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EDUCATION FOR SUSTAINABLE DEVELOPMENT –
THE IRISH CONSTRUCTION SECTOR AND THE NEED
FOR A SUSTAINABLE APPROACH



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April 2016

Thesis submitted for the award of M.Phil,
Dept. of Surveying and Construction Management, DIT.

Declaration

I hereby certify that the material which is submitted in this thesis towards award of the M.Phil is entirely my own work and has not been submitted for any academic assessment other than part-fulfilment of the award named above.

Signature of candidate: _____

Conor Mc Manus

A handwritten signature in black ink, appearing to be 'Conor Mc Manus', written over a horizontal line.

Date: _____

18/05/2016

Education for Sustainable Development – The Irish Construction Sector and the Need for a Sustainable Approach.

Abstract

This study explores the path to be taken towards achieving Sustainable Development. It examines the impact the construction industry has on the environment as a result of a knowledge and skills gap and considers how our present way of thinking facilitates this. It then goes on to show how a change in construction education can bring about change in the industry and facilitate the implementation of sustainable development.

The study examines how the singular emphasis on technology, the introduction of the ‘expert’ into the domestic building process and the narrow focus on operational energy conservation raises questions about Ireland's present path towards Sustainable Development. It will provide clear definitions for ‘sustainable building’. It will outline the significance of the 'local' and the ‘occupant’ in the sustainable building process. It will highlight conflicting sustainable philosophies and examines why the Irish construction industry has to go beyond Part L in order to align itself with Sustainable Development goals.

In order to ensure the success of the drive towards a sustainable economy in Ireland it is imperative that societal change occurs. This study concentrates on the recently depleted Irish construction sector and the potential for a new direction in the industry based on a sustainable ecological approach. The following hypothesis is presented; that in order to ensure Sustainable Development a paradigm shift which forms the fundamental attitudes that we hold concerning the environment must take place.

This paper will look at how higher level education may be the entry point where attitudes can be greatly influenced in parallel with the dissemination of knowledge and skills.

While outlining why the construction industry must take a lead role in the change towards a sustainable economy this paper looks at how and why the educational process itself must also change in order to embed sustainable development, its philosophy and ethos in the construction sector.

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List of Abbreviations and Acronyms

BEAM	Building Environmental Assessment Method
BER	Building Energy Rating
BREEAM	BRE Environmental Assessment Method
CAD	Computer-Aided Design
CPD	Continuing Professional Development
CSH	Code for Sustainable Homes
DEAP	Dwelling Energy Assessment Procedure
DGNB	Deutsche Gesellschaft für Nachhaltiges Bauen
DSP	Dominant Social Paradigm
EAM	Environmental Assessment Method
EE	Environmental Education
EPBD	Energy Performance in Buildings Directive
ESD	Education for Sustainable Development
DE	Development Education
DPC	Damp Proof Course
GGBS	Ground Granulated Blast Furnace Slag
IDP	Integrated Design Process
IGBC	Irish Green Building Council
ILO	International Labour Office
IOE	International Organization of Employers
ITUC	International Trade Union Confederation
LBC	Living Building Challenge
LEAN	Efficiency Assessment Method
LEED	Leadership in Energy and Environmental Design
NEP	New Environmental Paradigm
OSB	Oriented Strand Board
PROCEED	Programme of Research on Opportunities and Challenges in Engineering Education in Denmark
SD	Sustainable Development
UNEP	United Nations Environmental Programme
UNECE	United Nations Economic Commission for Europe
UNESCO	United Nations Educational, Scientific and Cultural Organization

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SECTION 1 – INTRODUCTION

Chapter 1: Introduction

1.1 Introduction

This chapter will outline the scope, aims and objectives of the research and the rationale behind it.

1.2 Background

There is universal understanding that the threat of climate change requires a coordinated holistic response and that the construction industry, as part of wider society has to play its part. Present methods of building contribute significantly to climate change, and resource depletion. Consequently, a long term holistic approach to construction is necessary if we are to deal with these issues. To this end, the construction sector must address an ever-broadening material knowledge and skills requirement to meet the demands of a new type of building, incorporating issues of social justice and wider concerns such as food, fuel and water security and sovereignty; future proofing against poverty; while considering the general wellbeing and future needs of building occupants and their community context.

1.3 Research Question and Aims

The Research Question addressed in this thesis is: how can educators, across the construction sector, modify their teaching practice to provide construction professionals with the appropriate skills to meet the challenges of global warming and diminishing resources? The associated research aims resulting from this are:

1. To determine practices aligned with Sustainable Development.
2. To identify and/or develop concise working definitions for associated terms and propose a concise outline framework or ‘transition tool’ for educators to utilise when developing new modules and programmes.

In order to address the research aims, the following objectives for the thesis were identified:

1. To ascertain the skill-based needs of the construction industry in regard to climate change and diminishing resources.
2. To ascertain if such skills are being developed in the education system.
3. To ascertain attitudes towards the environment in the education of construction students.
4. To audit exemplar projects to identify holistic solutions to climate change and/ skills deficits.
5. To consider bias towards technology driven solutions.
6. To review case studies in construction industry and education in Ireland.
7. To develop a concise working framework for module development in the industry using ESD in full principles.

1.4 Justification of Research

This research concerns one topic of global relevance; the transition to a sustainable society and the role of both education and the construction industry in this matter.

There is universal acknowledgement that an urgent response is now required to prepare communities for future difficulties that may arise from the crisis posed by man-made climate change and resource depletion. *The World Economic and Social Survey 2013: Sustainable Development Challenges* found that the vision of Sustainable Development, which it defines as: “promoting economic and social well-being while protecting the environment”, has not been achieved. It reiterates the premise that the key problem facing the planet is man-caused climate change which threatens to lead to irreversible changes in global eco-systems. The document outlines the areas which need to be tackled: land-use; food security; employment creation; transportation; infrastructure development; biodiversity conservation; water conservation; renewable energy sourcing; waste and recycling management and the provision of education, health care and housing. The report makes three key points (a) that sustainable development is crucial to the eradication of poverty (b) that we must promote an integrated approach to our development goals and ecosystems (c) that we must focus on systematically changing consumption and production patterns in all countries.

This thesis aims to contribute to two areas where gaps have been identified within the literature:

1. The skills deficit in the construction sector in Ireland.
2. Education

A publication on Skills and Employability by the International Labour Office (2011) states that the transition to a low carbon economy is one of the greater challenges facing governments, businesses, workers and organisations that represent them. Green Jobs Initiative, a partnership launched jointly with the United Nations environment programme (UNEP), the International Trade Union Confederation (ITUC) and the International Organization of Employers (IOE) in 2008, anticipates the skills needs for the low carbon economy. The ILO report states that a transition to a low carbon economy depends on radical energy reduction in building energy consumption. The main driver behind the Irish ‘green economy’, ‘green jobs’ and training initiatives is the need to deliver on the Energy Performance in Buildings Directive/ Recast (EPBD / R) by 2020, in an effort to cut greenhouse gas emissions. This is to be achieved through ‘green’ construction of new buildings and ‘green’ retrofitting of existing buildings. However, the ILO states that lack of available skills is seen as a barrier to this transition.

This thesis will address the key challenges by proposing a simple but clearly defined outcome in regard to skills development in the education sector and by developing a concise one page framework for Education of sustainable development which can be used to guide the implementation of ESD across the building sector. It is hoped that this framework will not only help shape future construction courses but allow for easy facilitation and adoption of same.

1.5 Methodology

Transitioning to a society built on sustainability requires that we change how we live. To this end, the literature suggests that we must change our approach to education in order to change how we think and act. The methodological approach used to conduct this research reflects the complexity of this challenge and like education must not only be the subject but also the agent of change. So too, does this thesis attempt to demonstrate this tension. For this reason a multi-method approach was chosen not only

to achieve a balance between theoretical and practical analysis but also as an approach that is in keeping with ESD methodology.

There is also a personal note adopted in this thesis, from time to time, where the researcher is referred to and sometimes speaks in the first person. Again, this is in keeping with ESD principles, which promote (1) the idea of a more personal approach to teaching (2) that the teacher can draw on personal experiences and skills to enhance the teaching experience and (3) that the teacher leads a life which also demonstrates sustainability in practice.

Techniques and Procedures

Data collation and analysis techniques used in achieving the research objectives will be outlined in the following points:

1. Preliminary informal interviews (objective 1)
2. Literature review (objectives 1, 2, 3, 4, 5)
3. Exemplar Projects (objective 1)
4. Audits (objectives 1, 2)
5. Research reviews, surveys, evaluation, observation and informal interviews (objectives 3, 4)
6. Development of framework (objective 6)
7. Validation (objective 6)

1.6 Thesis Outline

There are seven chapters in all, including the introduction and conclusion and recommendations:

- Chapter 2 outlines present knowledge and understanding on the topic based on a literature review.
- Chapter 3 details the methodological approach taken.
- Chapter 4 discusses current practice as analysed through exemplar projects.
- Chapter 5 presents all results of primary research.
- Chapter 6 presents findings and conclusions.

1.7 Delimitations of Scope

This thesis aims to address the question: how can educators across the construction sector modify their teaching practice to provide construction professionals with the appropriate skills to meet the challenges of climate change and diminishing resources? In considering this query, it was necessary to make certain choices about the scope and nature of the research.

1.7.1 Case Study Selection

While the literature review considers education in the broad third level context in Ireland with one of the audits supporting this, the focus of the research is limited to DIT in full and consequently to the discipline of construction education.

To this end the research considers DIT, or more specifically the School of Engineering and the Built Environment, as its ‘community’. This seemed a natural approach to research which considers ESD. ESD suggests that the educational institute must be embedded in the community and students must learn by solving problems of that community.

The DIT Construction Management department was focused on to establish the level of ESD practice as there was work in progress in this area in the engineering department and architects have been engaged in sustainable building for some time. It appeared from the literature, and considering the Qualibuild initiative which is concerned with the upskilling of crafts people, that while there was work going on in the design and craft areas, there was little happening in the management section. This was borne out by an audit of the Institute of Technologies in Ireland.

Another reason this department was chosen was because the researcher was affiliated to it and so had access for observation and informal discussion with lecturers and students.

1.7.2 Focusing Research on Educational Practice

The decision was taken to focus research on educational practice as opposed to content. This was driven by the literature review that suggested a re-orientation of the education system was needed; different skills had to be developed and a different methodology used to teach them. It also states that an integrated approach is preferable to a bolt-on approach where content about SD is included in already existing courses. Thus, the ‘tool-kit for transition’ proposed in this research can be applied to any discipline with

the specific course content added to teach core skills. The proposed framework and associated working definitions of key terms are seen as the first step in a process of transition expected of societies intending to embed SD.

1.8 Summary

In this chapter, the direction and main concepts of the thesis have been outlined. The background to the research and why it is needed is explored. The research question being addressed is:

How can educators across the construction sector modify their teaching practice to provide construction professionals with the appropriate skills to meet the challenges of global warming and diminishing resources?

The question will be central to the research undertaken as described in the aims and objectives section. The choice of the research area can be justified on the grounds of usefulness both to the study college and the wider society.

SECTION 2 – LITERATURE REVIEW

Chapter 2: The Need for a Paradigm Shift in Construction Education

2.1 Introduction

In order to ensure the success of the drive towards a sustainable economy in Ireland, it is imperative that societal change occurs. This chapter concentrates on the recently depleted Irish construction sector and the potential for a new direction in the industry, based on a sustainable education. The following is proposed; that in order to ensure sustainable development, a paradigm shift which forms the fundamental attitudes that we hold concerning the environment must take place.

This chapter will look at how education may be the entry point where attitudes can be greatly influenced in parallel with the dissemination of knowledge and skills.

While outlining why the construction industry must take a lead role in the change towards a sustainable economy, this chapter looks at how and why the educational process itself must also change in order to embed sustainable development, its philosophy and ethos in the construction sector.

2.2 Taking Responsibility

To sustain the activities of production, distribution and consumption of goods and services of any economic model, the resources and assets from which it draws its real wealth need to be managed and maintained. Efficient use of materials, energy and waste are key to an efficient competitive economy. This pertains to our minerals, our fossil fuels, our forests, the air we breathe and the water we drink. Sustainable economic growth hinges on the management of these resources.

For example, even in ‘wet’ Ireland, we are inextricably linked into the global water supply. Not only are we over dependent on imports of fuel and food – approximately 90% and 50% respectively (McCárthaigh, 2008; Sheehan, 2012) – but also water. When we consider the embodied energy in treating and distributing water, and the ‘virtual’ or embodied water imported in food, goods and energy, 70% of the world’s fresh water supply is consumed in the production of food alone (UNESCO, 2013). Conservation is increasingly becoming an economic and business decision. In a

report compiled by the World Economic Forum (2012), Martin Sorrell, CEO of the Wire and Plastic Products Company, argues that we must take responsibility for our consumption as the world's population increases, our climate changes, and water and natural resources become ever scarcer.

2.3 Sustainable Economics

Sustainably growing our economy can be a way of future proofing it against the vagaries of scarce resources, higher prices, globalisation, transient multi-nationals and competitiveness in the market place. Acting and thinking sustainably are about understanding the greater picture. It encompasses looking at all of the components simultaneously, understanding how they work together as well as the impact they have on each other. Thus, this requires a new way of thinking or a new paradigm within which to think (WEF, 2012). For example, any time we conserve a natural resource, we tend to conserve all natural resources. Energy conservation and recycling save water. Water conservation and recycling save energy. For example, recycling a single aluminium can saves the energy equivalent of about half that can full of petrol. Thus, it would be economically prudent to apply the 'precautionary principle'. That is to say, that we should, 'play it safe' and begin to put in place measures to address these issues now, rather than later. Simply put, it will be cheaper to engage with these issues and seek to solve them now rather than in the future. This however, requires a "new way of thinking or a new paradigm within which to think" (Brown, 2011).

It is becoming ever more apparent that all businesses will need to adapt to a low carbon future and recognise and embrace the need to use materials and resources efficiently, while acknowledging that a workforce with appropriate skills is required; an idea that is increasing in popularity. A publication on Skills and Employability by the International Labour Office (2011) states that the transition to a low carbon economy is one of the greater challenges facing governments, businesses, workers and organisations that represent them.

Until such time as economic 'growth' as it is presently understood, is decoupled from societal development in the policy-makers psyche, Ireland will not get clear thinking on this issue. Therefore, any measures taken to up skill Ireland's workforce with a non-holistic approach will not achieve the goal of a sustainable economy (ILO, 2008; EGFSN, 2010).

The construction industry as a key player in the economy has to embrace new ideas to fulfil its role in the drive towards sustainability. Attitudinal change is crucial and the importance of the educational process in bringing about that change. A shift in construction education will constitute a real instrument of change to upskill our crafts people and embed sustainable economic growth.

