Objective 1 - To examine the role of a project manager on green building rating systems.

This was addressed through examining the green building rating systems of BREEAM and LEED and the additional tasks faced by the PM on such projects. The results which are presented in section 2.4 show that PM must plan and coordinate tasks with achieving highest quality build while maintaining costs and delivering the project on time. Furthermore, this study carried out a semi-structured interviews with the industry panel that expressed their views and their experiences while carrying out green building rating system, which is presented in chapter 4. It can be concluded that the main role of PM on green projects is to fully understand the rating system and making sure everyone complies with objectives of GBRS. Furthermore, as highlighted in section 2.5 it is considered that the PM’s most important task is to deliver an effective communication amongst all parties involved.
Chapter 7 - Conclusion and Recommendations

**Objective 2** - To examine the challenges of meeting a complete set of sustainable indicators.

The main challenges on BREEAM/LEED projects were presented as producing the right documentation and understanding how the system works. This was examined through interviews as seen in section 4.4 and summarised in the findings section 5.2. Furthermore, it was discovered that sufficient training for industry professionals could mitigate the difficulties faced on GBRS projects and open new markets for the company in the area of green construction. This was presented in section 2.7 and section 4.8.

**Objective 3** - To determine on-site management challenges in relation to delivering BREEAM and LEED projects.

This objective was extensively researched in the literature review, showing that the PM will have to plan and schedule their activities with additional green factors taken into account. It is evident that closer monitoring of subcontractors will be needed, with more taught to waste management plans and organising JIT deliveries. It was highlighted in section 2.6 and 5.5 that training of subcontractors will determine the compliance with the project’s objectives. Furthermore, the role of BREEAM/LEED accredited professional was examined in order to see their responsibilities of managing certain on-site activities, such as gathering information from contractors/suppliers.

**Objective 4** - To investigate the forms of communication on sustainable project.

This objective was investigated in the literature review under the section 2.5 of communication, which presented the DMS as a form of effective collaboration. This finding was contradicted in quantitative analysis as the industry professionals argued the use of DMS and instead proposed that communication can be improved by developing in-house GBRS manual system and discussing the rating systems through weekly meetings and workshops.
Section 6.3: Conclusion

As Ireland is trying to meet its carbon emission reduction, the construction sector acts as the main contributor to its current unsustainable course. Green building assessment methods and other incentives can be presented as a solution for shifting the course of the current practices. The emission reduction presents greater opportunities for more effective design and management practices towards sustainable construction. As a result, BREEAM and LEED have emerged as the leading green building certification systems that demonstrate new opportunities in the current market.

For these reasons the research sets out the investigation of the two certification systems and the PM’s role of implementing them in practice. The green building certification schemes are designed to reduce the current carbon footprint and to create awareness amongst the different construction actors. As a result, clients chooses to specify BREEAM and LEED in order to provide ethical recognition of their building and to make monitory savings on energy usage that leads towards increasing value of the building. It can be seen that green building assessment schemes have number of weaknesses. The two certification schemes are a voluntary decision and can be costly to introduce, meaning that the impact on the current environment is limited. Another weakness of certification scheme is due to the government not having any incentives in place to become BREEAM or LEED certified, therefore the certification schemes depend on clients’ recognition.

It can be seen in this study that nearly all of the difficulties and challenges on GBRS projects are connected to a wider range of business practices rather than being directly connected to certification schemes. Therefore, BREEAM and LEED should not be perceived as a substantial task as a whole, but rather as small adjustments in everyday practice, which in time will become as common practice.

The main conclusion from this dissertation is that the role of project manager is constantly evolving. It can be argued that the implementation of certification schemes have not changed the traditional role of PM but instead has advanced their practice towards higher awareness of sustainability. As a result, PM will require more efficient management and knowledge of modern ways of construction. It has been illustrated throughout this dissertation the importance for PM’s to full understand the assessment system, in order for them to meet the project requirements.
Chapter 7 - Conclusion and Recommendations

It has been highlighted throughout the dissertation that the lack of professional knowledge is the main obstacle for taking on more sustainable construction practices. In order for BREEAM and LEED to be more recognised in the current market there needs to be more training opportunities for industry professionals. As a result, the public is becoming more aware of climate change, increasing demand for green building markets. Furthermore, green building certification schemes offer more social and environmental benefits, which has led to an increasing demand for sustainable construction. This research has represented green building certification systems as a significant step towards promoting sustainability in the current construction industry.

Section 6.4: Research Limitations

This research was limited due to a number of factors. The literature on project management and green building rating systems were sourced from foreign countries and not from the Irish construction market. As a result, the researcher had to adapt to different systems and make it applicable to the Irish context.

The selection of qualitative research has provided the author with great personal material from key participants that quantitative research may not have reached. However, it might be argued that the amount of interviewees does not sufficiently reflect the opinion of all project managers that have carried out BREEAM or LEED assessment.

When it comes to qualitative research, the author initially targeted project managers that have worked on BREEAM or LEED projects. Due to the niche of PM’s that have sufficient experience in GBRS projects, the author had to expand the interviewee range to integrate other professionals that have been involved in green building rating systems. Despite the difficulties, the researcher received positive responses which fulfilled the aims and objectives of this study.
Section 6.5: Recommendation

With the increase in greenhouse gas emissions the government has the responsibility to act on its targets set out in the Kyoto protocol of reducing the country’s gas emissions by 20 percent by 2020. The author presents BREEAM and LEED as the leading consideration from the construction industry point of view in order to reach these targets. The government should introduce BREEAM and LEED as a mandatory requirement on all public buildings as this would reduce the carbon emissions. This legislation has been in place in the United Kingdom since 2011. The current BER rating and Part L of the technical guidance documents only focus on the emissions and energy consumption of a building but this does not take into account the embodied energy produced during the construction stage.

From the literature review and the examined industry panel there is a lack of skills and training available towards BREEAM/LEED certification. Currently the IGBC only offer LEED green associate training and are not involved in the promotion of assessment tools. There needs to be more courses for professionals regarding certification that are not necessary to gain professional accreditation. As presented by one of the interviewees there needs to be a forum where people can get involved and answer questions regarding the certification process. Currently there is no service in Ireland that gives advice to unexperienced construction teams.

Construction professionals should develop their own internal systematic framework regarding BREEAM and LEED specifications. This was recommended by a project manager and a quantity surveyor during the interview stage, who feel that there is a great market for BREEAM or LEED projects.
Section 6.6: Further Research

The Irish construction industry has great demands from Building Information Modelling (BIM) and have therefore ‘Green BIM’ has been developed. Green BIM incorporates different solutions to energy performance where sustainability and design are incorporated under one model. This research could take the form of how BREEAM/LEED is implemented into the system and how both systems benefit from one another. BIM is still at its infancy and therefore it is the appropriate time to research the sustainable side of management.

Further, more in depth exploration would be to carry out a case study of on-site energy consumption on traditional construction projects and how they compare to the green building management practices. This form of research could monitoring certain element of waste in order to analyse how delivering a green building is environmentally safe while still making a profit.

Main dissimilarities between conventional and green construction projects exist, especially in the level of details and communication required; to overcome the barriers, a project management framework for green building construction should be developed, possibly promoting adoption of sustainable management approaches for future green building projects.
Bibliography
References


  Available at: https://www.breeam.nl/sites/breeam.nl/files/bijlagen/rapport_vergelijking.pdf


Appendix 1 – Participant A - Project Manager

Lorcan McCarran – PJ Hegarty & Sons - 10th March 2016

Davis: what is your profession?

Lorcan: My title would be project coordinator, project manager and the background would be of bachelor of engineering and civil engineering. My field would involve commercial and building sector in Ireland and Australia.

Davis: Have you worked on a green project before and if so was there any sustainable requirements that presented difficulties in achieving the project?

Lorcan: I have no previous projects that had sustainability factor but I’m currently working on a project that is seeking to gain LEED platinum. It’s one of the first projects in Ireland to target LEED platinum standard. The difficulties in achieving the project would be documentation really. Other than that it is well structured process. Other difficult part would be that it’s a whole new element to the company.

Davis: Was it easy to implement it into your company and your role?

Lorcan: It was easy as we had O’Connor Sutton Cronin who are the sustainability consultants and they have all the system laid out for us from setting up the project to ticking off the documentation. What they provide is in depth, especially when you get into the project you read the requirements and then when the project has started you know exactly what you are doing. To be honest it is a simple system. From a contractors point of view, once you set out the targets on what you have to achieve it is easy. Of course it does take up more work and understanding.

Davis: In what way is your role/work situation affected by BREEAM or LEED?

Lorcan: since starting this project my job description has changed as now I’m a BCAR champion which is a whole new element signed to my role so that would take up about 20 – 30% of my role. So LEED is a constant point of managing subcontractors, I make weekly environmental walks, documenting. So it’s not a fulltime job for me honestly but it does take up a substantial amount of time every week.

Davis: Is there more supervision required at the construction stage for LEED specified projects?
Lorcan: Yes that’s spot on of what I was talking about. The designs consultants OSCS would specify at the tender stage that we have to appoint a LEED champion so there is a one point of contact for the design consultants and there is one person intentionally taking on charge and they have to be part of the design team. So again just sitting down with subcontractors and stepping them through it again going back to the weekly environmental walks it’s all documentation so every point you are claiming and documenting. Such documentation would include weekly reports, photographing that the environmental checks are in place and that leads on to the monthly report. Then chasing down the waste logs such as moving waste off site so every piece has to be documented. Definitely requires more supervision and my role is to make everyone aware. For example it is a necessary to have a good demolition subcontractor who take on the whole package and take the waste management so if they have worked with LEED before it makes all the difference. It helps with the supervision.

Davis: what was the most difficult and time consuming aspect on implementing LEED on this project?

Lorcan: So it is the chasing of documentation. So another difficulties was the waste facilities. When we are sending waste of site we are targeting LEED platinum so 75% of construction demolition waste has to be recycled. Another difficulty would be waste facilities that would accept waste they are really reluctant to providing figures and information. They think that we are trying to track them. So that leads to a lot of chasing and hassle. So it took us a month to get the information that we wanted out of the waste facilities. So our demolition subcontractor has worked through LEED before and they have a really good system whereby they track waste so their documentation ends up being our main records even better than the waste facilities. Other subcontractors you are going to struggle a bit more. So if they haven’t worked on a LEED project before it seems to frighten the whole concept of it. It’s not that bad when you break it down.

Davis: do you think that communication or information exchange could be improved on a LEED project?

Lorcan: we are lucky to work with OCSC so they have a really good documentation system in place so we sit down with them every two weeks so we have monthly reports going back and forward again you can see the reason behind specifying a LEED champion behind the contractor’s team. So it is better that it all filters through one person.
Davis: Has there been training sessions implemented for staff on educating them about LEED specific credits that they have to obtain? For example toolbox talks or site meetings?

Lorcan: Before the project kicked off we sat down with OCSC site team and we had a workshop with them solely on contractor credits. So as they had worked with LEED before they presented the credits that we could obtain. So smaller subcontractors who had not dealt with it before we would run a workshop discussion on LEED where we would introduce templates that we would like them to use. So we would meet with our concrete or steelwork subcontractors so each workshop has to be tailored to the specific role. So for example we sat down with our mec & elec where we would have a kick-off meeting before we start and then one during the project to refresh what is required so as to see if they need any more information.

Davis: Is there any suggestions on how management could be improved on LEED projects?

Lorcan: Because it is our first project we are still learning but at the end of the project I will look to gain LEED green associate training. Another suggestion is to create our own internal framework as it is being specified on every new building that is coming up in Dublin. So we will need to create our own internal systems and framework that will be used at the start of a project. And that would be the starting point from a contractor’s point of view.

Lorcan: have you talked to anyone else?

Davis: yes I have contacted Bruce Shaw, Mot MacDonald, BREEAM assessor, Architect and few more.

Lorcan: have you contacted any Contractors?

Davis: no

Lorcan: There is definitely a niche in LEED and BREEAM. And it is the early days for LEED in Ireland. One thing I’m finding out there is that the information is US based and I think that there will be more Irish to work off and trough. There seems to be calls from few other developers who don’t know what LEED is and what does it mean. Or a contractor.

Davis: did you had to follow the American Ashear standards?

Lorcan: it takes a bit of work in tracking your recycled materials. So it is pretty open when you compare it to BREEAM its open to a bit of interpretation to what
Appendices

Appendix 2 – Participant B – Project Manager

Brian McCaffery - John Sisk & Son Ltd – 24th March 2016

Davis: The first question is: What is your profession?

Brian: I’m a project manager and I studied civil engineering. My role at the moment is managing a project from interface point of view from a life cycle product to a live building. In terms of project management on that site was a three story ground floor to second floor office block in Armagh city. It was the first project that Sisk had done in BREEAM area. So my role involved being the BREEAM coordinator of the site. So we had a client specifying BREEAM and it was a design and build project so we had our design team. We also employed BREEAM consultant from Scotland and she would advise everybody on the whole process. So on the day one we all sat around the table and advised everybody on the job and from my point of view anything to do with the site works was my responsibility. So it wasn’t QS or Forman it was my responsibility to coordinate all the information such as documentation and applications to provide it to BREEAM assessor.

Davis: So what way is your role/ work altered by BREEAM or LEED when you are working on a project?

Brian: It is a big thing. It’s getting the contractor to understand what BREEAM is all about. Obviously client knows all the benefits it’s going to bring to him and what the contract is all about. When you are doing your pre-qualification meetings with the contractors you want to make sure that what they are supplying is complying with BREEAM such as responsibly sourced and all that kind of stuff. I suppose its like a box tick saying what has to be checked. The role is just another thing you have to do on the job so you have to be organised with it.

Davis: What specific things do you have to do? Do you have to deal with the subcontractors and ask them to give you the documentation?

Brian: Before you even start on site you have to know what BREEAM is all about. So when you are the contractor and suddenly realise in six months’ time that you have lost a piece of paper that will cost a point. So you have to be aware of it all the time. I don’t know how it works with a standard project but with the design and build you have to understand that. We were able to manipulate the design at the predesign stage to make it more applicable and to make it more viable from a BREEAM point of view. So we were looking at the changes we
could make to get a certain point. So for example if we change this we are able to get this point but the other points may be too expensive. It comes down to the money in the project. So I suppose from a PM point of view, you have to consider your contractor and everything that you have to do as part of it. You have to oversee different energy sides of the project and just to make sure that contractors are complying.

Davis: The next one there is: Is there any sustainable requirements that presented difficulty in achieving the project?

Brian: Its five years since I did the project.

Davis: So it was one of the first ones done in Ireland?

Brian: Yes and it got a BREEAM excellent actually in the end. I think the difficulties were with the biomass boiler. I don’t know if that was originally spec in the actual design drawings. But I think that people have a general negative view of what a biomass boilers are. There was no major issue.

Davis: Would there be documentation that presented difficulty?

Brian: I think the whole process was very good and we had a very good assessor and she was able to in any way possible. So having a good assessor is the key. She laid out everything to us so there was no twisting arms so she knew everybody was new to the process.

Davis: I think it is very interesting to know on how all the documentation works.

Brian: So basically how the whole thing works is… First meeting we had was where we sat down with the clients design team and our design team and the BREEAM assessor wen through with every point that was applicable. So the design was able to change to a certain point but for some fundamentals it couldn’t. So she went through to everything that has to be achieved and they are your targets. So everybody went away with precise information on what each member had to do.

Brian: one difficult element of BREEAM was the builders users guide as it was a separate part and it kind of fell on us and I don’t think that it was right to fall on us. I think that may have been the weak area and it should have been the design team. It was a part about the occupants themselves. I didn’t really knew what I was doing there but it had to be got and I had to understand it. That was one thing I remember.
Davis: Is there more supervision required at the construction stage for LEED and BREEAM specified projects?

Brian: no there wouldn’t. It was just about making the contractor to comply with BREEAM.

Davis: how did you make the contractor comply?

Brian: So it was trough asking the contractor to send certifications from where they scored the timber so that it’s CEF or CEC cert. So they were the responsible sourcing areas. So there were certain parts of the criteria. These have to be BREEAM certified rating. So basically when the QS is asking for the rates so I had to look what had to be done here. So we had to find out what can or can’t be done here. So for example stone cladding. It is specified so, therefore it can’t be the cheapest. So I would say there that there was a certain amount of supervision. In terms of environmental aspect of the site so there was dust monitoring, recycling facilities, concrete washout areas which is king of standard stuff.

Brian: have you looked through the whole process yourself?

Davis: yea I am familiar with the process and I know that there are 51 points that you have to comply with and that together there is 110 points. There is the management side, energy side which contributes to 19% of the overall points and there is the indoor environmental quality.

Brian: that’s it. Another thing as well is that most sites now has recycling facilities. So there is a bit of supervision. Maybe it took me 5-10% more time but it’s not a huge task. So how it starts off is at the client then to the design team and then to the contractor and then to the subcontractor.

Davis: What was the most time-consuming aspect of implementing BREEAM/LEED on the project?