2.4 The Need for a Sustainable Approach

With global awareness of the need to develop sustainably, it has become universally acknowledged that, like health and dietary issues for example, the path to spreading the notion of sustainable development is best achieved through education. Sterling (1996) and Hopkins and McKeown (1999) agree that education is the key to change. Sterling (2011) states that it has to be at the centre of the task both as “subject and agent” meaning that not only is the content important, but also the methodology. Hopkins and McKeown (1999) are unambiguous about the fact that “our current path” will not bring about transition to a sustainable society and therefore we must take another approach using education.

Sterling (1999), citing his long experience of thirty years involvement in environmental and sustainable education states that he has come to the conclusion that there is a need for a complete overhaul of the education system; Sterling claims that a paradigm shift is needed to change how we view the world in order to embed an environmental ethos into the ideals held on construction by its workforce. Hopkins and Mc Keown (1999) state that in effect it is about teaching people not only skills and knowledge, but also perspective, and values, which will allow them to live sustainably. Further research bears this out, with some researchers believing that knowledge alone is not adequate to produce a change in behaviour. In other words, knowledge does not provide citizens with the skills to combat environmental problems (Clifton et al., 1998).

The UK produced document Nudge, Think, Shove (2010) states that the traditional information provision approach is unable to take into account the entire social, political and institutional factors that form attitudes and behaviours.

When one considers that the present education system may be having quite a detrimental effect on the environment, a paradigm shift is of the utmost importance. Presently we are being educated to “compete and consume” rather than “care and conserve” (Mc Nerney & Deakin, 1996).

Indeed, most educational theory and practice still supports unsustainable practices. A UNESCO report (2002) notes that a “new vision” and a deeper way of thinking about education is needed because the current education system falls short of what is required to bring about a sustainable future. This paradigm shift in education would create a citizenry who would apply the principles of sustainability to their everyday lives, thus enabling society to become more environmentally friendly (Hopkins & Mc Keown, 1999).

Furthermore, as sustainable education by its nature embeds itself in the local community in which it is based; its teaching methodologies and curriculum will be tailored to the needs of that community, thus increasing awareness, community integration and social adhesion while equipping the student to live in a sustainable way within their environment and community. No community however, is isolated and self-sustaining and thus people need to have a broader understanding of the wider economy, the more complex globalised economy and society and the impact their personal actions can have on the environment both locally and globally.

2.5 The Construction Industry Today

While seen as “dirty, dangerous and old fashioned” (Myers, 2004), the construction industry has been identified as having a crucial role to play in the move towards sustainability - mainly because more than any other sector it encompasses, the three corner posts of sustainability: economics and environment and society. But while being a positive force for economic growth, its impact on environment and community are more often than not, negative.

As we move towards a low carbon society, the construction industry has to lead the drive towards sustainability (World Economic Forum, 2012). To be part of this drive, the construction sector must incorporate issues of social justice and wider concerns such as food, fuel and water security and sovereignty, future proofing against poverty, while considering the general wellbeing and future needs of its occupants and the community within which it is situated.

Barriers to Change in the Industry

The construction industry as it stands is seen as fragmented – inefficient, dogged by short-term thinking, fractious cross-disciplinary relationships and slow to change, with little or no regard for both its employees and communities. It is a sector which operates

through unifying disparate components, professions and personalities to work for a short time, often under financial and time constraints, on a specific complex project. It is the single biggest drain on resources and is seen as highly wasteful. Myers (2004) states that it has a devastating effect on the environment and is responsible for the use of large amounts of resources and the generation of large amounts of waste. The ILO (2006) states that a lack of environmental awareness among stakeholders in the building process is a significant factor in the constraint of green building. Moreover, in what has been termed ‘the circle of blame’ none of the key drivers in the construction industry accept responsibility for lack of sustainable practice in the industry and due to the fragmentation of the sector no one wants to make the first move. Myers (2004) states this is a product of “mind-set.” Builders argue that they can only build what they are asked for; developers say there is no demand for sustainable construction and investors won’t take the risk. Resolving inherent inefficiencies in the building process is seen as crucial in ensuring sustainable development.

2.6 Sustainable Building

Sustainable building on the other hand prioritises efficiency, through an holistic approach, integrated design and build processes, long-termism, checks on negative environmental impact and wastage, and concern for occupants and community. This efficiency which underpins sustainable philosophy, and as found in sustainable building, parallels that which economists, capitalists and the industrial sector continually strive for, often referred to by sustainable thinkers as “the triple bottom line” or “win-win-win” (Myers, 2004). Such is the result when solutions that solve more than one problem simultaneously are found.

Sustainable building is broader in scope than traditional building practice and includes integrated design build processes, and a social justice component. In other words, it considers the impact the building and the building process will have on the society and community within which it is being built. Thus the definition of building must be broadened to incorporate an awareness of the built environment and the impact it has on occupants and the wider community.

2.7 Changing Mind-Sets

Due to the complex nature of sustainability, achieving sustainable development is not as easy as providing people with a particular set of practical skills because one cannot cover all the variables, meaning all the combinations and permutations of potential problems. Thus, each individual must be equipped with a new paradigm to enable them to think critically and assess and make decisions for themselves which are grounded in sustainable principles. Lyle (1994) states that coming to understand ecological processes is not just about learning another subject, but fundamentally changing the way we view the world.

One obstacle to achieving the sustainable building approach is the compartmentalisation of disciplines within the building industry. What is needed is a process that brings together the work of various designs and engineering management and craft disciplines; an idea which is gaining currency in commercial building is the Integrated Design Process, which brings together the whole team to ensure quality and efficiency of the build. This process is the beginning of viewing the building as a whole unit or single system. It reduces friction between the disciplines and makes for a more efficient building process.

2.8 World View, Attitude and Actions

Our personal attitudes determine that our actions are based on an all-encompassing worldview, or model of thinking which is a product of our society, our families, our communities and our education system. Thus, changing attitudes is a complex task and understanding and changing them in the context of sustainability is even more complex. An in depth analysis of attitude formation is beyond the scope of this paper. However, it is through underlying perceptions, assumptions, and cultural mores that we filter all our decision-making. The present world-view not necessarily pro-sustainability and in fact is often anti-sustainability. Over the last three hundred years, a world view which regards the cosmos as a nurturing living organism and treated nature with respect has been gradually eroded and replaced by a world view which regards nature to be dead and to be exploited (Huckle, 1996).

The present world view (Modernity) considers the environment as a commodity (Huckle, 1996) and there for man's disposal. This overarching view underpins much of the reasoning behind exploitation of the environment, both as a generator of wealth and a waste disposal unit. Lyle (1994) states that our present attitude towards the earth dates

back to the renaissance and is not only out of date but dangerous. This is the worldview that presently underpins the education system and with which our leaders, our managers and our future builders engage the world. This is the worldview that most of our decision-making is based upon. It impacts upon our politicians, policy makers, analysts, strategists and educators and consequently on how well the system operates.

2.9 Opposing World Views

Dunlap and Van Liere (1978) identified two fundamental paradigms, firstly, the Dominant Social Paradigm (DSP), which outlines the world view that guides our personal and policy decision making presently, and, secondly, the New Environmental Paradigm (NEP), which they envision is to replace the DSP in order to move society towards an environmentally friendly stance. Simply put, the present world view is anthropocentric and places man at the centre, giving him the right to manage his natural surrounding as he wishes, while the NEP is an eco-centric world-view which values all life-forms equally (Grenstad et al., 2006).

From an economic point of view, the main difference between both worldviews can be summed up as: priority for economic growth and development and a focus on short-term or immediate prosperity, versus priority for ecosystem viability and a focus on long-term sustainability. This dichotomy encapsulates the different approaches to the economy out of which come two different sets of goals or policies and thus two different economic systems: one which will maximise growth at the cost of pollution and the other which aims to reduce waste and avoid pollution even at economic cost.

The NEP prioritises societal wellbeing over wealth at all costs. It emphasises foresight and planning, to secure a brighter future, rather than reliance on markets to spur economic growth. It emphasises personal growth rather than material wealth. It focuses on horizontal structures that maximise interaction and learning as opposed to hierarchical and authoritarian models. It promotes and encourages greater personal and local responsibility. It recognises the need for holistic or integrative thinking as opposed to simplistic cause/effect thinking and narrow expertise. It emphasises co-operation, partnership and egalitarianism as opposed to competition, domination and patriarchy. It places humans in the context of being in an ecosystem as opposed to subordinating nature to human interests. The DSP is still guiding the way we think thus the implementation of sustainable actions and achieving the goal of sustainability and a sustainable economy is impeded.

2.10 Attitudinal Change

Rogerson et al. (1996) are of the opinion that business people, politicians and policy makers now accept that patterns of behaviour have to be modified in order to bring about change. There is a diverse range of views on how to stimulate this attitudinal change, including the use of legislation to enforce compliance, economic instruments such as tax breaks or grants, and consciousness raising, be it through the provision of information to the general public via ad campaigns or education (Department of Enterprise, Trade and Investment, 1996).

The UK report titled “Nudge, think or shove? Shifting values and attitudes towards sustainability” (DEA, 2010) enforces the goal of finding the optimal mix of these three strands, nudge, think and shove, to bring about change in social values. However, it is considered that the ‘think’ approach or deliberate action, which brings about attitudinal change, is more effective over the long term. Our society approaches the issue of sustainability presently with a ‘bolt-on’ attitude. For example, bolting on a solar panel or introducing technological solutions without considering ‘the whole’, which means the whole build system process through to the lifestyle of the occupants. Similarly, it is not good enough to add ‘sustainable’ modules onto traditional education courses. In essence, a whole new educational paradigm centred around four pillars; holism, systemic thinking, sustainability, and complexity are what are needed (Mc Nerney & Deakin, 1996).

Chapter 3: A Techno-Centric Approach to Sustainability

3.1 Introduction

This chapter examines how the singular emphasis on technology and the narrow focus on operational energy conservation raise questions about Ireland's present path towards Sustainable Development. This is illustrated through the examination of the changes to building control in Ireland, which contains a singular emphasis on energy and relies heavily on the expert as opposed to the end user and community. It will provide clear definitions for 'sustainable building' as well as outlining the significance of the 'local' and the 'occupant' in the sustainable building process. It will also highlight conflicting sustainable philosophies and examine why the Irish construction industry has to go beyond Part L in order to align itself with Sustainable Development goals.

3.2 The World Economic and Social Survey

The vision of Sustainable Development as defined in *The World Economic and Social Survey* (2013) "promoting economic and social well-being while protecting the environment", has not been achieved. The Survey reiterates the premise that the key problem facing the planet is man-caused climate change which threatens to lead to irreversible changes in global ecosystems. The document outlines the areas which need to be tackled including land-use; food security; employment creation; transportation; infrastructure development; biodiversity conservation; water conservation; renewable energy sourcing; waste and recycling management and the provision of education, health care and housing. The report makes three key points (a) that sustainable development is crucial to the eradication of poverty (b) we must promote an integrated approach to our development goals and ecosystems and (c) we must focus on systematically changing consumption and production patterns in all countries.

3.3 Construction and Sustainable Development Goals

The construction industry, more than any other sector, should encompass the three corner posts of sustainability: economics, environment and society. The industry has been identified as having a crucial role in the move towards global sustainability (World Economic Forum, 2012). Maiellaro (2001) states that its contribution can be realised

through the design and development of sustainable communities, construction and technology. Kibert (2012) defines sustainable construction as a subset of Sustainable Development and addresses the role of the built environment in the overall vision of sustainability. He says that sustainable building should be viewed as a tool to achieve Sustainable Development.

Change in the industry is slow in part due to a myriad of social interests and converse philosophical stances (Fernandes, 2013). Lack of understanding and entrenched assumptions in the industry (Jamieson, 2009) combined with lack of understanding among educators (Hopkins & Mc Keown, 1999) in the broader community have in part hindered the development of an environmental literacy and a social conscience within the industry.

While some of the approaches and skills required to build sustainably are present in the industry, they don't go far enough. LEAN, for example, is about streamlining the construction process. A number of authors agree (Wills, 2009; Gordon, 2001; Zokeai et al., 2013) that 'LEAN' and 'Green' go hand in hand with philosophical and structural similarities between both. But LEAN on its own is not enough. While philosophically based, there is no consideration given to society or the environment. IDP (Integrated Design Process) utilises whole systems thinking and emphasises communication and team work all of which feed into sustainable building, but it does not necessarily give priority to the environment and broader society and as a system it can be used without the consideration of broader social dimensions.

Moving the industry towards sustainability is also hampered by the misuse or misunderstanding of terminology. Kibert (2012), Wholley (2000), Fox (2000), and Connte and Monno (2001) all agree that words like 'sustainability' and 'green' are used interchangeably and are often misused. The word 'sustainable' is used to label solutions which do not consider the three pillars of sustainable development: economy, environment, and society. Kibert (2012) distinguishes between 'green building', which he defines as referring to the actual structure which is built using sustainable building principles, and methodologies, while 'sustainable construction' refers to the ecological, social and economic issues of a building in the context of a community. He also states that buildings of themselves cannot be sustainable but can only be designed to support sustainable patterns of living within a given community.

Rogers (1998) defines sustainable building as: “A holistic approach to design that combines social, economic and environmental objectives and that evaluates against their local and global impact.”

In other words, ‘sustainable building’, considers the impact the building and the building process will have on the society and community within which it is being built and also the wider world, not just the immediate ecosystem. Davis (2000) states that building is fundamentally a social enterprise. Thus, the definition and understanding of what it means to build must be broadened to incorporate the general wellbeing of workers and occupants and the community within which it is situated. It also incorporates issues of wider concern such as fuel poverty, access to inexpensive nutritious food and inexpensive clean water and issues of global justice, such as access to affordable housing (Hargreaves, 2008).

3.4 The Significance of the Local and its Role in Sustainable Building

The local plays a vital role in how we deal with problems arising from global warming and peak oil. The ability of a community to assess, respond and adapt to difficulty is known as resilience and is seen as a vital component in dealing with the problems posed by climate change and peak oil. UNEP'S recent Emissions Gap Report (2014) speaks of the need to protect communities from the “intensifying impact” of climate change. While communities will need external funding, it will ultimately be up to each community to solve problems specific to themselves with resources and knowledge specific to that community and in a way that meets the needs of that community.

Douthwaite (2001) highlights the conflict between regionally appropriate building practices within a global economic context. He is critical of the European model of governance which he says is maintaining an unsustainable way of living. He states that the process of European integration, as part of globalisation, is dismantling the powers of the nation state – the only unit capable of carrying out policies for the common good and is contrary to Localism, a key tenet in sustainable philosophy. The problem with this policy is that a solution will not be geographically, socially or culturally specific. The homogeneity brought about by national and international policy and trends eliminates local distinctiveness, which operates on an accessible scale and helps to bind and empower communities as opposed to the alienation brought about by “Big Government” and “faceless multinationals” (Fox, 2000).