Brian: There was initially time aspect of understanding it. That was a big element. A lot of the contractor’s didn’t know about it. Especially 5 years ago. There is that and then there is getting all that information as on a standard job of operations. But with BREEAM there was a whole folder that had to be issued and to go through the technical submittals. Another things was the technical builder’s guide that took up more time at the end of the project. They were a big thing for me. Other things were making e-mails and phone calls but that was your everyday task.

Davis: do you find it that there was chasing of documentation?
Brian: there was quite a bit of that especially towards the end where you had to provide your evidence. But I wouldn’t say time consuming wise. I would say more the designers can’t spec a certain boiler. They are designing it so.

Davis: How do you think that communication and information exchange could be improved on LEED and BREEAM project?

Brian: From my point I taught that it was very good. I would say it was from contractors and subcontractors where the whole process could be simplified. To make it in simple English would be a good idea so that the contractor can understand the whole process and subcontractor would understand exactly what is at stake here. I think now people are complying with all the different materials and specifications. In terms of communication from my own experience it was easy. Because it was design and build we could manage the design a bit more where our design team could make changes to suit BREEAM and that would be given to the clients design team.

So when we price the job we look at design and build and its specified that it has to be BREEAM excellent and that was the criteria that we price the job on so we signed a commitment that we are going to achieve that whereas by normal build its: client ‘I want a BREEAM excellent’

Referee to the drawing of the system

Davis: Who was the design team?

Brian: It was scot Wilson they are big in UK and then we had DA Architects from Armagh.

Davis: how it works now is that BREEAM is specified in the contractors documentation and also that they have to get their own external BREEAM assessor on board to carry out their point monitoring.

Brian: they need as assessor there as they have their own role and they don’t have time to deal with it.

Davis: Has there been training sessions implemented for the staff on educating them about BREEAM/LEED specified credits that they have to obtain?

Brian: Not really. Basically first day we had BREEAM assessor coming in and for the whole day went through the process and that’s how we learnt there was no other training.
Davis: So you learnt from experience?

Brian: that was 7 years ago and I’m assuming now but that how it was we learn from experience.

Davis: and what did you tell sub-contractors then? Did they know what BREEAM is?

Brian: well when we went through the list we kind of realised that where they have to be compliant by. So when they were supplying materials they had to know what they were doing and we originally had to put that in the pre-qualification documents and if you don’t even bother coming near this project and is as simple as that. So most of your material is like timber and all that kind of stuff so they have to order it from a good sore and the wood had to be stamped

Davis: Is there any suggestions on how management can be improved on BREEAM/LEED projects?

Brian: My own experience was quite positive. Definitely on the builders users guide so you have to get someone to come in and do that for you. I think there was that kind of option but we taught it was possible for us to do it and we would save money by doing it ourselves. Management wise it is important to have a good assessor and that communication was trough one person so with the client, design team, us and the contractor. As long as you have that you are on to success.

Davis: so what you are saying is that you have only one owner for the whole process of BREEAM?

Brian: I think it is important from the start to go through every single point and spend that day so everybody realises that and everybody realised that what we were doing.

Davis: I think that’s all the questions finished
Appendix 3 – Participant C – Project Quantity Surveyor

Michael Smith – Bruce Shaw – 10th March 2016

Davis: what is your profession?

Michael: My name is Michael Smith and my profession is a chartered quantity surveyor, and I’m working with Bruce Shaw for the last four years.

Davis: Have you worked on green projects before and if so was there any sustainable requirements that presented difficulty in achieving the project?

Michael: The biggest project that I have worked on achieved LEED Platinum which was the Diageo Brue house number four down on the keys. It was the first brewery in the world to achieve LEED platinum and it was the first manufacturing facilities in Ireland to achieve BREEAM outstanding. The initial difficulties was that we had to run energy models and there was certain items ruled out that were just to expensive like PV solar panels that just wouldn’t work as to how much it was going to cost. What gave us the capacity to achieve the required points for BREEAM outstanding and LEED platinum was the output from the building process was that energy was going to be used to power a lot of the buildings on site and it is able to sell the energy back to the grid.

So the main difficulties were that certain solutions didn’t work. In a lot of the jobs now we have to do cost trackers. The LEED assigned person will come up with all the points that are required for LEED platinum and then we as cost consultants have to assess how much they are going to cost. At this stage you have to choose which points we are going for and which points are too costly. You still have to reach you goal but the points that can’t be achieved have to be taken off the list. For example for that project PV panels or rainwater harvesting just don’t work for the cost point of view.

That’s the only project that I have worked from the start to finish where I have gone the full circle from the inspection to the solution in the Brew house no 4. At the moment we have a number of office blocks that we are working on handover key and the client is looking to get LEED gold.

Davis: did he decide at the start of the project? Because I find it that research states that it is difficult to bring in LEED/BREEAM when the design is finalized
Michael: it is very difficult because when you know it at the outset you can adapt your design to suit but if you come in the 11 hour and say I want to get LEED gold then you have missed the boat. A big element of LEED is that at your design stage you have to upload a lot of documentation and then you have the construction stage. So at the design stage is where a lot of the points can be gained because you can adapt your design. You can say that your PV panels are not going to work on this project documentation is uploaded to the USGBC. So if you come in at the construction stage then all the opportunities are gone. It is still possible but it is going to cost a huge premium to go back and retrofit so at the design stage is where you can adapt. You can work out your tracker and how much it is going to cost you.

Davis: did it take much of your time to adapt to LEED or BRREAM or was it your normal job and it didn’t bother you to much?

Michael: it is part of my role but you do have to dedicate your time to it. When we go to a meeting now with the design team LEED and BREEAM is the section on the minutes. The client has designated an assigned person to facilitate the process. We as QS doing or cost plan we have a LEED and BREEAM section the as well. It is more and more now. It’s part of the norm. When we go to the meeting the very first question we get asked is the goal regards LEED and BREEAM as we need to know now because we need to know A- the cost and B- the design needs to adapt. It can have a huge effect on your façade so all your glazing. If you are going for LEED platinum you may need a twin wall system so you got your outer layer of glass and then a gap and then an inner layer of glass. That is a huge cost so you need to see that that’s too costly, can we get the points through another way. So it’s part of the job now that has to be factored in. So a lot of the jobs now we do cost trackers so we would get the LEED and BREEAM list so we would put a total cost column to the right hand side and to see which points are feasible top get and which ones are not.

Davis: So how much cost would you dedicate towards LEED? As research shows that it is between 1- 5% if you want a BREEAM or LEED

Michael: Are you talking about cost or time?

Davis: about the cost on the project and your time as well. The research also shows that BREEAM would take up about 20% of your time?
Michael: As QS not it would not, maybe the architect or the assigned certifier but for us it would be 5%.

From a cost perspective we have found on jobs that LEED gold can add about 2-3% in cost and LEED platinum 5 – 6%. About time at the time you initially spend a lot of time at the beginning but once the project kicks off it just becomes as part of the spec then and it just runs as the job progresses. The contractor would then have to build to the spec that is given to them which would include all the LEED requirements and so it’s just administered as normal job.

Davis: in what way is your role or work situation affected by BREEAM?

Michael: So a week ago we had Patrick Field in from OCSC and he gave a presentation on LEED. So majority of client now are looking for LEED. So our role is affected by it and it’s another thing we have to upskill on and the clients are asking how much is it going to cost, what’s the effect and then we have to agree the cost of the design stage to agree that cost with the contractor then.

Davis: Research shows that it will increase the value of the property by 11%

Michael: that’s more of a question towards the property value. But we do see at meetings that it is a big selling point. So you know the way there is the version 3 and version 4 so people tend to go for the newer versions.

Davis: Is there more supervision required at the construction stage for BREEAM or LEED specified projects?

Michael: Yes there is as they would have an assigned person to manage the process so there is a higher fee and supervision element required. The assigned person would monitor that. The project that we had in the Diageo had a cost tracker at the outset so we said of how much LEED is going to cost so we then had to monitor that trough the construction stage. So if we had Landscaping in we would have a budget for what the landscaping is going to be and then we have to manage that during the process and agree the costs and administer. So that validates that there is more supervision required at the construction stage. Especially the contractor has a big responsibility in LEED and BREEAM. So if they are not up to speed on it not going to work. So documentation control and documentation upload and administration, clean site policy’s all that kind so stuff, they have a big role to manage that and that has to be supervised as well. So now it’s built in the contract documents so it’s a contractual requirements now so they have to work towards gaining the BREEAM gold so they have a big part to play.
Davis: What was the most difficult and time-consuming aspect of implementing BREEAM or LEED on a project?