In a survey carried out to assess the state of Austrian building regulation, one respondent replied that by focusing solely on energy efficiency, the EU missed an opportunity to promote the broader concepts of sustainability. He states that government regulation was often contradictory and counterproductive to aims and objectives of sustainable construction. He states that BREAM or LEED could be used as tools to create a new way of thinking about building (Austria Country Report, 2014).

Whoolley (2012) and Nanda (1999) are concerned about homogenisation and globalisation and Nanda criticises architectural practice and a building industry that are subject to what he calls “a global culture of commodification and homogenisation” and who dismiss local skills and knowledge in favour universal building materials and systems that ignore the regional resource base and aesthetic. Fernandes (2013) gives three reasons for the use of local materials: reduced building cost; reduced embodied energy; promotion of local economies. The first two of these are in accordance with Vittrup’s findings (see below). Cooper (2003) states that sustainable construction through use of local resources helps to ground communities by giving them direction and thus underlining local identity. He states that a bioregional approach to material choice and usage, which incorporates cultural, social, economic, physical and geographical considerations are the most comprehensive approach to truly sustainable construction.

Hines (2003) acknowledges the need for global interconnectedness which he defines as the flow of ideas, technology and information across borders for the betterment of local communities, but distinguishes between this and globalisation, which he says is solely designed to eliminate trade barriers and manipulate workforces for profit and internationalism. This transference of beneficial ideas needs to be considered in a way which does not compromise local or regional appropriateness (Gann, 2003).

3.5 The Significance of ‘the Occupant’ in Sustainable Building

The recently introduced Building Control Amendment Regulations (2013) require an assigned certifier to sign-off at key stages of the building process. This should ensure higher building quality and compliance, but instead has an associated cost in financial terms. Bringing in the experts, so to speak, raises issues around what Oliver (2006) refers to as the “ethics of intervention in vernacular architecture.” Referring to the global context, Oliver (2006) says that by mid-century, the world’s population will have

increased by 3 billion, so he explores just who will house this boom in the population. The associated building boom raises the spectre of huge environmental and social impact with the only answer being a green holistic solution. He concludes that part of the answer is to empower the communities through education in the building of their own homes and structures themselves. Connte and Monno (2001), Nanda (1999), and Oliver (2006) feel present practice of bringing in an outside expert often results in the disempowerment of the dweller and a breakdown of community and family. Barucco's (2013) contention that builders must communicate with the inhabitants who are informed and concerned about the environment supports this.

Brand and Karvonen (2007) define what they call an "expertocracy" with the power to shape society. These 'technical experts', engineers being one example, are specialists in their discipline, with the consequent narrow field of vision being unsuitable for addressing complex issues of sustainability. Their knowledge base is abstract and reductionist and separates man from nature in contrast to indigenous knowledge which is holistic, territorial and concrete. Impersonal, quantitative precision clashes with local, tacit, real life experience.

Connte and Monno (2001) predict that an 'expert' will be necessary and suggest the only difficulty is trying to strike the balance between the experts involved and the occupants. This, they say, will require an appreciation of the local by the expert and an awareness of his or her own biases.

3.6 Technology and Nature – Opposing Views

Barucco (2013) and Fernandes (2013) see the advent of technology and cheap oil as the cause of the shift away from traditional solutions and the development of a society and a way of life that is based on consumption of natural resources and consequently, something that cannot be maintained indefinitely. Techno-centric environmentalists believe that environmental problems can be solved by innovation and control of the environment through techno-economic change, with science and technology providing the solutions (Fox, 2000). Woolley (2012) is critical of 'technocrats' who write policy and seek solutions through technology and the drive for efficiency and he says there is still an overreliance on what he calls "synthetic petrochemical based technocratic solutions" which are often dictated by industry with an increasing influence over the construction research agenda. Woolley (2012) states that many of the assessment methods arise from this influence and the quest for easily measurable standards or the

“holy grail of mathematical systems of environmental assessment” lack any ethical or moral direction, meaning a social justice component which considers local and global impact.

Eco-centric environmentalists base their approach on a more holistic framework, prioritising man and his relationship with nature, which recognises the interactions, networks, and interdependency of all facets of the enviro-socio-economic matrix. Light (2003) believes the restoration of man’s reconnection with nature is needed. Vittrup (2007) concludes his study by stating that ‘a more holistic permaculture approach is necessary’ and in a final definitive statement states that, ‘A fractionalised approach will never secure the aim of Sustainable Development’.

Fernandes (2013) and Stephenson (2006), with regard to technology and nature, conclude that the optimum is the usage of modern technology and techniques to maximise local resources. In order to achieve new standards, it is necessary to balance the socio-economic needs of the occupant on the one hand, with technical-environmental issues on the other.

3.7 Why We Need Broader Qualification Criteria

3.7.1 DEAP and Passiv Haus

Passiv Haus and Part L (Technical Guidance. Document L - Conservation of Fuel and Energy - Dwellings) are similar in their narrow focus on operational energy use. The ultimate goal of Part L is to achieve carbon neutral buildings but this is only in relation to operational energy usage. DEAP focuses on a combination of the energy efficiency of the building and renewable energy sources. Passiv Haus places more emphasis on energy conservation through attention to building design and detail, and less on heat source.

3.7.2 Passiv Haus

Crawford and Stephan (2013) set out to show that the embodied energy in building material for Passiv Haus purposes is miscalculated and that not only is embodied energy higher than a conventional house but it is higher than was previously believed. They find that a Passiv Haus can use more energy over 80 years than a similar conventional house, mainly due to materials required to achieve high operational energy efficiency levels. They call for a widening of Passiv Haus criteria to include embodied energy measurement.

Holladay (2011) suggests the lack of a cost-return analysis as part of Passiv Haus standard can make it unnecessarily expensive to achieve the standards both in resource terms and financial terms. He suggests, for example, that the benefit of excessive insulation in the base is negligible and states that seven houses with two inches of insulation is a more efficient use of resources than one house with fourteen inches. Holladay's holistic approach considers resources in their totality and the method in which they should be used. Holliday states that the measurement tool does not alert you to when the thickness of insulation stops being cost effective and can actually be wasteful. Bringing this argument to its logical conclusion raises some questions such as (a) are there enough resources if every house was built according to present Passiv Haus standards? (b) Do we actually know? (c) Has this been considered?

The measurement criteria of Passiv Haus fail as it is easier to achieve a better result on a bigger house by virtue of its "envelope to floor area" ratio. He suggests that we start measuring energy consumption per occupant. He also states that PPH does not consider alternative heat sources. He questions that if one had access to renewable fuel, why would one have to consume resources needed to achieve high U- values?

In the UK, Passiv Haus has been touted as a solution for fuel poverty, which is in line with sustainability goals. However, an issue highlighted at The UK Passive House 2014 Conference was that landlords were impressed with the Passiv Haus model as it would allow them to charge higher rents while developers could look forward to value being added to their assets if they built and refurbished to a Passiv standard (Passive House Plus, 2014). This would negate any economic benefits for the occupant from reduced energy bills.

This side-effect is not the fault of the Passiv Haus model but a misuse and abuse of a building practice in an unregulated market which highlights the disconnection from any holistic housing strategy that would ensure affordable homes. Jones (2014) believes that the family home is one of the main determinants of health. She says it is impossible to maintain health without an affordable home and states that we need a different housing strategy, preferably one which integrates housing and health. This thinking would be in line with UNESCO's definition of Sustainable Development.

May (2010) states that the introduction of Passiv Haus as a process of building has the potential to further remove the occupant from the building process, thus disempowering the citizenry as it removes any control they may want to exercise over how they wish to live. The disjoint between the occupant and the building process are

compounded by the added cost incurred by hi-tech goods and expert's fees, making access to a home more difficult. This can result in disempowerment and alienation. Vittrup (2007) highlights this struggle between the control over one's life that individuals feel they need and the market. It also points to the trend in Denmark where straw bale construction has become a means by which owner-builders can become financially independent.

3.7.3 Broader Assessment Criteria

An online review of LEED and the Code for Sustainable Homes (2014) demonstrates the broad scope and holistic approach required to achieve good sustainable building practice, while highlighting the narrowness and inadequacies of a building process which focuses solely on operational energy consumption.

LEED's main credit categories show that 'energy and atmosphere', the category which would cover Passiv Haus criteria, comprises only two of the twelve categories which make up the LEED assessment criteria.

Category 3, Materials, considers the materials used and their sourcing, under the term 'responsibly sourced'. This includes distance travelled and impact of production on employees and environment. The Passive Haus design has no requirement to consider the impact of the manufacturing process of the materials on their environment on the people employed in their manufacture nor any social issues connected to the manufacture of materials or the building process.

Category 5 of the Code for Sustainable Homes, Waste, not only considers household waste but also considers site waste. Category 8, Management, considers site management best practices during the build. Possibly one of the most expressive categories from a sustainable point of view is the points allocated for bicycle storage. This demonstrates long term visioning and a whole systems approach inherent in the code and the impact travelling to and from the home can have throughout the duration of occupancy. It also accredits the provision of a room that can be set up as a home office, demonstrating a low cost facility for self-employment or a work-from-home option which cuts travel. LEED also encourages this with its 'location and linkages' credits by promoting living within walking distance of work, shops and public transport.

LEED's Adaptable Design, Multipurpose Usage and Development, credits awareness of the specific locale. Passive Haus does not consider the impact of the house on the landscape and local ecology. It does not consider the impact a build will have on

a community, nor does it outline how to build for community, considering public/private spaces, communal living for example, which a holistic sustainable approach would consider.

In a comparative analysis of two passive houses, one built from straw-bale, the other from lime and sand block with EPS insulation, Vittrup (2007) shows that not only is the passive house of LS/EPS more expensive to build but that it also may have a greater environmental impact as it did in his study. LEED, he says, gives a broader assessment and safe guards against a situation arising where, if energy efficient buildings, using materials with a negative environmental impact, could be built cheaply, they would proliferate with detrimental consequences.

The accessibility and voluntary use of these tools is another significant difference between them and the DEAP. These tools are designed to educate and empower the occupant or builder and give them ‘buy in’ into the building process. Again, this idea of personal empowerment for the owner or occupant is central to developing sustainably.

Du Boisson (2014) in a comprehensive article considering the Irish context, compares the Passive House standard and the DEAP to other methods of measurement and certification such as LEED, The Code for Sustainable Homes, BREEAM, DGNB, and the Living Building Challenge (LBC) and suggests that there is room for an ‘Irish BEAM’ (Building Environmental Assessment Method) which reflects the Irish context and the Irish construction industry. Du Boisson quotes the Irish Green Building Council (IGBC) who state that there is merit in the introduction of similar schemes for the Irish residential building sector and want to implement such a scheme by 2015.

3.8 Education for Sustainable Development – An Introduction to the Concept

Education for Sustainable Development (ESD) differs from traditional teaching methodologies in that it uses a whole-school multi-disciplinary approach with curriculum developed in conjunction with and by the students and based on the needs of the region/community within which the learning centre is based (Hopkins & Mc Keown, 1999). Huckle (1999) is in agreement with this, suggesting that communities and educational systems need to work together towards a sustainable outcome with the community setting sustainability goals and the education system modifying its curriculum to underpin support and reinforce these goals.

Due to its complexity and holistic nature, an interdisciplinary teaching approach must be taken. Such an educational approach will require the help of many disciplines focusing on interconnections between the natural and built environment, and the economic and political forces that influence the world around us (Mc Nerney & Deakin, 1996). Thus, traditional methods of education based on compartmentalisation of subjects, need to be dismantled. A multidisciplinary approach, which utilises a variety of educational tools such as case-based collaborative learning, problem-based learning, community-focused education, service learning and an extant body of knowledge from across the disciplines to draw upon, must be engaged. Such an approach in itself leads to an educational process, which develops other core skills such as systematic thinking, communication, teamwork and interdisciplinary understanding. Sterling (1999) states that people should be engaged in a “critical pedagogy” or participative action research. These skills are crucial in solving complex environmental and social problems in the real world – a significant part of which entails building relationships and understanding the needs of all involved. This fulfils what Sterling calls, “putting the relationship back into learning” (2001).

To meet the demands of a low carbon sustainable economy and society, I propose that change needs to occur in the educational process in order to bring about change in the building industry. I have shown that fundamental attitudes based on an obsolete world view need to change to embed this new way forward and that education is key, not only as a tool to facilitate the dissemination of knowledge and skills, but also to achieve attitude changes. I propose that the present education process itself has to change in both method and content, by introducing a ‘holistic systems thinking’ approach, in order to bring about this fundamental change. We need to equip our builders with the necessary problem solving skills and promote a greater understanding of the relationship between building, habitation and society.

3.9 Conclusion

This chapter has shown that our present construction path does not align itself with the path towards Sustainable Development that The World Economic and Social Survey advocates. The present approach is focused on reducing operational energy usage through technology, while failing to consider our eco-systems and broader Sustainable Development goals. When compared to the goals and objectives of LEED, or the CSH, our present direction in Ireland is based on a very narrow set of criteria. It fails to

address the issue of poverty or access to housing. In fact, the opposite is the case – the hi-tech approach separated from the broader social context and introduction of the expert will alienate occupants, increase rents and move owning-your-own-home out of the reach of a greater number of people, contrary to Sustainable Development principles.

Chapter 4: Education for Sustainable Development in Construction

“You can't solve problems with the same thinking that created those problems.”

Albert Einstein

4.1 Introduction

When one considers that the present education system may be having quite a detrimental effect on the environment, a paradigm shift is of the utmost importance. Currently we are being educated to “compete and consume” rather than “care and conserve” (Mc Nerney & Deakin, 1996). Indeed, most educational theory and practice still supports unsustainable practices. A UNESCO report (2002) notes that a “new vision” and a deeper way of thinking about education is needed because the current education system falls short of what is required to bring about a sustainable future.

The UN World Summit in Johannesburg (2002) outlines the need for a reorientation of our education system and for integrating sustainability into education. This objective was restated at the United Nations Conference on Sustainable Development in 2012. There have been calls from numerous governmental, non-governmental bodies and academics for a reorientation of education in the US and the UK, while studies are showing that students wish more and more to work with ethical employers. Employers too are turning to universities to prepare students for a more socially responsible role (Van Nierop, 2008).

The UK's new Sustainable Development strategy, *Securing the Future: Delivering UK Sustainable Development Strategy* places emphasis on the education system's role in both raising awareness about Sustainable Development and teaching the skills needed to implement sustainable practices. The document also states that the traditional information provision approach is unable to take into account the entire social, political and institutional factors which form attitudes and behaviours. It argues that “sustainable development principles must lay at the core of the education system such that schools, colleges, and universities become showcases of sustainable development among the communities they serve” (Department of Environment, Food and Rural Affairs, 2005). It places a priority on the development of sustainability literacy as a ‘core competency’ among graduates.