Michael: The most time consuming is that there are certain points such as energy models and the building fabric to price is very time-consuming as for the designers to find out what kind of building control system is going to work and how does it tie in with the façade so its time-consuming at the outset to set their goals and to see how the design is going to evolve. So for the design team the most time-consuming part would be the outset as they have the role of getting the design right. From the QS perspective it’s trying to get the budgets right as its time-consuming and then during the construction stage there is no time consumption as the costs have been finalized as it’s then passed to the contractor. So we put it in our preliminaries documents that the contractor needs to have an assigned person as well to manage all of the project, to gain all the documentation, to upload it, to make sure to implement site waste management plans are being implemented.

Davis: How do you think that communication and information exchange can be improved on LEED or BREEAM projects? Between

Michael: The projects that we have worked to date has been very good. So we have a dedicated section in the meetings, so it is not treated as an after taught at the meetings. So we would hold specific LEED and BREEAM meetings.

Davis: would you use special software to exchange the information such as drop box or management software system?

Michael: there is a big exchange between services consultant and the architect. So it would impact them more as regarding communication. But from our point as I said there is specific minutes of the meetings to do with BREEAM where we get the specific information, the design team gives the design details. So we tend to deal with things in the traditional end where by the Engineer the architect and consultant do their jobs and then they give us the design implementations and then we cost it.

Michael: LEED tends to be more popular as regarding all the headlines and how global it has got. Especially American multinationals tend to know what LEED is and not BREEAM. And also LEED has a very good system.

Davis: Have there been training sessions implemented to staff on educating them about BREEAM or LEED on the specific credits that they have to obtain?
Michael: Yes there has. So we have had a couple of training sessions and we are more aware of it now. So when a project is coming up and they are saying that they are going for LEED we have the learnings from other projects. So first thing is to set up the cost tracker and you need to be involved in the meetings and you need to know what is going on not just a few tweaks here and there. Depending on the building, the façade could be affected, services could be affected. So we do have in-house talks and in-house team get together and always LEED and BREEAM is the cost holder on the budget and the contract documents that go out. So then we develop our database of the specific credits such as if there is bike racks or solar panels or if there is rainwater harvesting and then we look at how much that is going to cost on that project and therefore we may have to change the light fittings to sustainable LED. So now the training is an ongoing process so for every job that you go to you learn more about the systems. So the big element is the preliminaries. So when contractor is going to price the job he needs to be fully aware of what his requirements are so we have to document that out and give it to the contractor and say ‘you need an assigned person, you need to control all these documents, you need to have a clean site policy’ and all those things cost money so they need to be in the contract document that comes back.

Davis: is there any suggestions on how the management can be improved on BREEAM or LEED projects?

Michael: So it’s a good goal to reach. But so far we have not had a bad experience with it to begin with so everyone has set up the meetings gone through the design so we haven’t really. Sometimes the interpretations can be a not clear on certain points. So on one project regarding the Environmental Declaration of Product EDP of materials it is a very complicated process whether you can or can’t be achieved. So we are trying to negotiate a contract sum with the contractor so we are saying that we want this point for the EDP and he is saying what are the design implications? So we answer you have to use chip board or ironmongery from specific suppliers because they have been accredited EDP rating and it therefor can be difficult process because there can be certain interpretations on certain products so it is difficult to distinguish if some products can be used or not.
Appendix 4 – Participant D – Mechanical & Electrical Engineer, LEED AP

Patrick Field - O'Connor Sutton Cronin – 19th March 2016

Davis: What is your profession?

Patrick: I’m a director in OCSC mechanical and electrical sustainability’s. There are two different companies. There is OCSC associates which is the civil structure and then there is OCSC M&E and sustainability. And I’m a director of that company but specifically sustainability in that company. I graduated in 2008 from D.I.T. I did building services engineering and I went traveling for about six weeks then I came back and the managing director of M&E set up the company in here and I started in that same day and from that I have gone from senior to associate and then to the director of the company. That is all to the fact that I took lead on sustainability so I set up the section within the company and it has just grown to 7 peoples staff under the sustainability alone.

Davis: I just recently browsed your webpage and noticed that you are specifically going in the direction of LEED. Are you currently doing the refurbishment project on Bank of Ireland? It’s BREEAM.

Patrick: Yes we are currently working on the project and so far it has achieved BREEAM outstanding at the design stage rating. And then we have 14 LEED projects currently ongoing and 10 BREEAM projects in London and then one in Dublin which is the Central Bank of Ireland.

Davis: Are you involved in the LEED project in Dublin Airport?

Patrick: Yes we are the LEED Accredited professionals. It’s the HOB building.

Davis: I have to interview Rob Fox on that building.

Patrick: I’m the LEED AP on the shell and core works.

Davis: Have you worked on ‘green’ project before? If so was there any sustainable requirements that presented difficulty in achieving the project?

Patrick: The first green project that I worked on in Ireland was BD medical. BD medical produce pen needles for diabetes. They are based in Pottery road. They are a global company and Pottery road is their Dublin branch. BD have a corporate policy that was broth in 2009 that
stated that all new buildings will be LEED certified. On that building we were broth vey late in the process. Design team had already gone to tender. The tenders came back so the contractors were picked and only then we were broth in to the project as the LEED AP. They had someone on board before who gave them a bit of information in relation to the background on LEED but it wasn’t helping them to get towards certifications. When we went on board we reviewed all the information that had come back and they already had started construction on site and we proved that they can only barely get past the point ‘LEED certified’. From a corporate perspective yes they started late but surely they can still achieve silver so the key challenge to that was to get everybody up to speed on LEED within the design team in the matter of six weeks. They had to give us their information and only then we could sit with the contractors to make sure they knew what they were doing for LEED. The one key challenge was to get from certified to silver. On this project we were not the M&E on it but LEED AP’s. What we did was: the boiler system there that was giving hot water to the facility we recommended that they take that out and there was a compressor that was providing compressed air for the whole facility and there was waste heat coming from that so we were able to convert that into hot water and use that in the building instead of the boiler. So that system picked up 12 points in the energy and pushed us from the certified to silver. We got LEED silver on the building which was a massive accomplishment. The key challenges there was the LEED AP was broth in too late, nobody knew how to design to LEED, the current design didn’t match so they had to make changes to the current M&E design to get the points.

Davis: what is the maximum points that you can get in the energy section 19?

Patrick: 21 points in total depending if it is core and shell or if it’s new construction so it changes slightly so it varies between 19 and 21.

Davis: Was that new construction?

Patrick: that was new construction and they were going to be end user. Other buildings we are doing in Dublin like DAA with shell and core the HOB building, because, well, at the time they didn’t know who the tenant was. Now, if you were to draw it out, you have the DAA facility, hum… it’s kind of slit like that [sounds of drawings]. This is the main tendered areas. So this all facility will get LEAD. Hum, Core and Shell… now, they actually have a tenant to move in, and for this element it works, we are the LEAD AP. But when the tenant comes in, ESB are going to be the tenant moving in, and we are going to be the M&E consultants and LEAD AP for the commercial interior fit out. So there is a kind of cross reference cos there’s
not that many LEAD AP in Dublin and Ireland so you kind of design, you kind of, a couple of people can go to it so there’s a little bit of a link there, you know.

**Davis:** Oh wow, ok! Yeah, I did a project on the Dublin airport project and it was very hard to find information on it… but… yeah so it’s like refurbishment then

**Patrick:** correct

**Davis:** yeah so have you already done the models?

Patrick: yeah we have yes, so with the model part of it, there was an original consultant brought on so we were not doing the model and it was a crowd from STS. Now they always predicted they’d get five points, which is extremely poor when you see the type of building that they were building. So it basically came to the point where they were six months late with the report. We were asked to step in and do the LEED model. And we proved that they were able to actually get 13 points. But it was because you’re … with the energy model, I don’t know if you’re aware but there’s a baseline you can compare it to. And that’s when it shows the points increase but when you get an existing building, you compare to the existing building façade. So it was single glazed, no insolation in the walls, so we score really well on the basis that we were improving from that. Cos it was a refurbishment project.

**Davis:** Oh wow, that’s a nice one! Hum, was there anything else that had been difficult?

Patrick: anything else that had been difficult? Hum… I think the production of tender documents. So what we’ve tried to do here is simplify. To give one manual that’s to be followed, ok. And it covers everything that’s needed, from LEAD perspective on all the credits. So what that allowed us to do is, it simplifies it for everybody on the design team. So they don’t have to put it on all their tenders’ documents, “to comply with LEAD, you need to comply with these standards…” they just say, “refer to OCSCs LEAD document for complying. So, before we did that, it got fairly tedious in reviewing the information, cross-checking, all that kind of stuff. So we’ve simplified it by doing that, but that was a definite challenge.

**Davis:** all right, yeah, I’ve researched that one as well. So now, the next question: What are the greatest differences between projects without certification and project with LEAD / BREEM requirements?

Of course that’s a very broad question there but is there anything that you really have to go out of your traditional way of … even at tender stage, or at building stage, or…
Patrick: yeah, yeah… ok, I suppose if you were to look at… I’ll give you an example of a building. So, we were the LEAD APs on exchange building, in Dublin. So with that building… it didn’t start out as LEAD, but the client did want a B, or an A3 on the building. So a building energy rating. Which is regulation so, on the regulation you only have to get a C1 to comply but they wanted to push the border cos he was very energy efficient, and he said “can we get an A3?” so we proved that you can get an A3. So, they were doing all the energy stuff that links up with LEAD but they weren’t going for LEAD assessment. So then, everybody in the market place was going for LEAD assessment so I said “right, we will as well”. So the differences that I saw… so we were going to go straight ahead for a B or.. And build it, and don’t worry about LEAD. But what changed then when we brought it in was that people had to then worry about the tendering information that covers LEAD, that they had the right type of lighting system in, that they didn’t just comply with the BER, met the LEAD criteria as well… so they were minor changes to the MNE systems. The facades, there was no changes. The concrete and steel there was no change or specifications. Because everything they were doing anyway complied with the LEAD criteria. We just had to document it. So the biggest thing that I saw was that all they had to do was to document it in the LEAD format. And you were fine. We got gold, no problem, and ok. But that would be the biggest difference. I see what people are building in Dublin, if you didn’t do a LEAD assessment of a BREEM.. The building that you would build will still achieve… could still achieve a LEAD gold or a BREEM very good.

Davis: by just complying with the technical guidance documents

Patrick: exactly. So they’ll do that anyway but it’s just the fact “right, well I want a badge on the wall, this is what we have to do” which is just paperwork really. And if you want to go for the platinum, or outstanding they are changes, definitely they are changes. But if you were to go with like a good or a very good on a BREEM they wouldn’t change anything. They’d no difference, it’s just a bit more paperwork, that’s all.

Davis: all right, so… what are the most difficult and time consuming aspects of implementing LEAD / BREEM on projects?

Patrick: I think, that BD medical, that first project that we had, was getting, at the time, in 2009, was getting the design team of the speed. So everybody… nobody cared, at the time. Everybody was like “oh, another standard, I have to comply with it, you know, can you not do it?” but we had to give everybody the information, make sure they understood what they were doing, and
then produce the right information for us. So there was enough going back and forward, and back and forward… I know, you need to do this, you need to do that… so that took us so much time. And there was a confusion over that. But what we found is that architects, contractors, even clients are all up to speed with LEAD. So, that time consuming thing has reduced. So that isn’t there anymore. So the only thing that’s time consuming now that we see is when you have a main contractor who doesn’t know what they’re doing on site. You have to sit and hold their hand. So when they get technical submittals in for USGBC, or something like that, everything is sent to you instead of him now. “Oh that complies, oh that’s fine now”. That’s the time consuming thing now. Back in 2009, it was getting all the documentation together and all. But that’s not the case anymore. It’s more so the construction stuff so yeah.

Davis: all right yeah! And so, what kind of things would you do to reduce the time maybe? Like, is there a special system, like you said, you’ll have your own documentation that you refer to…

Patrick: Yeah correct. So what we do is, we’ve got a design team manual. We now have a construction team manual. So the design team manual summarizes, instead of going through the all manual, what they need to do. And if you take a credit like cycle spaces, we give them examples from other projects. As to, “this is the calculation you need to do”, “that’s the drawing that matches it”, “you can see what you need to do on the drawing”. “Do that on your drawings and you’ll be fine” so it’s almost like a step by step on the design team. And on the construction site it’s exactly the same. So, “look you need to prevent local sources from sedimentation getting in, this is what to, do there’s an example on another project, and that’s how you record it on a weekly basis”. So everything is now systemized and the minute we get appointed we give that out to everybody. Ok, so it wouldn’t change much. You would have small variations, on different projects but it’s very little.

Davis: All right! Well I didn’t know people were so up to speed like.

Patrick: yeah no but it is like you know, like we started back in 2009 and what are we on now… 14 projects so… for us to make money out of it, we need to have these things in place. You now, so as efficient as we can be, you know.

Davis: all right yeah, and the 5th one is: how do you think that communication and information could be improved in LEAD/ BREEM projects? And that in in kind of reference to document management software, and if you have used any on previous projects?
Patrick: Yeah so, I suppose, the typical way the projects go with LEAD or without LEAD is everybody tends to go to an A site type of thing. I don’t know if you’ve seen that

Davis: I haven’t no

Patrick: so it’s almost like a fancy drop box. So what it is that there’s a platform, everybody uploads their information and then they assign different people to sign them off. Ok so during a construction program, the main contractor puts it in place, they get all their technical submittals or the design team their stuff in, and everybody works off the one platform. What happens is that with the LEAD you add in another layer the people have to check. So we tend to stay away from that platform as much as we can because everything gets very procedural and it doesn’t need to be. So what we do is, we give a presentation of design stage. So say, “These are the key credits, and here are the examples, ok. Send them to us, we’ll review it and then you’ll upload it so it’s correct.” There’s not forward and back, forward and back. Then we’ll do the same with the construction team. And then when we go to submit the USGBC everything is ready to go. So we take away from that A site website so. As far as document control. The quickest way we’ve learned, we’ve tried to do it the A site way, it doesn’t work. Too complicated. We do it our way. We have our procedure. Everybody sends it to us, and then everybody uploads to LEAD online. That’s the quickest way of doing it. It’s the most… we deal with the directly instead of everything going through the contract manager, which is messy.

Davis: so you have your own quality control system

Patrick: right, yes, so we have, obviously BREEM or LEAD check everything. We have our own Q/A system internally. And we run everything through

Davis: nice! yeah so, had there been any training sessions implemented for staff or subcontractors, about educating them on LEAD / BREEM and specific credits that they have to obtain

Patrick: yeah. So, when we get appointed on a job, we’ll do a pre-assessment strait away on the building. And we’ll come in a give a presentation. Very high level of… “we think, based on the current design you can get gold. “ he client will always ask : so what will I have to do to gain platinum ?” so we do a very simple outline, a bit more on the credits and on the outline , without flustering everybody around the table. We do the same thing for the construction team. Presented in a “user friendly English” so everybody understands it, instead of some
American terminology they use, and we present it again. And if then people are still struggling
with the stuff, we go and meet them individually and present just their part. And that’s a number
of 6 or 7 presentations, for different scenarios.

Davis: so you’re actually the kind of lecturer for the staff and for the subcontractors?

Patrick: correct, so you’ll still get the people request, I’d like to get a qualification myself so…
there’s the Irish Green Building council, with training sessions in that… so certain people will
go and trained up themselves, you know. And that’s fine, you know. But we just say, “Look if
you just want to get through the project, we do enough of the guidance on it, and we’ll explain
it, to what you need to do”. And then we do it ourselves.

Davis: ok. And do you ever get in here any training sessions? For your staff, you said you have
6 people or…

Patrick: yeah so, what we’ll do is that at Christmas time, two of our engineers got qualified as
LEAD APs. The way I’ve always found it is that, they did a course in the Irish Green Building
Council, just a couple of hours.. It’s not beneficial. It’s not, as far as we’ve seen it. Like when
I’ve done my training there was no training. I bought the manual, I read it cover to cover, and
understood it and went to do the exam. And that’s what they’ve done. And what I found is that
you just.. You pick it up a bit better, instead of listening to somebody. Because what they’re
trying to do, is get you to pass the exam, not to be a good LEAD assessor. Ok. And there’re
two different things, people will pass the exam but not understand how to do a good LEAD
assessment. And I need engineers who are ready to go and manage a project, not to just pass
an exam.

Davis: this is just a question for myself, I was looking at also may be doing the… not LEAD
AP but general associate, yeah. Is that easy to do or…

Patrick: very easy yeah. I would definitely recommend it. If you’re potentially going out and
looking for a job, come at the end of the year, to have it on your CV that you’ve done it, and
you’re going out to a main contractor, that, I think it’s fantastic because all of a sudden you’re
the ideal candidate for being the LEAD champion for them, on jobs. And you take all the info
and you give it to the LEAD AP.

Davis: Oh and did you have to do yourself the general associate before you become an AP?
Patrick: yeah, the green associate. Yeah so, for my exam I had to do both. Two exams. You have to pass both to become an AP. If you failed the green associate you couldn’t pass the AP exam. So you have to pass two. You know, that 5 hour exam.

Davis: so it’s a bachelor and a master type of thing

Patrick: yeah, kind of, that’s exactly what it’s like. It is quite easy, it’s just the principles of green designs, but then the AP is just specific to the LEAD manual. So you can pass the green associate. You could probably go on and pass it now, if you had a good understanding of general sustainability. Generally. But the AP, you need to read the manual.