In the US, the Green Building Council has argued that all students across all faculties should learn about sustainable building as its knowledge and understanding is crucial in dealing with sustainability issues, the theory being that you create a discerning citizenry who will request sustainable product and methodologies, thus forcing companies to provide them.

Furthermore, there is consensus in the literature among academics and educators that the education system is central to the process of driving the change necessary for a sustainable society (Applied Research and Public Policy, 1999). A cultural-shift in the way we see education and learning, based on a more ecological or relational view of the world, is needed. This is highlighted as necessary over a piecemeal, bolt-on response which leaves the mainstream otherwise untouched.

Hopkins and Mc Keown (1999) are unambiguous about the fact that “our current path” will not bring about transition to a sustainable society and that therefore we must take another approach through the implementation of education. They also explore the idea that the desired outcomes of this new education process would be radically different to what we now experience, consequently, the teaching methodologies used in achieving these outcomes must also be reconsidered. Reorienting education will give people skills to make lifestyle changes and will enable a society to become more sustainable. Hopkins and Mc Keown (1999) state that it is about teaching people not only skills and knowledge, but also perspectives and values which will allow them to live sustainably. This entails systemic change in thinking and practice, informed by what can be called ecological thinking and values.

Sterling (1996) agrees that education is the key to change. He says it has to be at the centre of the task both as “subject and agent,” meaning that not only is the content important but the methodology also. Sterling (1999), citing his long experience of thirty years involvement in environmental and sustainable education, says he has come to the conclusion about the need for a complete overhaul of the education system, or as he states, a paradigm shift is needed to change how we view the world in order to embed an environmental ethos. Further research bears this out with some researchers believing that knowledge alone is not adequate to produce a change in behaviour. In other words, knowledge alone does not provide citizens with the skills needed to transition to a sustainable society (Clifton et al., 1998).

4.2 Education for Sustainable Development

Genesis

Education for Sustainable Development is an amalgam of Development Education (DE) which usually focuses strongly on equality, inclusion issues as well as these more practical points: social justice issues, such as food, water, fuel sovereignty and poverty, and Environmental Education (EE), which is concerned with protecting the environment.

The methodologies and content matter of DE/EE and ESD are closely aligned and include the concept of education as a tool of empowerment, inspiring individuals to assume sustainable lifestyles for the benefit of present and future generations. The coming together of these two ideologies creates a complex but more realistic approach to problems which are clearly intertwined in Sustainable Development.

The aim of ESD is to build resilience by changing attitudes and associated behaviour through an education process which produces ecologically literate, socially conscious, technically or practically skilled problem solvers.

An Overview

In 2007 UNESCO defined ESD as a practice which:

- Promotes a shift in mental models
- Engages formal, non-formal and informal education
- Promotes lifelong learning
- Uses a variety of techniques that promote participatory learning and critical reflective skills
- Promotes social justice
- Accommodates the evolving nature of sustainability
- Is locally relevant and culturally appropriate
- Is based on local needs, perceptions and conditions which acknowledge that fulfilling local needs has global consequences and builds civic capacity for community-based decision making

Education for Sustainable Development (ESD) differs from traditional teaching methodologies in that it uses a whole-school, multi-disciplinary approach, with curriculum developed in conjunction with and by the students and based on the needs of the region or community within which the learning centre is based. Hopkins and Mc

Keown (1999) and Huckle (1999) are in agreement with this, suggesting that communities and educational systems need to work together towards a sustainable outcome with the community setting sustainability goals and the education system modifying its curriculum to underpin support and reinforce these goals. ESD demonstrates skills, values, knowledge and understanding that support positive action toward sustainable management of the environment and greater social equity and poverty eradication (Centre for Global Education Policy, 2008). ESD takes a holistic approach to our global concerns and seeks to solve problems, taking into account social, economic and environmental considerations.

The overriding aim of ESD is to develop resilience in the individual and the community to meet the challenges of global warming and peak oil. Teaching resilience is best achieved by equipping individuals and communities with problem-solving capabilities. This is deemed achievable through raising awareness of global justice issues and enhancing eco-literacy skills, developing interpersonal skills and thinking skills.

Eco-literacy skills allow us to understand environmental systems and the interconnectedness between man and nature. Interpersonal skills, developed through team work and trans-disciplinary collaboration, allow us to communicate our concerns and ideas effectively. While critical thinking, whole-systems thinking and vital approaches to problem solving are developed through engaging in holistic analysis, generation, assessment and implementation of relevant knowledge solve real problems.

4.3 Curricula Methodology Approaches

Key to Education for Sustainability is the actual process of learning which explores the ways in which we learn, not just what we learn. Sterling (2001) suggests that the curriculum's goals, aims, knowledge, methods and assessment are developed by the learner, based in part on personal knowledge. This involves developing a curriculum that recognises that knowledge is provisional and approximate, involves the learner in determining goals and methods, allows for negotiation and flexibility, and promotes local, personal, applied, and first-hand knowledge. The emphasis here is on knowledge that is applicable, practical, inclusive, and self-critical. Evaluation is based on self-evaluation, self-generated indicators, critical feedback and support from others, and assessment that is qualitative as well as quantitative.

Education for Sustainable Development requires a holistic, participatory and solution-focused approach (Sterling, 2001). Learning through experience, participation and reflection is known as Transformative Education and asks the learner to take responsibility for real issues. Learners are to be encouraged to take their knowledge out into the real world and engage with real issues that impact upon our society and other human beings (Mezirow, 1991). Thus, traditional methods of education, based on compartmentalisation of subjects, needs to be dismantled. A multidisciplinary approach, which utilises a variety of educational tools, such as case-based collaborative learning, problem-based learning, community focused education, service learning and an extant body of knowledge from across the disciplines, must be engaged. Such an approach in itself leads to an educational process, which develops other core skills such as systematic thinking, communication, teamwork and interdisciplinary understanding. Sterling (1996, cited in Huckle 1999) states that people should be engaged in a “critical pedagogy” or “participative action research”. These skills are crucial in solving complex environmental and social problems in the real world - a big part of which entails building relationships and understanding the needs of all involved. This fulfils what Steven Sterling calls putting the relationship back into learning. Such an educational approach will require the help of many disciplines focusing on interconnections between the natural and built environment, and the economic and political forces that influence the world around us (Mc Nerney & Deakin, 1996).

As such, ESD recognises the need for a holistic approach which incorporates the teacher, the student, the institution and the community. The literature suggests that the best way to teach sustainability is by action and example, stating that educational institutions should themselves be pursuing a policy of sustainability in every facet, from maintenance, to energy conservation, to organisational structure. Furthermore, as sustainable education by its nature, embeds itself in the local community where it is based. Its teaching methodologies and curriculum will be tailored to the needs of that community thus increasing awareness, community integration and social adhesion, while equipping the students to live a sustainable lifestyle within their community.

Hopkins and Mc Keown (1999) explore the idea that a program for SD must be developed for each region and should be defined by the communities of those regions. But no community is isolated and self-sustaining, thus, people need to have a broader understanding of the more complex globalised economy and society, and the impact that their individual actions can have on the environment and others, both locally and

globally. Thus, any programme for Education for Sustainable Development (ESD) must be based on local need but devised and implemented with global considerations (Mc Keown, 2002).

4.4 Barriers to Change

‘Red flowers are red young man...’

Harry Chapin

Hopkins and McKeown cite lack of vision, lack of awareness, lack of funding and lack of institutional commitment as impeding the implementation of ESD to varying degrees. They go on to say that the biggest problem is lack of clarity regarding goals, and ask the question “do educators understand what is being asked of them?” (Hopkins & Mc Keown, 1999) According to the writers, there is a lack of awareness within the educational community and public that reorienting education to achieve sustainability is essential (Hopkins & Mc Keown, 1999). Van Neiroop (2008) and Hargreaves (2008) would support this and say that there is a need to raise awareness of Sustainable Development among educational staff. Moreover, it is necessary to highlight the importance of integrating SD into curricula as opposed to ‘adding on’ or creating new courses. This addresses the issue of burdening teachers and students with more work, and more information, often where curricula are already overloaded. Adding on SD modules to the curriculum merely gives the impression of sustainability. Mc Keown (2002) is careful about the use of terminology. She identifies the need to distinguish between education *for* sustainable development and education *about* sustainable development, stating that one is an awareness raising theoretical discussion, and the other is using education as a tool to achieve SD (Sterling, 2001, cited in Huckle & Sterling, 1996).

A number of the issues outlined above are borne out in the Irish context. In 2014, the Department of Education, Skills and Employment produced a comprehensive document relating to ESD. With regard to sustainable education in Ireland, they cite numerous programmes and initiatives being undertaken by third level institutions, though they say ‘silo-isation’ of subject prevents a holistic cross-disciplinary approach. They also highlight the concerns about preparedness of lecturers to engage in participatory learning and they emphasise the need for a whole-institution approach as opposed to its fragmented nature at present. The document also makes the point that

there is a lot happening in this area though not framed or categorised as ESD by facilitators.

Corless (2011) supports this. He states that a survey carried out to assess Environmental Sustainability in third level institutions in Ireland, finds that many individual protection measures are being adopted, but a more systematic approach is preferable, of which, he says, there is a clear lack. He recommends that all colleges should adopt a formal Environmental Management System.

4.5 ESD and Construction Education

To be part of this drive towards a state of sustained development and to facilitate wider social concerns, the construction sector will be required to deal with the barriers within its own profession. These include: skills shortage; mind-set; short-termism; lack of innovation; reluctance to change and compartmentalisation of the building process. These difficulties are compounded by a lack of clarity around terms such as ‘green’, ‘eco’, ‘sustainable’ and its variants.

Sustainable Building Education

The aim of a Sustainable Building Education is to build resilience in students by equipping them with core competencies such as the skills and knowledge to solve problems arising from climate change and resource depletion. This section considers a number of definitions for sustainable building in order to assess how construction education might change to achieve same.

As ‘green building’ in practice cannot be separated from a broader understanding of Sustainable Development, so too, green building education cannot be separated from the broader understanding of ecological literacy and sustainability principles (Kibert, 2012). If we are to equip construction graduates with the skills and knowledge to solve problems arising from climate change and resource depletion, ‘green building’ can only be studied in the context of a fuller understanding of Sustainable Development and all its principles and issues.

Elshof (2005) states that the builders of the future need to be immersed in the problems and challenges that arise in today's society. To do so, a technological education must be created with the potential to help students to think, process, design and build in a more sustainable manner. Clayton and Radcliffe (1996) argue that “this change must be a move away from a closed systems perspective, in which there are

simple definitions, fixed concepts and ultimate solutions, to an open systems perspective, in which both problems and solutions are multi-dimensional, dynamic and evolving.”

Jamieson (2009), who has been developing a ‘new education’ for engineers, has already identified the strains occurring within the engineering profession as it attempts to manage this change. He concludes that a fundamental rethinking and reorganisation of engineering education needs to occur. If not approached correctly, changes can have the effect of overcrowding the curriculum and increasing the workload of both teachers and students. The PROCEED programme, which Jamieson played a key role in developing, was a research programme which lasted three years and set out to resolve this very issue.

Jamieson et al. (2011) also touch on the notion of changing fundamental attitudes. They are specific about this matter, stating that we must shed the attitude of “hubris” and take on an attitude of “humility”. We must also acknowledge the limits of our species and recognise the constraints imposed by “reality,” as well as the constraints to our individual skills and knowledge. Jamieson concludes that fostering a “hybrid imagination” is required to develop a problem-solving competence comprised of scientific knowledge, technical skills and empathy for culture and global justice issues. He also defines this competency as: “mixing natural and social, local and global, academic and activist forms of teaching and learning in new combinations.”

This chapter has considered why the education system needs to change and how Education for Sustainable Development can facilitate this change. It has also looked at the building education sector and how Education for Sustainable Development principles can be used to develop a sustainable building education that will build resilience in students and communities to meet the challenges of climate change and resource depletion.

SECTION 3 – METHODOLOGY

Chapter 5: Research Methods

5.1 Introduction

This chapter will provide the reader with an understanding of the research methodologies used to address the research question as defined in chapter one. The research approach is outlined, as are the underpinning philosophies. All activities undertaken with regard to data collection will be outlined, including the aims and objectives of the research. It will establish the link between the secondary research, as derived from literature reviews, the surveys, the case studies, the audits and observations.

The research shows where and how qualitative research aligns itself with ESD practice and methodology. As this research has at its core, knowledge and how we construct it, the chapter outlines how this research attempts to take the form of a solution-focused, problem-solving learning process, using research methodologies which are in keeping with ESD principles. This chapter outlines the three stages of primary data generation.

Firstly, a number of informal interviews were carried out with practitioners in both the sustainable building and construction education fields. These were both on the phone and in person, the goal being to identify a gap where research would be needed, and from there to develop a research topic. Based on the above discussions, a literature review was conducted to verify or disregard areas of research needed. The second stage involved two separate surveys of two student groups in the construction education system to (1) determine attitudes on the environment and (2) to assess the understanding of core sustainability issues. Finally, educators in the construction sector and directly related to the area of study, in this case being Dublin Institute of Technology, were interviewed.

5.2 Research Paradigm

Of the four epistemological perspectives, positivist, interpretive, critical and postmodern, this research is least of all, positivist. It is Interpretive, in that it seeks to

assess the attitudes of students and teachers through survey, discussion, interview and observation. It is critical, through analysis of policy documents, case studies and curriculum audits in order to illustrate the problem or lack of initiative towards solving the problem. It is post-modern in how it questions definitions giving understandings, assumptions and the presentation of results in a number of ways, including narrative/anecdotal form and field notes and quotes. Post modernism considers multiple perspectives, multiple voices, and multiple interpretations. Post modernism would appear to merge with Participatory Action Research in its questioning of the orthodoxy. This signifies the economic system and philosophy within which we function which involves the positivist/techno/ scientific approach permeating the education system and the way we think. Education for Sustainable Development too, attempts to turn the orthodoxy on its head and challenges the way we think as borne out in the literature review.

Merriam (2009) defines the role of the qualitative researcher as thus:

“Qualitative researchers build towards an intuitive understanding gleaned from being in the field. Bits and pieces of information from interviews, observation, documents, are combined and ordered into a more familiar quantitative approach.”

And she states that what she calls an “applied qualitative study” is ideal for research in the educational environment.

This thesis engages both strands of applied research: evaluation research and action research. The research methodology is, in part, evaluation research in that it sets out to evaluate the current practice of Sustainable Construction in the construction education sector in Ireland. It is action research, in that it sets out to address a specific problem, seeks a practical solution and brings about social change (Merriam, 2000). This is in keeping with Creswell’s elements of, Advocacy, or participatory research category, defined by Creswell as encompassing political issues, and so it is empowerment-issues oriented and collaborative-change oriented. Participatory Action Research has the ability to produce knowledge and action that is useful to the community while raising consciousness among those involved. It is also seen as a tool to lead empowerment and social change (Radermacher & Sonn, 2007). It is pluralistic in nature and participant led, thus its parameters and methodology are not clearly defined. In effect, the participants define the problem and gather information, create knowledge

and seek a solution, possibly guided and facilitated in this process but ultimately they operate within their own skill set.