Davis: of course yeah. Ok. In what way is your role, work situation affected by BREEM and LEAD? So what you would have done before and now that you have gone on LEAD projects, like obviously you took on the training, is there anything additional, I would say, in your role?

Patrick: that we do, I suppose from reading and writing it’s kind of, you know, what way we approach our role, based on we’ve done or what’s happening in LEAD and BREEM. Like, it’s great for us, honestly that we do it, cos at the end when we go to present for a new job to a client, they’ll say “right, when you design a mechanical system and an electrical, what do you do differently?” that’s the question you’re always asked. So what we say is “look, we are LEAD assessors, we are energy modellers, so what we’ll do is the system that goes in is already at a good level of sustainability. It’s already adopted to principles. We’ll not come back and retrofit in it”. Clients love to hear that. A lot of LEAD APs are architects but they don’t understand MNE. So what we do as well is the extents of energy modelling in houses, we do the MNE systems, the lighting, the façade we give advice on, and how to maximise daylight, and take out solar gain. So we do this all encompassing study and that will improve sustainability, lead to a great LEAD score, and not cost the client any money. So that’s what they love to hear. It’s the fact that you offer all these services, and because we have LEAD and BREEM in house, we already have a compliant MNE design. And we can give advice to the architect for the façade. We’re giving them a lot more stuff for just the basic MNE provision that they’re looking for. You know, so…

Davis: all right! I’m finding out more now than I am in textbooks like. So yeah, is there any suggestions on how management can be improved on LEAD / BREEM projects?

Patrick: suggestions, hum… from our point of view it is.. Like it’s constant monitoring. It is. Constant monitoring. The one thing we’ve seen, like the first project we did was BD. SISK,
who are the biggest construction teams, because they have great procedures in place, they find it very easy to bring in the LEAD stuff. But how it is now, with even the smaller guys like Hegarties they knew they had to adjust to LEED or BREEM. So we went to meet them for the first time and we were expecting right “we’ll give them the full presentation and come back in two weeks” they had all the LEAD documents ready for us to review, straight away. And they were in fantastic shape, with everything that we needed, they had everything that we needed and it was already ready to go, so there was a contactor there that knew how to manage the process, they had LEAD AP in place on their site that was going to give us all the information. It was absolutely ideal. So really it’s just awareness that everybody’s aware for what’s actually needed to be done. But because LEAD is so common now, everybody is just adapting to it. And the contactors can go and sell themselves and say “look that are our costs for the project but you know what, here’s the benefit: we do LEAD on the daily basis, there won’t be any problem due to construction and we guaranty that we’ll get the gold or the platinum. So everybody is moving on to it, it just took a bit of time but every main contractors, the likes of walls, or SIKS, or Hegarties, or Bam…, they know exactly what they’re doing, you know. They have the guys in place so… Is there anything on the design side that can be improved? Not so much on the management side. I think once you’ve got a good LEAD AP, he will be the manager. So it’s a guy who knows, who hasn’t just passed the exam, it’s a guy who knows how… and that’s a key thing, the two engineers I have, they’re maybe two years working, so they’ve passed the LEAD exam, they’re getting up to speed with MNE systems, but they don’t know how a project runs, how do contracts work, how the tenders documents go, what comes back, what’s a technical submittal. So until they understand that, they’re not going to be able to manage properly a project correctly. So that’s the big thing, is that, you know, they need to understand how a project runs before they can be a good manager of the LEAD process.

Davis: ok so you definitely need experience before you take on a LEAD and stuff

Patrick: Oh yeah, exactly. So yeah, I hope that answers everything

Davis: oh yeah, thank you
Appendix 5 – Participant E – Sustainability Manager, BREEAM/LEED AP

Ronan Hellissey – Mott MacDonald – 10th February 2016

Davis: What is your profession?

Ronan: I’m an environmental consultant and scientist and I have expertise in rainwater quality and I do a lot of environmental assessment work. I’m also the sustainability champion for Mott MacDonald in Ireland and Europe

Jessika: I’m a sustainability consultant based in Cambridge in the UK and I work for Mott MacDonald clean energy and did a couple of years in waste management and I have worked for Mott MacDonald for three years

Davis: Have you worked on green projects before and if so was there any requirements that presented difficulty in achieving the points? Specifically to BREEAM and LEED.

Jessika: So the major part of my work is being a LEED AP and also a BREEAM AP so a large part of my role is to do the assessments is the LEED and BREEAM projects. In terms of issues I would say that it is projects specific depending on what the client wants from the project and where the project is located as it influences certain things. So the key difficulties would be where the sustainability is an after taught for a project as opposed to when it is integrated in the project requirements from the outset of the project. Also a difficulty comes when the design of the project has progressed significantly and the client tries to implement LEED or BREEAM and that’s where it can be difficult or costly for a project to even achieve points.

Davis: In what way is your role/ work situation is affected by LEED or BREEAM?

Jessika: Well that’s one of my key parts of my job is to assess LEED or BREEAM and that’s where I spend 80 – 90% of my time when working on the projects where I’m appointed as the party consultants by project parties or by project teams to undertake the role of LEED or BREEAM assessments. So my role is to review documentation and monitor the points online which goes of to final approval to the USGBC or the BER and provide advice.

Davis: Is there more supervision required at the construction stage on BREEAM or LEED?

Jessika: Yes I would say so. I would recommend especially on LEED projects to have a sustainability champion or LEED champion as part of the contractor team and a dedicated person on site so that the contractor does not have to spend 100% of their time doing LEED or
BREEAM but just to assist with the documentation and tracking of the points and progress of the construction. If it is left to someone like site manager it can often get forgotten as there is quite a lot documentation and tracking of materials used and waste management there is quite a lot of tracking involved in the process.

Ronan: So Jessika on a lot of the projects there is obviously nobody that is assigned.

Jessika: often we tend to make it as a contract requirement for both LEED and BREEAM that goes into the tender documents for contractors so that they can practice it before the jobs. But more often they tend to put someone forward that will we the owner of LEED and BREEAM from the contractor’s side. They will look after all the construction related credits and that they are documented. But they would not spend 100% of their time spending on just BREEAM or LEED.

Davis: so your role would be just to deal with the documentation and order site managers and project managers to hand in all the documentation so you can put it in a system?

Jessika: yes that’s right. They both go to the USGBC or BER to go through the quality assurance. With LEED they have an online platform. For my role we help the project team and the contractor. We tend to upload the documentation on to the Mott Macdonald online platform and review it before it goes out to USGBC for their review.

Davis: What was the most difficult and time consuming aspect of implementing BREEAM/LEED on a project?

Jessika: When you start of on a project and people are not aware of the assessment methods so we have to take on the role on educating the team and explaining the requirements to them and try to make it as clear as possible and as easy as possible for the team. Also to produce the documentation. I think LEED and BREEAM try to accept the documentation which the project team will be producing anyway for the project as opposed to requesting LEED or BREEAM specific documentation just for the credits. Also LEED uses the Ashrey standards which is the US standards so it is a difficulty to undertake the Ashrey models. In Ireland it is not common.

Davis: how do you think that information exchange could be improved on LEED or BREEAM projects? And would you use a document management software for managing all the documents?
Jessika: We tend to produce trackers such as x-cell documents. We have in-house document systems for LEED and BREEAM. On a previous BREEAM project we have used ‘Tracker Plus which is an online management tool and ‘IS Tap’ which is quite useful on project teams and often request that they are used because it is an online management tool so everyone has access to it and reports would be generated. But generally we tend to use the tools that are generated by ourselves. LEED has an online platform which the whole team has the access to so they are able to review progress.

On the documentation exchange we tend to recommend that somebody needs to own the process tough out the project. Weather that is the project manager who would ensure that sustainability is always on the agenda throughout the design team meetings and throughout the construction stage as well.

Davis: Has there been training sessions implemented for the staff on educating them about BREEAM and LEED and the specific credits that they have to obtain? Is there credits that you would really try to achieve on projects when advising the clients?

Jessika: There is no mandatory training that we would give to the project team but we tend to hold workshops as part of our scope of works. So a pre-assessment workshop where we would gather the whole team and talk about the specific requirements that are to obtain the credits so in that there will be an education within that respect as we would be teaching about the different standards. We would usually pass down the experience that we have had from previous projects. In terms of the credits we tend to go for so the location of the project would determine the specification strategy. So in BREEAM and LEED there is quite a high number of credits available for public transport access or being located to local amenities so if we are able to gain credits there it would not be costly. So we tend to focus on the easy wins and then we develop a specification strategy from there.

Davis: Is there any suggestions on how management could be improved on LEED and BREEAM projects?

Jessika: As I said before someone needs to own the process. We have had situations where people want to do LEED or BREEAM at the start of the projects and it always need to be on the agenda on the meetings. So if the people don’t talk about in for a long time people tend to forget about it and it is important to acknowledge that there is a common goal of reaching BREEAM or LEED and try to drag the process that way.
Ronan: I would think that the earlier in the project it is introduced the more beneficial it would be.

Jessika: Yes definitely. So we have had projects where the first thing a client mentions is BREEAM so it is involved in an early stage so therefore it is much easier to achieve the goal. On the other hand we have had projects where the design is almost finished and only then we get asked to come in and go for LEED or BREEAM. That’s where it gets very difficult or even impossible to achieve the standard. There are credits that have to be achieved in the design stage so if it is not from the beginning on it may make it difficult to and costly to change.

Ronan: So what projects have you been working on recently?

Jessika: There was one on Bagot Street and capital dock. So we work for confidential clients
Appendix 6 – Participant F – Sustainability consultant, BREEAM AP

Amanda Gallagher - Easlár – 22nd February 2016

Davis: Have you worked on ‘green’ project before? If so was there any sustainable requirements that presented difficulty in achieving the project?

Amanda: BREEAM can be difficult to achieve as some of the credit criteria is very prescriptive and some of the credits need to be achieved early on in the project. For example stakeholder participation credits need to be implemented at brief/concept design stage. If the client/design team decide to implement BREEAM at later stages in the project they may have already missed out on achieving some credits. Difficult credits to achieve are Life Cycle Costing credits, Responsible Sourcing of Materials credit, Refrigerants credits and recycled aggregate credits. In addition, rural areas will struggle with transport credits and site selection credits.

Davis: What are the greatest differences between traditional project without certification and project with LEED/BREEAM requirements?

Amanda: It depends on the design team’s knowledge of sustainability. If the design team and client are well informed they may not need to use BREEAM or LEED. If they aren’t well informed and want to cut costs to the detriment of sustainability BREEAM/LEED can prevent this as it ensures sustainability is present in the project throughout. Also clients will use the BREEAM/LEED badge to attract tenants and inward investment or add value to their property portfolios.

Davis: What was the most difficult and time consuming aspect of implementing LEED/BREEAM on projects?

Amanda: Gathering the evidence from the design team/client/contractor. The evidence has to be exact or it won’t pass QA processes from BREEAM or USGBC. This can be time consuming and involves a lot of back and forth between assessor and design team, particularly if the team hasn’t done LEED or BREEAM before.

Davis: How do you think that communication and information exchange could be improved in a LEED/BREEAM project?

Amanda: Using file share systems can be helpful. If BREEAM was more of a web enabled system where the evidence for each credit could be uploaded into a dedicated space that links
to each credit requirement. I think LEED already has this. The team could upload their evidence individually to the correct place. Example of acceptable evidence could be provided to help teams get their evidence right.

Davis: Has there been training sessions implemented for subcontractors/staff on educating them about LEED/BREEAM and specific credits that they have to obtain?

Amanda: Yes, we have regular meetings during the process and BRE run specific courses for clients/design teams and contractors.

Davis: In what way is your role/work situation affected by LEED/BREEAM?

Amanda: I am a BREEAM AP and BREEAM Assessor and am currently delivering numerous projects in the UK and Ireland. It makes up about 50% of my workload.
Appendices

Appendix 7 – Participant G - Architect

Pat O'Sullivan – Grangegorman Development Agency – 22nd February 2016

Davis: The first one, what is your profession?

Pat: I am an Architect.

Davis: What were the pros and cons of implementing BREEAM on this project?

Pat: I suppose the pros is publicity. The cons were time. Weather they use green materials that’s another thing we went from an energy point of view but still used blocks.

Davis: In what way is your role/work situation affected by LEED/BREEAM?

Pat: Not really. It’s just managing and producing information as to back up and just give it to them and to see how to achieve the credits to try to help it’s as if you are trying to give a report and evidence to try and report it that helps rather than giving rough a pile of documents.

Pat: It does take up more time. Like you could do a project without certification. It’s a case of if you can manage getting a ‘very good’ without doing any work to do a little bit of extra for excellent is better again

Davis: What are the greatest differences between traditional projects without certification and project with LEED/BREEAM requirements?

Pat: with BREEAM you are looking at what would involve in actually getting in accreditation there is a lot more time involved and it’s a lot more structured and I would say that it’s a lot better document let’s say traditional. You get a lot more detail in achieving the credits. With a standard one you just fill in the numbers you know the volume the house you have and the window you have this is probably a lot more structured and measured and a better qualification and in terms of commitment to it the other one is just a case of sitting down and filling numbers and that is. You just get a kilowatt per hour and per year and if it’s in a certain range it’s an A 1, 2, 3 whereas with this is kind of you are striving the whole time to find the information to prove that you got and there is a lot more reading involved there is a lot of research and as such you are rewarded with better accreditation.

Davis: What are the most difficult and time consuming aspects of implementing LEED bream on the project?
Pat: Documents it’s one thing to say yea I got to do that and another thing to going about and doing it and approving it.

Davis: do you have to do an additional training then for yourself to understand the documents?

Pat: No Amanda was the person she facilitated the whole thing and compiled everything and put it together and she was involved in the original design team. Amanda do any time information went out to both of them in drop box in terms of what was being issued. Gives you a much better idea of what’s out there and involved. I’m guessing accreditation as I said earlier the BER one is numerical things where as this is a lot more information and gives you a lot more better chance of what you are trying to achieve in terms of EMBODIED ENERGY usage and you know makes you think about what you are doing and where you are situating the building.

Davis: How do you think that communication and information exchange could be improved is a LEED/BREEAM project?

Pat: Document control and information exchange I mean you are talking about common data environment where you drop everything into it like a drop box. There is a lot of problems with E-mails that don’t concern me but has my address on it. We use SharePoint here as well but we only started initiating it as its only last couple of months but its set up and running. We have an FTP site which is an external sever where we allow access to information to. But yea I think information and communication is critically important to any of these documents. The problem is if there was a better system. The responses for me would have been dealt with a lot quicker than just to drop in to drop box as it’s a nightmare using it

Davis: has there been training sessions implemented for staff about the BREEAM accreditation?

Pat: we haven’t had any. We did have a sustainability engineering firm come in that gave presentation. I spoke to him about it but he never really sat down to address the information that was required but we rely on other such as consultants. Amanda was a consultant that we used to prepare that. outside of that when it comes to subcontractors it’s up to them to have the information and the training and its straight forward it’s not very tactical in the information that is required.

Pat: it won’t be bam but it will be whoever successful contractor. This project that I’m looking at is design finance and operate. Basically when we get into project agreements say you give
us the building there is the parameters to design it you have to that it and finish it off in designing it do it. We want you to give us back something that is excellent be on the exemplar type of design and to see that it is able to achieve it and all these credits you take it and do better on some stuff if you can’t get it on others.

Pat: of course BIM is going to be 20% of savings straight up and so. Mainly go to do with us is occupations evaluations where you can actually can enter design errors certificate where its after 12 months assess how building has performed and you know we will see where we are improving. Everybody you know they want to say that you will improve the energy efficiency of the building by using BIM so. There is reports out there, research out there that. But if you look at any of the ‘seta’ documentation. They document themselves. There is sort of papers where they identified that they halved saved it I don’t know if you can get your hands on seta. I know Louis is a member of seta. The seta report for it would have been a 2015 that’s actually quite a good one. They are quite big big documents but they sort of talk about BIM on achieving energy and BIM aligned with BREEAM like energy in BIM go together with BREEAM.

Davis: Have you ever worked on a green project before if so was there any BREEAM requirements that presented difficulties in achieving the project?

Pat: Now in the briefing documents the DIT when they gave it to us it actually specified you know either LEED or BREEAM so that’s what we went with and then whether design team came on board we actually went about trying to procure the BREEAM so we got in touch with Amanda Gallaher who is based at Donegal who is involved in the project

Davis: Who is the BREEAM assessor?

Pat: and she has been actively involved in producing the documents so we got a quote and we got to them and then we got 3 quotes there was an original quote there was the quote for design and during the construction and then after project assessment yea BREEAM in use and to see how it goes after 12 months currently at fault and we are verging on very good we at the outset we were looking for excellent but we came apparent that we did the introduction meetings and we understood that we are not going to understand a BREEAM excellent accreditation so we went for very good.

Davis: and what did you find that was stopping you from achieving the excellent

Pat: Time. And that what happened was we sat down there with them and they had never done a BREEAM project so this is all new to them and to me as well so it was a case of you know
finding out what was happening in the bream and what you needed to do but nobody told me as a client that I was going to have to produce a lot of information because it was originally that de

Davis: So the documentation involved is a lot, do you see it passed through your table a lot with everything you design or do with BREEAM, do you just come back to the points to see if you can achieve it?