The elements defined by Creswell align themselves with the Education for Sustainable Development learning process and community action on the ground which is at the core of dealing with climate change issues. Thus, a qualitative approach to the research and participatory action stance, where the researcher is bringing his skills, opinions and knowledge to bear, is considered most appropriate for this area of study. The quantitative aspect was deemed necessary to ensure the gathering of clear, unbiased, concrete data which would counteract or verify in an unbiased way any pre-suppositions of the researcher. This entailed the use of the NEP scale to determine attitudes towards the environment. To this end, a mixed method qualitative approach with a quantitative component has been chosen, which covers a variety of research practices and is designed to give a more holistic assessment.

The thesis development follows an accepted sequence, starting with selecting a topic research design and methodology; literature review; data collection; data analysis; findings; conclusion. In broad terms, the research can be viewed as comprising of three parts as can be seen below, with each part addressing one or more of the following objectives as outlined here:

1. To ascertain the skill needs of the construction industry in regard to climate change and diminishing resources
 2. To ascertain if such skills are being developed in the education system
 3. To ascertain attitudes towards the environment in construction students
 4. To audit exemplar projects to identify holistic solutions
 5. To consider bias towards technology driven solutions
 6. To review case studies in industry and education in Ireland
 7. To develop a concise working framework for module development in the industry using ESD principles.
- A. Secondary research: literature review which establishes definitions, with which to evaluate the current educational practice and sustainable construction methodologies.
- Literature Review (objectives 1, 2, 3, 4, 5)
 - Exemplar Projects (objective 1)

- B. Primary research: the evaluation of the current educational practice.
- Preliminary informal interviews (objective 1)
 - Audits (objectives 1, 2)
 - Course Evaluation comprising research review, surveys, evaluation, observation and informal interviews (objectives 3, 4)
- C. Applying the findings to the problem; development of a framework document
- Development of framework (objective 6)
 - Validation (objective 6)

5.3 Research and the Person

Jamieson (2015), an engineer and educator, portrays his creative side through song writing and shows how he tries to combine his academic life and his “own kind of personal political activism,” to communicate and bring about change. From time to time, I use the first person narrative in order to infuse the work with a sense of the personal and in keeping with ESD principles and the importance of the social dimension in Sustainable Development, highlight the role of the author in the research. As such, I must clarify my background and my relationship with the research topic.

I have a joint honours degree in history and geography and an interest in both. I have a higher diploma in education and I am a builder who has built numerous timber houses and enjoys working with my hands. As a building contractor, I specialised in sustainable building. I am an environmental activist and have been on the board of Cork Environmental Forum, Cork Transition Town and other community groups. I cycle and promote cycling as a mode of transport and I am a member of L.E.T.S., a local economic trading system. Finally, I am a writer who has published both short stories and poetry, though interestingly, none of this creative work is sustainability focused.

Validity and Reliability

Internal Validity: The research follows a clear sequence: literature review; methodology; case studies; data analysis; development of framework; validation; conclusion. It measures what it sets out to measure, meaning attitudes towards the environment and the current level of ESD in construction education.

Transparent Procedures: The fact that this research was carried out by one individual leaves it open to charges of bias and deficiency. This is especially the case

when the research question has evolved from the researcher's personal experience as a professional builder and also since the researcher engages in pro-sustainability activities in his personal life. These standpoints are validated by both action research and Education for Sustainable Development philosophies. By being as clear and as open as possible, I have highlighted my own weaknesses and biases. For example, one of my assumptions was that there was nothing being done in the education system to train sustainable builders, and another was that conventional builders had little or no concern for the environment. The research showed that there was work going on in the area and that some skills already being learned would be applicable in a sustainable construction sector and that the present students and future builders had a concern for the environment. I have also outlined clearly the steps taken in the research showing that the data collection was as complete and as accurate as possible.

Qualitative Research: Multiple sources of data address the question from different angles. Quantitative research provides significant data based on the opinions and perceptions of the participants which are inherently valid.

Triangulation: The finding in the surveys and discussions are cross checked with the literature. The most recent policy documents and closely associated research encompass attitudes of the general population, while a quantitative measurement is determined by use of the NEP scale. The NEP scale has its own internal validation system and will be discussed later.

Consensual Validation – This validation is in the form of agreement across and from respondents, students and lecturers engaged in the present education process. (Appendices: B, C, D, E, F)

Peer Review: One conference paper and two journal articles have been peer reviewed and published. (Appendices; A (1), (2), (3))

5.4 ESD – Methodology for Establishing Current Practice

5.4.1 Secondary Research

Based on the preliminary interviews, a literature review was conducted to verify or disregard areas of research needed. The secondary research, as presented in the literature review, was vital in directing the study. These sources were used to justify the research, define key terms, highlight barriers with regard to the implementation of ESD, provide direction for the research and help develop questions. The range of sources were wide and included policy documents, academic reports, papers and journals,

construction magazines, building manuals, published books and relevant theses. The literature covered a wide range, including education, sustainable development and education for sustainable development, green building and the construction industry. The key topics covered in the literature review were:

1. Sustainable development – Establishing a working definition
2. Education for Sustainable Development – Establishing a working definition
3. Construction Industry Education – Towards assessing current practice
4. Sustainable Building Education
5. Education as a Tool for Change – The need, barriers and drivers
6. Assessing a Pro-Environmental Attitude

5.4.2 Primary Research

The primary research was comprised of new knowledge gathered through surveys, interviews, observation and conversation, workshops, data collation and analytical techniques used in achieving the research objectives will be outlined in the following section.

5.5 Data Collection

5.5.1 Preliminary Interviews/Discussions (Appendix B)

These were carried out both on the phone and in person. This is cheap and time saving with a high response rate. The target population were a mix of construction practitioners; (builders, architects and architectural technicians) educators in the main stream construction sector; educators in the sustainable building sector; and environmental activists. These were selected because they were known to the researcher either in person or through contacts. In some cases, the selected respondents were first contacted through email and the topic and form of discussion was outlined. A date and time was arranged for the phone discussions.

Some discussions also took place after a workshop held with a view to putting in place an upskilling programme for construction workers (Appendix G). It entailed a roundtable discussion comprised of men from different trades.

All the interviews were exploratory in nature and the primary aim was the gathering of ideas, not facts. The discussions centred on the needs of a building sector

facing the challenges of global warming and resource depletion. They were unstructured and allowed for spontaneity and followed the general ebb and flow of conversation. Written notes were made during phone interviews and after personal discussions. However, these were very informal discussions and one or two salient points were noted and used to direct the study but notes were not maintained in a presentable manner.

The target population was small. There were eight respondents in total. (Appendix B)

5.5.2 Audits

There were two audits (1) of third level institutes in Ireland and (2) one of the schools of engineering in Dublin Institute of Technology. Both audits were done online.

The first audit was a search of all the Institutes of Technology in Ireland for sustainable building courses. This search covered engineering, management and craft. It included both undergraduate and post graduate courses. Course titles and promotional blurbs were read and key words such as ‘sustainable’ and ‘eco’ were searched for. Where relevant the course title, duration and level were recorded.

The second audit was a search through all the programmes in the School of Engineering and the Built Environment in Dublin Institute of Technology. This school was chosen as the student cohort surveyed are part of it. The idea behind this was to give a more holistic overview of the school and its practice as the student cohort is not in isolation.

These audits yielded significant and telling results and gave a further quantitative dimension to the research while adding to the overall picture of current practice.

5.5.3 Course Evaluation

The evaluation comprised a number of parts:

1. **Latest/most pertinent government policy review:** This entailed reviewing government policy on ESD. Education for Sustainability, the National Strategy on Education for Sustainable Development in Ireland, 2014-2020 (2014). This is a review of the most up to date government policy document concerning ESD and highlights the context within which the construction education sector is working.

2. **Latest/most pertinent research findings:** These are the outputs from a current PhD thesis. This is a review of recent research carried out on Engineers in DIT with regard to Sustainable Development and their understanding and knowledge of it.
Title: What do Final Year Engineering Students Know about Sustainable Development? (Nicolaou & Conlon, 2012)
3. **Programme audit:** An audit of the Construction Management Programme in DIT (2015) was carried out. This entailed a search for key words to assess if it aligned itself with ESD principles.
 - 3a. Module assessment: One module titled, Construction Technology, Sustainable Design and Build was reviewed for ESD methodologies and practices. (2015)
 - 3b. Surveys One and Two (2014)

Survey One (Appendix C)

A final year student cohort was selected for the online surveys. The research concentrated on a single group of students who would be in a position of influence with regard to the implementation of SD principles and practice onsite in the future. As this research is concerned with educational processes, it was felt that a student cohort of similar vintage were ideal candidates. They would have all had the same training to date and would have been subject to the same influences as far as course content, lecturers, college ethos is concerned.

An online survey was presented to a class of 19 construction management students. The New Ecological Paradigm Scale (NEP Scale) (Dunlap et al, 1978) was used for this. As seen in the literature review the NEP Scale is a proven tool for measuring ecological world view or pro-environmental attitudes, the theory being that attitude influences behaviour thus one must have a pro-environmental attitude to embed the philosophy of sustainability. It was felt that there was no need to reinvent the wheel and this survey targeted exactly what was being looked at in this study. There was no pilot survey used.

The NEP Scale is designed to give an empirical measurement of 'attitude'. As it is an accepted tool worldwide for this purpose not without its flaws and detractors, it was decided that the scope of devising another such scale was unnecessary as well as beyond the skills base of this researcher. The fifteen questions are designed to assess attitudes to five aspects of environmental sociology: balance of nature; limits to growth;

anti-anthropocentrism; possibility of an eco-crisis and the rejection of ‘exemptionalist’ attitudes.

The survey went one step further and added a sixteenth question concerning social justice. The question asked, did the students believe that fuel poverty and access to fuel and water should concern them as a professional in the construction sector?

Survey Two (Appendix D)

This survey was to assess the students understanding of SD and also to assess the level of ESD practice in the programme and gather student feedback. Eight concepts of SD were presented and students were asked to rate these and their association of each concept with SD on a scale of 1-5, 1 being irrelevant and 5 being very relevant. Other questions pertained to ESD, e.g. do you feel there is enough 'real life' problem-solving opportunities/experience in your training presently?

This survey was circulated but with poor response initially, and the class was approached by the researcher in person to assess the reason for this. It was reported by class members that the concepts were so far removed from their understanding of SD that they didn't have the information to answer. However, I explained that what I was looking for was their initial perception/feeling: e.g., ‘In your opinion, do you consider gender equality as having any relevance to SD. If so, grade this relevance on the scale 1-5’. I also explained that if they couldn't make a connection that in itself was an answer. This elicited responses from over half the students.

- 4. Research review:** This entailed reviewing sample research projects from both graduate and undergraduate work in the department (2015). Three samples of project work were reviewed:
 - 4a) ‘Scenario learning to identify the principal psychological components for WEB based Pedagogy for dislocated students in engineering and construction.’
 - 4b) ‘Sustainable framed structures in educational buildings: the benefit of an EAM.’
 - 4c) ‘How will remote sensing and 3D parametric CAD modelling assist the conservation of traditional African building?’

The primary aim of these reviews was to ascertain the level of SD thinking and motivation in the student's work and, by extension, the level of awareness, understanding or concern the student had for SD. The reviews of the research abstracts were subjective and I reviewed them from a sustainable stance.

This Approach

- (a) Look for terms which highlight a presence of SD thinking and/or ESD content and methodology.
- (b) Consider the problem the author is trying to solve, and its potential and limits in the context of SD or ESD.
- (c) The tools being used to solve the problem.
- (d) The key idea of the paper and other ideas it may contain which could be pertinent elsewhere in the context of SD, ESD.
- (e) Look for assumptions or weaknesses in the idea and implementation in the context of what is or is not sustainable and suggest how the idea could be developed and/or corrected or avoided if necessary, in the context of SD, ESD.

5. Second Round Informal Interviews/Observations: These were informal interviews with lecturers in the department combined with discussion and general observations from visits there. Some discussion was carried out via email. These discussions and informal interviews were primarily face to face, around the topic of ESD and largely followed the format as outlined in the preliminary discussions.

5.5.4 Questionnaire to Lecturers

A questionnaire was sent to a total of eight lecturers across a range of disciplines followed by a brief email discussion with a number of them. As with the preliminary interviews, the respondents were contacted initially by an email requesting their participation and outlining the research being carried out and the format of the questionnaire and the topic. A paper which had been published as part of the research was attached to convey the theme of the research. The purpose of this part of the research was to gather lecturers' opinions on the implementation of ESD principles and to clarify aspects of understanding around current teaching practice.

The questionnaire was preceded by an email requesting permission to send the follow up questionnaire. In the introductory email, I outlined the nature, content and number of questions. I outlined the scope of the research and attached a published paper which was part of the work.

This target population was chosen as they were deemed to be the cohort that aligned itself most closely with the research. Some were chosen because they were directly involved with the student cohort who were already surveyed and assessed for pro-environmental attitudes; one was chosen because he had been involved in research in this area and the rest were selected to cover the broad range of the construction industry, covering craft, management and design in order to reflect a multi-disciplinary approach.

5.5.5 Email Discussion

The questionnaire was followed up with an email discussion with some of the respondents. Two of the eight engaged in broader discussion and expanded on their ideas around ESD and the implementation of same in the construction sector and DIT.

5.5.6 Exemplar Projects

The Exemplar projects provide specific, tangible examples of sustainable building philosophy, methods and materials as used in the field. Based on the practical experience of the researcher, they are examined to show how a philosophical underpinning to design and work practice can produce sustainable buildings. The main aim was to establish what could be learned from practical experience and also demonstrate the implementation of sustainable building principles. It also provides an indication of current sustainable building practice.

The researcher was the main contractor for the three case study projects. They were selected because they are the most comprehensively recorded examples and also because they demonstrate sustainable principles across a variety of designs, methods and materials.

No interviews were done in relation to the studies and all the assessment is based on the first-hand knowledge of the researcher as main contractor. A detailed outline of build process and the thinking behind the same and decisions made, is provided. Each project is also broken down and assessed with regard to key criteria set out by the UN in a definition of Sustainable Development found in the literature review. This definition is

also the same definition used in Survey 2 on the student cohort to assess their understanding of sustainable development. The reason for this is to use an internationally accepted definition of SD to maintain consistency of definition and clarity in the research and to leave no doubt as to the author's interpretation of sustainable development.

The aim of conducting these case studies was to establish a perspective on how sustainable building is being practiced in Ireland at present. Definitions for sustainable building are proffered in the literature review and the way we build presently is discussed in the context of these definitions. Three examples are selected to assess the practical application of sustainable philosophy. The studies will examine and explain the key 'sustainable' attributes associated with each build. The studies selected are:

1. Private residence at Carrick-on-Shannon, Co. Leitrim: a cedar-clad, timber-frame domestic dwelling
2. Private residence at Leitrim Village, Co. Leitrim: domestic dwelling with garage
3. Private residence at Drumahaire, Co. Leitrim: split level, domestic dwelling

The uses of the terms 'sustainable' and 'sustainable building' need to be qualified here, as none of these projects are totally sustainable. The best that can be said is that they are possibly 'more sustainable' than conventional build. It must also be stated that no embodied carbon, embodied energy calculations or life cycle analysis have been done. However, a commonality across all the projects is the concern of clients, designers and builders, to varying degrees, for the environment, the ethical sourcing of materials and the health and wellbeing of the occupants. I do believe that they give a good indication of the direction in which building needs to go to become a useful tool, by which society will achieve Sustainable Development.

A simple matrix was developed to display the data and relationship between the build processes. Cross referencing was used on site/land use, design, materials and building methodology, with key components of SD such as health, rural development, gender, environmental stewardship, security, urbanisation and consumption.

5.6 Research Limitations

Research can be limited by any number of factors including the researcher's skill set. Jamieson (2009) suggests that we must be conscious of our abilities when approaching a problem. This is in keeping with Education for Sustainable Development thinking which emphasises reflection and self-knowledge and an understanding of our own strengths, weaknesses, biases and the humility to acknowledge same. Jamieson suggests we need to move away from a position of arrogance to one of humility.

This researcher encountered a number of obstacles which impeded progress. One such obstacle was the lack of clarity around terms and definitions. While I felt I understood intuitively from experience and general reading what SD was, lack of a precise definition hindered clarity of thought and also the expression of my own ideas. The literature showed that this is a widespread issue; there is a lack of understanding around the key terms and they are used interchangeably.

I overcame this problem by seeking clear concise definitions from reputable sources and identifying the main principles being conveyed by each. This allowed me to think clearly about the topic. By constantly using the key principles of a UN definition as a reference point, it allowed me to maintain consistency in my research. The amount of published information on this topic was another obstacle. There is substantial material on SD and ESD but less on sustainable building and almost none on sustainable building education. There is also minimal information on applying the principles of ESD to construction management. While this appeared to be an obstacle initially, it was resolved by the fact that the nature of ESD allows itself to be applied to all learning.

There was also a lack of policy pertaining to the Irish education system. The document critiqued in this paper was the first of its kind and only published after this research was well underway. Other sources such as outputs from PhD research are referred to. Furthermore, there were other documents concerning the economy which talked of 'the green economy' or 'upskilling for the green sector,' but when assessed closely the concepts were not in line with internationally understood definitions of sustainability. This area around terminology cropped up again in preliminary discussions and clouded the debate. Some practitioners equated energy efficiency and associated upskilling, as the implementation of sustainable practice. However, the upside of this was that the researcher had to come to grips with the terminology and provide a clear definition of SD as a point from which to start.

Another obstacle with this topic is its prevalence in mainstream society and the values attached to it. Everybody is aware to some extent of the negative impact man is having on the environment. Everybody is aware of it, has a partial understanding or misunderstanding and responds accordingly. Consequently, the researcher and the interviewee were often talking about two different things. This was compounded by the political correctness around this topic. It is taken as given that we are all responsible and thus everybody wants to be seen to be doing their bit and consequently it felt like they were trying to fit square peg into a round hole or tailor what they were already doing to suit the criteria. With regard to definitions, 'energy efficiency' is seen to be interchangeable with 'sustainability'. This is similar to holding 'environment' up as an equivalent to 'sustainability'.

5.7 Summary

This chapter has outlined the research process, methods and design. A mixed method approach using qualitative and quantitative was taken for the thesis research. While the emphasis was on qualitative research, it was backed up by quantitative data where suitable. The qualitative method is in keeping with ESD principles and is appropriate to the research question. It allows the researcher to be flexible and adapt the method as the research develops. Daly (2011) states that this flexibility is very suitable for a research where a practical outcome is desired. Each of the methods outlined have contributed greatly to the evaluation and development of a sustainable building module. They added considerably to the knowledge and understanding gained from the literature review. The interviews gave insight into attitudes, perceptions and understanding around sustainable building in an informal way while the survey provided a measurement. The case studies, audits and document critique along with the survey and interviews gave a full picture of the problem while used to support findings in the literature.

SECTION 4 – PRESENTATION OF FINDINGS

Chapter 6: Audit of Sustainable Practice

Case Studies

6.1 Introduction

The aim of conducting these case studies was to establish a perspective on how sustainable building is being practiced in Ireland at present. In this section, three examples are selected to assess the practical application of sustainable philosophy. The studies will examine and explain the key ‘sustainable’ attributes associated with each build. The studies selected are:

1. Private residence at Carrick-on-Shannon, Co. Leitrim: a cedar-clad, timber-frame domestic dwelling
2. Private residence at Leitrim Village, Co. Leitrim: domestic dwelling with garage
3. Private residence at Drumahaire, Co. Leitrim: split level, domestic dwelling

6.2 Exemplar Project 1



Figure 1: A cedar-clad, timber-frame residence in Carrick-on-Shannon, Co. Leitrim

6.2.1 Site and Land Use

Built on a rural, one-acre site, this development was envisioned by the occupant as multifunctional: a place to live, a place to work, a place for recreation, and a source of fuel and food.

6.2.2 Design, Process and Philosophy

The overarching philosophy of this build was to be sustainable where practically possible whilst providing the occupants with all the comfort and needs of modern living. The environment and local economy were considerations for every purchase and won out where practically and financially feasible.

The property was designed and drawn by the owners who had taken a 'design your own home' course given by a local architect. The principle of the course was to empower the occupant in the act of building his or own shelter. The owners jointly designed and specked their own house.

While there is nothing complex in the design to enhance solar gain, the occupant or designer adhered to some basic principles of passive solar design. The house is oriented to the south with more glazing to maximise light. The primary living area is to the south while scullery, stairwell and downstairs toilet requiring less light (and thus reduced window size) are kept to the north face. The house is highly insulated, airtight and uses a combination of solid fuel and renewables such as photo voltaic, solar and wind to generate energy. Materials specked were also to be primarily local and/or organic.

This house was built pre-BER and at a time when the idea of involving a mechanical/electrical engineer to spec heating and energy systems on a one-off house would not be the practice. The occupant/designer used a simple rule of thumb and that was to go above and beyond the current building regulations. He was aware of the passive house concept, a design which provided comfort in much colder winters, without the need for a heat source. He felt if he insulated and made the property airtight to a high standard and also added renewables, he would achieve considerable financial savings over the life of the house and reduce carbon emissions. However, he did also fit a solid fuel stove and gas fired central and hot water heating system but with greatly reduced radiator sizes.

He also felt a mechanical heat-recovery system would not be necessary and considering the embodied energy in the manufacture, maintenance and running, felt it

counter-productive. Instead, he opted for natural ventilation. This simplicity of thought adheres to sustainable principles. He avoided over-specification as well as the need for unnecessary experts and associated costs, thus keeping the build simple and manageable for the non-expert.

The reduction in the use of concrete and cement-based products was seen as a simple way of reducing the building's carbon foot print.

On-site construction using local tradesmen was seen as more sustainable, while dry construction methods were also viewed as more sustainable, reducing the need for cement-based plasters and associated water consumption. It was felt that using treated water with a considerable embodied energy for making mortar was wasteful.

6.2.3 *Materials and Methodology*

Foundation



Figure 2: The rising wall, DPC, timber deck and stud wall

The base was a hybrid of standard strip foundation with rising walls built up to DPC level and a suspended timber floor. This is accepted building practice and is covered by regulation. It is just no longer in frequent use. The suspended timber floor was insulated with natural fibre hemp insulation and the subfloor of Irish made 11mm OSB sheathing was made airtight. The use of hard-core, oil-based insulations, membranes and concrete were eliminated.

6.2.4 External Walls



Figure 3: External walls with diffuse open Panelvent

The frame was built on site as opposed to being prefabricated. This method is known as 'stick framing'. A diffuse-open wall was constructed using Panel vent as structural sheathing. The wall was a 275mm stud filled with hemp insulation and made airtight internally. Standard external membranes were used before battening and counter-battening to create a ventilated space and laying on board Irish grown cedar-cladding. Corner details were built to reduce thermal bridging and allow maximum insulation for ease of same.



Figure 4: External cladding

Internally, a paper-based airtight membrane was fitted before counter battening, counter insulating (50mm), plaster boarding, taping and jointing. Large quantities of water were spared by taping and jointing; an Irish manufactured jointing compound was used. Counter-battening allowed for run of services and reduced breaches to the airtight membrane while also allowing for counter insulating which greatly reduced thermal bridging.



Figure 5: Internal Airtight Membrane and Counter battening

For the most part, the standard roof specification was employed with one difference. The rafters were hung from a ridge beam. This removed pressure off the walls and with a 275mm rafter, eliminated low-level collar ties. It also allowed for a continuous blanket of insulation up and over the ridge beam, further reducing thermal bridging. Natural slate was used.

6.2.5 Windows and Doors

Irish manufactured, quality double-glazed wood windows and doors were used in the build.

6.2.6 *Internal Finishes*



Figure 6: Stairs

The fitted-kitchen was made on site, from material sourced in the local hardware. The stairs was made from a locally grown sycamore, the components being milled before being brought to site and assembled. All components arrived on site as square and planed scantling and dressed as required. Natural paints were used throughout.



Figure 7: The completed build

Table 1: Comparative Analysis with Criteria set out by the UN as Key Considerations in any Sustainable Project

	SITE/LAND USE	DESIGN	MATERIALS	BUILDING METHODOLOGY
HEALTH	- Benefits of country living	-Aspect -Non-toxic materials -Paints - Empowerment	- Reduced Toxicity	- Safety of workers
RURAL DEVELOPMENT	-Rural Regeneration	Functional: -Work -Play -Food	-Sourced Locally	-Local Trades
GENDER		-Lifestyle of both partners considered in design		-Empowerment
ENVIRONMENTAL STEWARDSHIP	-Environ restoration and management		-Production/transport impact considered	
SECURITY	-Food security			
URBANISATION				
CONSUMPTION		-Passive solar use of renewables	-Recycled -Low embodied Energy	- On site dry construct iron

6.3 Exemplar Project 2



Figure 8: House at Leitrim Village on a one-acre site

6.3.1 Site and Land Use

This dwelling is visually unobtrusive in the surrounding landscape. On an elevated site it is ‘stepped back’ and is not easily seen from the road below.

6.3.2 Design / Process/ Philosophy Material

The design and specification are primarily the work of the occupant/designer with the help of a draughtsman. The primary objectives were to (1) minimise energy consumption and provide necessary areas with renewables and (2) to respect the vernacular and be visually unobtrusive.

The design proposes to emulate the traditional story and a half with an outhouse attached. This utilises two key vernacular features (a) punch-hole windows and (b) stepped roof levels, a common sight in rural Ireland. The effect is enhanced by the roof coverings: natural slate and corrugated sheeting, while the colour scheme, red and white, also lend to this.

6.3.3 Material / Methodology

Foundation: As standard.

6.3.4 Walls

The shell was a pre-fabricated timber-frame construction insulated using wet-blown cellulose and made airtight with traditional block outer leaf and rendered as standard.

6.3.5 Roof

Bitumen-impregnated, paper-based corrugated sheeting was used as roof covering on the main section.

6.3.6 Window and Doors

Triple glazed and imported



Figure 9: Doors

6.3.7 Internal Finishes

Finishes were kept to a minimum. The doors were traditional lath and brace (white deal). Architrave and skirting were reduced to 50mm X 10mm. Standard pine doorstop was used for this. OSB was varnished and left finished for floor covering in main living area.



Figure 10: OSB Flooring

6.3.8 Energy Source

A combination of wood pellet boiler and solar hot water heating.

Table 2: A Comparative Analysis with Criteria set out by the UN as Key Considerations in any Sustainable Project

	SITE	DESIGN	MATERIALS	BUILDING METHODOLOGY
HEALTH	-Benefits of country living		-Reduced toxicity	-Safety of workers
RURAL DEVELOPMENT	-Rural regeneration			-Local trades
GENDER		-Needs of both partners considered		
ENVIRONMENTAL STEWARDSHIP	-Environ restoration	-Visually unobtrusive		
SECURITY	-Potential			
URBANISATION				
CONSUMPTION		- Minimalist Detailing	-Recycled -Low embodied Energy	-On site

6.4 Exemplar Project 3



Figure 11: Residence at Dromahair, Co. Leitrim

6.4.1 Site and Land Use

Set in a hollow, the design allows the house to blend into the landscape.

6.4.2 Design / Process/ Philosophy

Purists would argue that the use of concrete, glass and extruded polyurethane insulation in the Mimetic house renders it unsustainable. And with regard to energy efficiency, it is not attempting to reach Passiv Haus standards, but like everything else about the Mimetic House; its illusory qualities hide the underlying philosophy of sustainability that guided the build. As a whole unit, the Mimetic house may fail the sustainable test, but there are many facets to it that merit the attention of the sustainable practitioner.

6.4.3 Visually Unobtrusive

The Mimetic house does this like no other. It can be a wildflower-meadow in summer and an ice-berg in a field of snow in winter. In this way, the Mimetic house pushes the boundaries in a sustainable aesthetic that seeks to merge with the landscape. By burying part of the house and cladding the top section in reflective glass that camouflages, it achieves this. In our quest for a truly organic structure which fits seamlessly into the

land, the Mimetic house shows us what can be done. Now the trick is to do it with totally sustainable materials.

6.4.4 Material / Methodology

Foundations



Figure 12: Foundations of the house

Since half of the house is concealed underground, compromises in material had to be made. A concrete-retaining wall and cavity block wall formed the lower section. However, it is only the bottom half that is built with concrete and block. It was decided to use Irish grown timber for the upper portion of the house. This was designed by the architect and the structural engineer to reduce as far as possible, the need for steel. Timber beams and column sections are bolted together to provide the stability.

Making up the beams and columns on-site is more labour intensive than buying in rolled steel joists, but there is considerably less steel used. The timbers used for the columns are 225mm spruce stud and allow for 225mm of Rockwool insulation to be fitted in all the solid panels. The panels were constructed with breather membrane to the outside and OSB to the inside. The OSB doubles for racking strength and vapour, check and polythene was eliminated. Not having the OSB to the outside complicated the build somewhat. The OSB would have tied members together and stabilised individual components, which would have eased assembly. Each individual stud (no two of which were the same length and all leaning outwards at 10 degrees) had to be propped and

braced until the roof members were fitted and everything was tied together.