Pat: That was more of the design teams side of it, like the guys Philip Grey and the others were actually preparing the documents. It would be there responsibility to do that, once we identified that we were going to get a credit, they would then have to adhere to that. I think the document you are talking about is a huge big book.

Davis: Do you feel at the start it could have been better explained to you what was involved?

Pat: As a client you normally pay for a services and expect somebody else to do it. You don’t expect that you then have to start producing information but that is probably particular to this project. I would have been expecting if you were doing a BREEAM project you would ask the questions then take that information to the client and you’d draft it up. In this case I have been walking around the site trying to count the number of bus stops. But that’s all in the document, if you are going to embrace BREEAM you have to take this on board. The other thing is whether it was in the original letter of appointment to architect and the design team we want you to deliver a BREEAM project they get paid for it and then turn around and say that’s not in our scope of services it’s going to be an extra, so you end up doing it yourself. Often we have access to information as well confirmation meetings we have had with the neighbours so we were able to furnish them with that information.

Davis: Would earlier contractor involvement in the design have been more beneficial in the achievement of BREEAM credits and is more supervision required at the construction stage?

Pat: I would say yes, BAM are at that stage now where we are looking for excellent, we have taken a decision that we would get a very good. Whereas if the contractor had been involved at the outset it would have pushed us a little bit more. They pushed and pushed, like there was meetings upon meetings where they pushed and pushed for information.

Davis: Do you find it was easier to implement BREEAM on the design and build opposed to traditional where there would have been many variations.
Pat: Yes because they are building it, if you talk about concrete delivers because they have their own green procurement/ specification, their own obligations when it comes to waste separation on site and that ties into what BREEAM is doing on site as well.

Davis: What was the most problematic and time consuming aspect of Implementing BREEAM on this project?

Pat: I would say documentation, because we are the project coordinators we don’t have a list of people below us to help, there was a lot of search for documents. If there was more people this would have made it easier. It was a slow torturous process, it’s not like whereas if you were doing it start after you would remember it and you would keep note of it, we just forgot about it. I suppose because the BREEAM at that stage wasn’t something you were conscious of. It’s only afterwards that you become aware of this response.

Davis: Which, if any of the BREEAM assessment areas, was difficult to attain credits?

Pat: I’m going to say cycling one for the simple reason it was easy to get.

Davis: What they were easy credits but you didn’t manage to get them?

Pat: Yeah. The actual consultation with stakeholders/ neighbours that was a difficult one just to get the documentation.
Appendix 8 – Participant H – Sustainability coordinator LEED AP

Susan McGarry - Ecocem – 8th March 2016

Davis: You are the BREEAM/ LEED associate, yeah?

Susan: I’m the environmental manager in Ecocem and part of that job, I take care of the internal environmental side of things. That involves our management systems and certifications. But the external part of my job is on LEED/BREEAM on side. What I’m doing is, chasing certifications. So in order for our product to end up in the Aviva Stadium we’ve to contact architects, engineers, contractors and get them to use our product if they want to get the specification. What found is the product will be specified for technical reasons and the problem the engineers will use it for the durability and the strength and then the environmental thing, well it’s just a nice thing to have. But what LEED has done for us is that it had given us the commercial reason for specifying for the environment. So I’ve a direct reason to sell to all the environmental conscious architects or engineers cos I can tell it can contribute of 15 of the total of 110 point of LEED. It actually contributes of 15, and that’s only one product. It doesn’t cost many more, it doesn’t cost the customer any more, they just write in 50% GGBS and then when they do their LEED calculations there’s 15 that results directly. So that’s my job, it’s go out and tell everybody. We have our technical guide. So we’ve actively promoted this. And I’ve targeted it, as much as I can I’ve tried to get a list of all the LEED assessors in the country and I’ve tried target them all, go and meet them, and just get the word out there cos some people would know that GGBS, say it would add to recycle content that’s quite an obvious one. But there’s a lot of other points that GGBS, they certainly wouldn’t know that GGBS contributes to. So it’s kind of just going out and trying to educate everybody. So that’s my job.

Davis: Have you worked on green projects before? Is there any sustainable requirements that presented difficulties in achieving the project?

Susan: My help comes in to sell the concrete to the concrete producer. So a LEED consultant would come in and request information from the contractor on the materials. Then the contractor passes the documentation on to all the material suppliers. So the concrete producers are asked a lot of information on recycled content on where the cement came from and the continuance of the concrete. Over the past 18 months we have been asked for this over a lot of our jobs. This is why I upskilled to become a LEED green associate to be able to answer those
questions. I have helped on all the big LEED projects that have happened over the past 18 months. Such as the Kerry innovation Centre in Nass. I have worked with the environmental manager in the Diageo the new brew house. It is the same contractors and consultants that would come up on all the LEED and BREEAM jobs. I come in as the advisory most of the time.

Davis: Who specifies LEED?

Susan: It’s the Architect or the consulting engineer that would specify the product. Sometimes the Architect and the engineer can overlap with the LEED consultancy and there may not be third party LEED assessor. I have been involved in Canada house which is a big job in the city center and it has been demolished and rebuilt and it is going for LEED gold. For that project there was a separate LEED consultant. Their job was not to be on site but just to gather the LEED points. It is supposed to be an integrated process where everybody would meet on the site. That would be your Contractor, Architect, the engineer and everybody that is involved on the physical site and that is supposed to happen on certain milestones of the project. In my experience that does not happen. They just want to build a building and they are concerned of how it looks like. So the LEED consultant tries to gather all the information and gather all the points. So sometimes it does not work as it is supposed to.

Davis: In what way is your role/ work situation been affected by BREEAM /LEED?

Susan: Its that I actively promote LEED and BREEAM in order to promote my product more as they benefit my product by on their LEED and BREEM credits. So we would provide the documentation of where our product comes from, how we transport it, and that it is 100% pre-consumer recycled material. They are the four main points that get you credit in LEED.

Davis: Is there more information required at the construction stage for BREEAM and LEED specified projects?

Susan: I can’t comment on that as I have not had that experience. What I have from my experience is that LEED consultant wants to know what has happened in order to get his LEED credits. It can be hard for him to communicate with the contractor on site as the contractor is trying to build and may not have the time for all the information. That’s where communication can get difficult.

Davis: What was the most difficult and time consuming aspect of implementing BREEAM and LEED on a project?
Susan: It would be the information gathering. There is a lot of companies for whom LEED and BREEAM is new so they would ask ‘why do you need this information’ and ignore it and not realize how critical it is to get the information over to the contractor so he would pass it on to the LEED consultant as soon as possible. So I would say Information gathering and communication would be a major issue.

Davis: How do you think that information and communication could be improved on BREEAM and LEED projects?

Susan: I think that there needs to be training courses run more than what it is right now. Currently there is LEED assessors training and BREEAM assessors training and that is all. People don’t want to share their ideas. It can be seen since LEED updated from version 3 to version 4. Sometimes people want to gain just basic information and not go for the full accreditation. The only way is to call USGBC where you have to look at the time difference and they usually give you quite a generic answer. There should be a form where everyone could get together instead of keeping their information to themselves which does not work as everyone has to collaborate together. I have been involved in 20 projects over the past 18 months and only the same people have been working on the same projects. They are the people with the knowledge and if they could share their experiences it would be a bit easier.

Davis: Would you think of using document management software?

Susan: No as it is going in the BIM territory so I would not know about it but it would help with life cycle analysis and the documentation tracking. All you would use now is a drop box folder or a special drive. If somebody does not update it is going to be gone in 2 weeks. Contractors are too busy and they are not going to update things like that.

Davis: Has there been training sessions implemented for staff on educating them about LEED/ BREEAM and specific credits that they have to obtain?

Susan: We have continuous professional development presentations like the CPD presentations that you would do in engineers Ireland or the institute of architects. So I give a presentation on LEED and BREEAM and the environmental credits. So we have given that as an internal presentation to all of our staff and I also go into all the architectural and engineering firms and deliver presentations. In that regard that’s what we are doing. I know that the Irish Green Building Council they run the green associate training and they run the BREEAM assessor training.
Davis: Is there any suggestions on how management can be improved on LEED BREEAM projects?

Susan: I think we need to discuss it more openly. I think IGBC could gain more knowledge on it and nobody knows who to talk to. The list of who is a green associate is not up to date and half of those people don’t exist and I have met people who are green assessors and I have never met them before. I think if there was a society where they could run training courses and do general meetings and deal with FAQ during the month. I think there is a scope for something like that and more information exchange because there is a more efficient way of doing things. And it would help to open the market for other firms as only the same people tender for those projects.