OSB was also used for sheathing the roof and floor. It is the ideal sustainable sheet material. Made from low grade, fast growing timber such as Sitka spruce, OSB is made in Ireland from Irish timber; it has low glue content (2-3%) and formaldehyde emissions are correspondingly low.

The roof is finished with butyl rubber, drainage mat made from recycled sneakers, Styrodur Insulation and clay from the site. There were only two outlets through the rubber, one for the flue of the solid fuel stove and one for a rainwater pipe. These were welded on in the factory to ensure a perfect seal.

6.4.5 Reduce and Reuse

From the roof beams down to the internal finishes, the first principal of sustainability, which is, 'reduce', was applied. Fascias, soffits, gutters, window-heads, windowsills and all associated detailing were eliminated. Inside, plastering to the floor and a dyed sand /cement screed eliminated skirting boards, architraves and floor finishes. The owners engaged with some of the finer finishes such as painting and overseeing the built-in units in the bedrooms.

The second principle of sustainability, which is, 'reuse', is also evident in the build. Railway sleepers have been used to retain banking, but something more substantial was needed when a large, gravel pit was encountered and gave way during the excavations. The solution was to use the materials available on site and to source materials that could be recycled. The structural engineer for the project came up with the idea of using discarded car tyres to form a retaining wall. The on-site sands and gravels provided ideal base materials for concrete and when dry-mixed with Portland cement, a concrete retaining wall in a permanent formwork was born.

Tyres, sourced from nearby garages, were stacked and packed on a strip foundation. Each tyre had about three wheelbarrows of gravel/cement mix packed into it with sledge hammers. It was laborious work.

6.4.6 Local

Another key element to the philosophy of sustainability which guided the build was to source as much material locally as possible. Quality pine windows were sourced from a small local joiner and treated on-site. The window treatment was the only chemical preservative used in the whole build. Borax was used for the structural timbers to

prevent fungal decay and insect attack. Borax is ideal as a natural wood preservative. It is easily applied with a brush or sprayed on and its toxicity is low. It is relatively harmless and wood treated with it can easily be recycled and is not regarded as toxic waste.

The components for the spiral staircase were designed by Dominic Stevens and fabricated by a local welder/fabricator (again a one man operation) and assembled on site by GreenTek. On the lower section, the blockwork was clad with Irish grown, western red cedar sourced from a local one-man operated saw-mill. Said man is a farmer when he's not milling timber. While the Mimetic house looks like something dropped from Mars, all the work has been done on site by local tradesmen. The simplicity in detailing allowed for this. There were no specialist sub-contractors. Even the fixing of the glass cladding was uncomplicated and the fixings were easily sourced. Are sustainable local economies not the bedrock of any sustainable society?

6.4.7 Spaces Around the House

The design eliminated the usual footpaths, and grass is allowed grow right up to the house. Access is provided via gravel paths from the car park to the entranceways. No paving or hard surfaces were used and this considerably reduced the run-off. To deal with the rainwater, some land drainage pipe was used but PVC piping, gullies, manholes and associated ground works were totally eliminated. Run-off is an issue rarely considered in mainstream building and its effects can be detrimental. It can cause flooding of the drainage and sewerage systems, damaging ecosystems and plant and animal habitats. On a larger scale, it can prevent ground reservoirs from filling up. Furthermore, hard surfaces can prevent oxygen from getting to micro-organisms and eventually kills the soil.

The clay from the site had good drainage properties, the only downside of which was that it took a long time for vegetation to take hold. After two years of no growth, topsoil was imported, bringing its own flora and fauna with it. This is not detrimental, but it was hoped that all the soil from the dig would be sufficient to landscape the site, without disturbing the subtle variations in flora and fauna that can occur from field to field, thereby promoting environmental restoration.

6.4.8 Sewage Treatment

The sewage system consisted of four lengths of pipe and two manholes to make the

hook up to the wastewater treatment unit. Planning specified a polishing filter bed to be used, which did demand the use of more piping. Planning also specified pea gravel in the filter bed which entails the excavation of same and transportation to site.

6.4.9 Working from Home

A secondary use for the mimetic house was to act as a gallery space for the work of the owners who are artists.

6.4.10 Energy Source

Gas central heating provided a source of energy in the property.

Table 3: A Comparative Analysis with Criteria set out by the UN as Key Considerations in any Sustainable Project

	SITE	DESIGN	MATERIALS	BUILDING METHODOLOGY
HEALTH	-Benefits of country living		-Reduced toxicity	-Safety of workers
RURAL DEVELOPMENT	-Rural regeneration	-Functional -Work from home	-Sourced locally	-Local trades
GENDER		-Needs of both partners considered		
ENVIRONMENTAL STEWARDSHIP	-Environ restoration	-Visually unobtrusive	-Production method	
SECURITY	-Potential			
URBANISATION				
CONSUMPTION	-Use of site material	- Minimalist detailing	-Recycled -Low embodied energy	-On site

6.5 Findings

- a. The case studies reflected a broader understanding of sustainability rather than just energy efficiency.
- b. The local economy was being considered through the sourcing of materials and local trading.
- c. In two of the studies, the aesthetic considerations of the build in its surrounds was given much consideration.
- d. Working from home and the utilisation of the site for food and fuel sources was considered in at least two cases.
- e. An awareness of sustainability issues among clients and builder and an attempt to reduce the global impact of these builds is in keeping with the literature.

6.6 Conclusion

The aim of conducting these case studies was to establish a perspective on how sustainable building is being practiced in Ireland at present. The key attributes common to all of these projects are the emphasis on the local with regards to both material and skills; the emphasis on energy efficiency and the emphasis on environmentally friendly materials. Also, all clients had a motivation to build sustainably, driven by an awareness of the impact one individual's actions can have on the wider world.

Chapter 7: Research Results

7.1 Introduction

The result of a set of audits and surveys which identify and attempt to measure the extent, requirement and attitude towards education for sustainable development is presented in this chapter. Three key points led to determining the focus of the study:

1. It was decided that the focus should be on construction implementation and management as opposed to design. The preliminary interviews and the literature review highlighted that, designers and engineers are already moving in that direction as professional bodies, while the Qualibuild programme is being rolled out to up-skill building workers in the area of energy efficiency. It was also identified that arising from the third level course audit, there was no Fetac Level 8 course in Sustainable Building in Ireland.
2. Education was chosen as a place where substantial attitudinal change can occur. It was decided that the education of students in the construction sector was of paramount importance in ensuring sustainable development. Thus, it was decided an examination of the attitudes of these students would gauge if they had the appropriate attitude towards the environment required to ensure the implementation of sustainable building techniques and processes.
3. In keeping with SD principles, some focus on 'community' as an issue was deemed appropriate. The students on the Construction Management programme were seen as the 'community' most closely related to the researcher. The idea of focusing on Construction Managers to assess their level of knowledge and understanding around sustainable issues arising from present educational approach was deemed an appropriate focus group.

7.2 Secondary Research

The following points were concluded from the literature review:

- A. The attitude of society in general towards the environment was one of the key barriers to sustainable development. This was in keeping with findings in the

Preliminary interviews that showed that attitude amongst builders was a barrier to implementation of sustainable practice on site.

- B. Instilling an environmentally sensitive attitude is probably the best (but the most difficult) method to ensure that sustainable development is embedded.

The UN World Summit in Johannesburg (2002) outlines the need for a reorientation of our education system and the integration of sustainability into education. This objective was restated at the United Nations Conference on Sustainable Development in 2012. There have been calls from numerous governmental, non-governmental bodies and academics for a reorientation of education in the US and the UK while studies are showing that increasingly, students want to work with ethical employers. Employers are also turning to universities to prepare students to work with more socially responsible employers (Van Nierop, 2008).

The preliminary interviews had shown that clarity around terminology was critical to discussing and pinning down the research topic. The secondary research provided definition and meaning for some of the key concepts. The three key terms to be defined for this research were: Sustainable Development, Education for Sustainable Development and Sustainable Building. Once these were clearly defined I could then conduct the research within clearly defined parameters.

The secondary research was also used to compare attitudes from the study group with the wider society and also explore in greater depth, the meaning and construction of knowledge. To me, this understanding became integral to the research. Not only are we being asked to change our attitude towards the environment, but, to do so, we are being asked to change how we teach and how we learn and in effect, how we construct knowledge.

7.2.1 Definition of Sustainable Development

Two definitions are identified here; one outlined by the UN; another more tangible one from FEASTA.

Sustainability is not so much about the environment, but about an all-encompassing way of life which meets the needs of the present without compromising the needs of the future. It is a concept which frames a way of thinking about how we would like to live; one which requires us to think holistically about the symbiotic relationship between man and nature and expects us to act accordingly.

Numerous definitions of sustainable development exist, but the most widely used one is from the Brundtland World Commission on Environment and Development report, presented in 1987 (Brundtland Commission): “Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

The FEASTA definition considers a sustainable system as being: “Capable of being continued unchanged for hundreds of years without causing deterioration in any of the factors which make it up” (FEASTA Review, 2001).

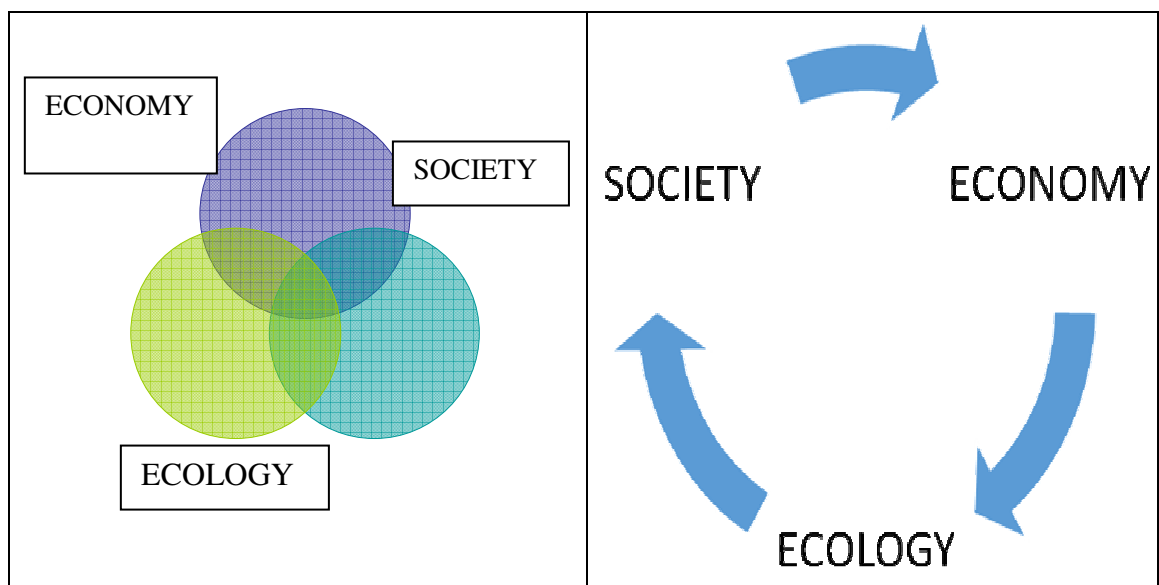


Figure 13: Represents the interconnectedness of the three pillars of SD

7.2.2 *Definitions of ESD*

Education for Sustainable Development is an amalgam of Development Education (DE) which has grown out of work on the ground in developing countries and is primarily concerned with social justice issues such as food, water, fuel sovereignty and poverty and Environmental Education (EE) which is concerned with protecting the environment. The methodologies and content matter of DE/EE and ESD are closely aligned and include the concept of education as a tool of empowerment, inspiring individuals and society to assume sustainable lifestyles for the benefit of present and future generations. The coming together of these two ideologies creates a complex but more realistic approach to problems which are clearly intertwined.

ESD demonstrates skills, values, knowledge and understanding that support positive action toward sustainable management of the environment and greater social

equity and poverty eradication (Centre for Global education Policy, 2008).

Promoting knowledge of ESD and developing the relevant skills involves moving away from more prescriptive modes of teaching that focus on knowledge transfer, towards teaching methodologies that facilitate more problem-based, interdisciplinary and collaborative student participation and learning where knowledge is co-created (UNESCO, 2012, pp. 23-26; UNECE, 2005, pp. 6-7; UNECE, 2009, p. iii).

The research found various combinations of the principles of ESD throughout the literature. In 2007, UNESCO defined ESD as a practice which:

- a. Promotes a shift in mental models
- b. Engages formal, non-formal and informal education
- c. Promotes lifelong learning
- d. Uses a variety of techniques that promote participatory learning and critical reflective skills
- e. Promotes social justice
- f. Accommodates the evolving nature of sustainability
- g. Is locally relevant and culturally appropriate
- h. Is based on local needs, perceptions and conditions which acknowledge that fulfilling local needs has global consequences
- i. Builds civic capacity for community-based decision making

Table 4: A list of the most pertinent and recurring ideas and terms

Recurring terms and phrases in the literature associated with ESD content and methodology	Key components as defined by the UN:
Learning through Experience	<ol style="list-style-type: none"> 1. Health 2. Rural Development 3. Gender Equality/Equity 4. Environmental Stewardship 5. Cultural Diversity 6. Peace and Human Security 7. Sustainable Urbanisation 8. Sustainable Consumption
Participation and Reflection	
Engaging with Real Issues	
Holistic/Participatory	
Solution-focused Approach	
Multidisciplinary Approach	
Case-based Collaborative Learning	
Problem-based Learning	
Community-focused Education	
Service Learning	
Learner Driven	
Personal Experience	
Reflective	
Interpersonal Skills	
Through Action and Example	

This chart shows the recurring ideas and terms associated with ESD methodology on the left hand column. On the right is a list of key components of SD considered pertinent by the U.N. The purpose of this chart is to bring both of these together in a clear format. However, in practice, there should be a continual overlapping, symbiosis and interconnectedness, to varying degrees, of all the sections. The column on the right should form the basis for our core areas of knowledge while the column on the left outlines the methods through which we are to learn.

ESD practices a holistic approach to our global concerns and seeks to solve problems, taking into account social, economic and environmental considerations. It covers a broad range of social issues such as gender equality, health, cultural diversity, environmental stewardship, peace, ethics, democracy and governance (UNESCO, 2007). The overarching objective is to raise awareness and understanding of SD and global issues.

7.2.3 Definitions of Sustainable Building

Sustainable building should be viewed as a tool to achieve Sustainable Development. Kibert (2012). Rogers (1998) defines ‘sustainable building’ as “a holistic approach to design that combines social, economic and environmental objectives and that evaluates against their local and global impact.”

The definition and understanding of what it means to build must be broadened to incorporate the general wellbeing of workers and occupants and the community within which the building is situated and also deal with issues of wider concern such as fuel poverty, access to inexpensive, nutritious food and access to inexpensive clean water as well as issues of global justice, such as access to affordable housing (Hargreaves, 2008).

7.2.4 Working Definition

Building sustainably entails balancing diverse needs, cultural perceptions, economic constraints while conserving resources and protecting the environment and people’s health and well-being.

7.2.5 Defining Knowledge and Education

“Science inevitably tempts its practitioners to scientism, scientific hubris, dogmatic arrogance and even childish naiveté” (Bauer, 2001).

Jamieson, who promotes the concept of the Hybrid imagination in response to the hubris of scientism, which has led to the present crisis, suggests, “...mixing natural and social, local and global, academic and activist forms of teaching and learning in new combinations” (2009).

Polanyi, who wrote *Personal Knowledge* (1957) and developed the concept of ‘Tacit Knowledge’, criticises what he calls the mechanistic world view, and elevates the importance of innate knowledge, or, in regard to a craft, knowledge gained through practice and experience, which may not be so easily expressed.

“...experiential, local, or tacit knowledge that arises from personal experience and exploration outside the confines of educational institutions and without full adherence to the scientific method” (Kavornen, 2007).

Sterling (2001), a sustainable development educator, suggests that the curriculums, goals, aims and knowledge, and methods and assessment, be developed by the learner based in part on personal knowledge.

7.2.6 Key Findings

1. Definitions of key concepts
2. Changing attitude is the best way to embed SD and this is best achieved through orientating the education system
3. The main aim of ESD is to develop resilience and this is best achieved through developing interpersonal skills, critical thinking skills and empowerment

7.3 Primary Research Results

7.3.1 Preliminary Interviews

The first informal interviews were with education professionals in the construction field and out of this came one suggestion; a skills audit of the construction sector. A literature review and informal discussions with sustainable building practitioners would inform a skills audit as to direction, specificity and method. However, the lit review on skills audits in this sector turned up the fact that a number of other countries had already carried these out, for example, Australia, the UK and the EU, as well as general research related to Ireland on the need for upskilling or ‘greening’ the economy. Thus, it was judged that there must be a skills deficit here also in this area. This was borne out by discussions with industry professionals which backed up my own experience and knowledge. Further research showed there was work actually going on in the general area, including a workshop seeking to address the skills gap in the renewable energy sector. This workshop, motivated by EU policy around the need to reduce our carbon emissions by 2020, was conducting discussions with building practitioners to find out what the specific skills needs were, with the hope of retraining and upskilling the relevant crafts people.

In the current Irish context, with an excess of housing stock outside Dublin, renovations were seen as the priority. Also, this researcher felt that, as with legislation, the main concern of the workshops was around energy consumption. It was not broad ranging and all-encompassing enough to be classed as sustainable. It did not, for example, consider the embodied energy of building materials. Thus, this researcher decided to focus on the building needs for sustainable construction and an all-encompassing sustainable approach to construction. But with the work already going on in the area of energy efficient building, the idea of a skills audit became less tenable as it would be hard to explain and could be seen as splitting hairs.

This misunderstanding of words like ‘sustainable’ ‘green’ and ‘low carbon’ crops up in the literature review but it had emerged in practice in the preliminary interviews where sustainability and low carbon, energy efficiency were used interchangeably. It was clear to me from a very early stage that this was an issue I would have to deal with. It also meant that I had to be very clear and succinct in my own head about what I was trying to communicate.

Through this preliminary round of informal discussions, on the phone and face to face with sustainable building practitioners, the idea of identifying a skills gap for low carbon construction began to unravel, because these discussions highlighted difficulties around what ‘sustainable’ means. The term ‘low carbon’ was used to conceptualise what was going on in the industry at present, however a number of important points need to be considered:

1. There is no single definition of what ‘low carbon’ building is. Thus, it was felt that engaging in a process where there were not clearly understood definitions would be untenable.
2. It was realised that if there is a skills gap in the renewable energy/conservation sector, there must certainly be a lack of understanding of skills and knowledge when it comes to ‘low carbon’ building.

Another viewpoint that guided the research was from an educator in the sector who suggested that the students were already being equipped with the technical skills. Even though not packaged as such, they were learning the skills in building physics required to design sustainably or at least if presented with the remit, they could design an energy efficient building. This combined with the fact that there was also research work going on in the upskilling of trades for energy efficient building in Ireland. It was felt that a study in the area of low carbon building would not be distinct enough and would lead to confusion, thus making the angle of research hard to justify.

However, also from these discussions the question arose as to how to develop a truly sustainable construction sector. Other questions around this included, what were the barriers to implementing a truly sustainable building practice? How do you ‘make’ a sustainable builder? What role would the sustainable builder play in the future? A clear distinction between builders and architects was defined, in other words between designers and crafts people.

During these informal discussions with sustainable building professionals, one architect made the point that while he did feel there was a need for upskilling the crafts people, he felt the core skills were already there; it was the ‘attitude’ and ‘enthusiasm’ that was lacking. This statement was crucial in directing the focus of the study. This also paralleled what was later found through the secondary research which was (1) that attitude was crucial in bringing about change and (2) in this specific research area, core beliefs around the relationship between man and his environment would be key factors in the successful implementation of the goals of sustainable development. The key findings from these interviews were:

1. Language and terminology would have to be more clearly defined for the purposes of this study.
2. The idea that ‘attitudes to the environment’ among building workers were a crucial focus for change.
3. That some conventional courses were at least in part providing students with the core skills to build sustainably.

These three findings directed further research. Definitions were sought to frame the key concepts of the study. ‘Attitudes’ were researched and conventional or current courses in construction studies were audited for skills to build sustainably.

7.3.2 Audits

Audit 1

An audit of available sustainable construction courses was carried out. All the construction programmes from all the ITs in the country were reviewed for courses with the word ‘sustainable’ in the title. This showed that there were two Level 7 sustainable construction courses in the country, one in Sligo IT and one in Limerick IT. These were innovative and combined a practical component, carpentry, with management and sustainable building design and methodology.

There were four courses nationwide on sustainable engineering, comprising three at Level 8 and one at Level 9. There was a one year add-on Level 7 course in construction management.

Table 5: Available Sustainable Building courses (see appendix for full details)

	Sligo IT	DKIT	LYIT	AIT	DIT	IT Tralee	WIT	Carlow IT	Cork IT
Sustainable Construction	1	0	0	0	0	0	0	0	0
Engineering	0	0	0	1	0	0	2	0	1
Sustainable Construction Management	0	0	1	0	0	0	0	0	0

Key Finding: There is no Sustainable Construction Management course at Level 8 being offered in the country at present.

Audit 2

Audit 1 was followed by a more in depth audit of the School of Engineering and the Built Environment, to ascertain if sustainable practice and methodologies were being engaged in but not mentioned in the title. This was felt necessary after one lecturer raised the point that the students were being taught the skills necessary to build passive houses, meaning in building physics and this has always been the case, it is simply not highlighted. Thus, a more in-depth review of course content and module descriptors was decided on to ascertain the depth of sustainable thinking in the school.

The table below shows the number of modules in each course, the number of module with sustainable in the title and the number of key words in the course description. Key words are any words or terms referring to sustainability or social justice issues. Also words like ‘green’ or ‘eco’. Words like environment, in isolation, were not considered as this term is widely used but not necessarily in the context of sustainability where it is considered in conjunction with social justice issues and the economy.

Table 6: Sustainable Modules

	Total Number of Modules	Number of Sustainable Modules	Use of Key Words
Bachelor of Architecture <i>DT101</i>	40	2	0
Bachelor Engineering Tec (Ord) Building Services Engineering <i>DT005</i>	32	0	0
Bachelor of Engineering (Hons) Structural Engineering <i>DT024</i>	31	0	0
Bachelor of Engineering (Hons) Civil Engineering <i>DT027</i>	25	0	0
Bachelor of Technology (Ord) Timber Product Technology <i>DT169</i>	40	0	0
Higher Certificate Buildings Management (Maintenance and Conservation) <i>DT170</i>	22	1	0
Bachelor of Science (Hons) Construction (Management) <i>DT117</i>	36	1	3
Bachelor of Engineering (Hons) Electrical/Electronic Engineering <i>DT021</i>	26	0	0
Bachelor of Engineering (Hons) Manufacturing Engineering <i>DT023</i>	42	0	0
Bachelor of Engineering (Hons) Mechanical Engineering <i>DT022</i>	41	0	0

	Total Number of Modules	Number of Sustainable Modules	Use of Key Words
Bachelor of Science (Hons) Surveying (Construction Economics and Management) DT111	28	0	0
Bachelor of Science (Hons) Surveying (Property Economics) DT110	31	0	0
Bachelor of Science (Ord) Auctioneering, Valuation and Estate Agency DT104	23	0	0
Bachelor of Science (Hons) Environmental Planning and Management DT106	57	0	2
TOT	474	4	5

Less than 1% of modules use the word sustainable in the title. Of fourteen programme descriptors, the key term or terms, only appear five times. The weakness of this piece of research is that while it does not fully verify that ‘sustainability’ is not being taught, it does show that overall, it is not embedded in the School. This is based on the assumption that if ‘sustainability’ was being taught, it would be flagged up throughout, as it is in some cases. In order to do this, a detailed review of one programme was decided upon.

Key Findings: That Sustainable Development, either as an ethos, or a way of educating, is not embedded in the Engineering and the Built Environment sector.

7.4 Course Evaluation

It was felt that a detailed review of the present Construction Management course in DIT be carried out and assessed for level of sustainable building practice and attitude. This was to be ascertained by establishing the adherence to ESD practice and methodology

within the department and assessed through informal interviews, surveys, review of research and review of the programme.

In effect, what the research was looking for was evidence that SD was at the core of the curriculum. This would be ascertained by measuring the attitudes of the students towards the environment and assessing the knowledge and understanding of SD among students and lecturers through surveys, informal interviews, reviewing policy, reviewing research work, reviewing the course programme for SD content and ESD principles and practices.

Ideally, ESD should be implemented through a whole school approach. Learning should entail a mixed method approach with a practical component and emphasis on community based, real-life, problem solving. It should entail multi-disciplinary and trans-disciplinary collaboration and critical analysis and whole-systems thinking approach to problem solving. Outcomes should be a development of interpersonal skills, critical thinking skills, eco-literacy, empowerment and social justice awareness.

7.4.1 Policy Review

Education for Sustainability: The National Strategy on Education for Sustainable Development in Ireland (2014-2020) is the most recent policy document produced by the Department of Education to promote ESD. The document outlines proposals for the implementation of ESD at all levels of education. It suggests further professional development for teachers and outlines skills to be attained and methodologies to achieve them. It promotes the idea of a whole school approach. The document is holistic in that it is also self-reflective, suggesting that the functioning of the department itself must become more sustainable. The ideas promoted are in keeping with those associated with ESD found throughout the secondary research.

Key Finding: The Department of Education see it as an imperative that change occurs in the education system in order to develop skills required to cope with climate change and resource depletion.

7.4.2 Most Pertinent Research

What do Final Year Engineering Students Know about Sustainable Development?

(Nicolaou & Conlon, 2012).

This paper focuses on final year engineering students' knowledge of Sustainable Development. The study finds that the students have a discipline-led understanding of sustainable development; the majority of the students fail to acknowledge the complexity of the concept and focus only on environmental protection. Their knowledge of legislation regarding SD and the social aspect of sustainability is deficient.

The study also found that the students viewed SD as something that was important to them as professionals rather than an issue of personal commitment. The authors suggest that the curriculum may not be generating this personal commitment and that engineers may view sustainability as a constraint to be grappled with. The study also showed that the students have a low level of understanding of the complexity of SD and neglect the social dimension.

The authors also suggest that while academics might believe they are giving adequate coverage to SD issues, these might be too discipline specific. Here they state that by this they mean, 'technology' specific, and that the students are not getting the broad understanding they need to fully understand SD. They also generate a further research area by asking; why do students have a narrow understanding of SD?

Leading on from this research and theories found in the literature review I have decided to look at attitudes towards the environment as a possible reason as to why students have a narrow understanding of SD. This is done as part of a comprehensive audit of the Construction Management programme to assess the level of knowledge and understanding and skill development with regard to SD.

Key Findings

1. The majority of engineering students in Ireland fail to acknowledge the complexity of the concept and focus only on environmental protection.
2. Students viewed SD as something that was important to them as professionals rather than an issue of personal commitment.
3. The authors suggest that the curriculum may not be generating this personal commitment.

7.4.3 Programme Audit / Evaluation

Title: DT117 Construction Management level 8 BSc.

Duration: 4 years

Type: Honours Degree

Number of places: 40

General

Though sustainability is referenced three times in the blurb, only one of the 36 modules references the same in the title. There are no modules concerned with raising consciousness or empowerment. There is no evidence of trans/multi/inter-disciplinary collaboration. There is no evidence of real-life application of learning and knowledge generation.

7.4.4 Modules

Title: CONS 4001 Construction Technology 4A Sustainable Design and Build

Number of credits: 5/240 credits, 2.08 % of overall

This is the only module that sets its stall out as coming from an SD perspective. It cites the Earth Summit, the Brundtland Commission and Agenda 21. It highlights the Agenda 21 aim of reducing the consumption of energy, resources and the production of pollution and waste and to this end, the modules aim is to teach ‘the main principles of sustainable design and build with innovation in the construction process.’

This module does promote critical appraisal of issues and solutions (though not necessarily SD issues or from an SD perspective) and gives 30% of the final assessment to project work. It cites one outcome as the ability to ‘apply the main principles of sustainability to the construction processes. The module focuses on, energy conservation, embodied energy, renewable energy sources, BREEAM, and environmental pollution.

In ‘Learning and Teaching Methods’ and ‘Module Content’ there is no mention of terms such as case-based collaborative learning, community-based problem solving, whole-systems approach, or in fact, any of the terms mentioned above in relation to ESD. Nor is there any reference to knowledge and understanding around climate/resource/social justice issues in regard to raising awareness and empowerment and no specific mention of interpersonal skills development or problem solving skills.

The Final Project: 25/240 credits and 10.41%

Promotes communication, analysis, judgement, evaluation and presentation covering, in part, some of the interpersonal and critical thinking skills required.

Work Placement Module: 30/240 credits and 12.5%

Key Findings

1. There is consideration given to the concept of Sustainable Development, suggesting an awareness of the need for a sustainable approach to construction.
2. Skills being assessed in the Final Project parallel those embodied in ESD. It also demonstrates that the teaching skill of same is within the department.
3. Less than 25% of the programme demonstrates parallels with either content or methodology as required in ESD. However, the reality could be much less than this - the largest portion of this comes from the Final Project and Workplace modules and there is no guarantee that the learning and knowledge gained will be related to SD.
4. There is no suggestion that there is a whole-systems approach to learning which combines content and methodology.
5. There is no suggestion that there is a conscious, vision, purpose or direction in regard to SD.

7.4.5 Survey One

Questionnaire to assess attitude towards the environment given to 4th year Construction Management students

The Survey attempts to assess attitude towards the environment of final year construction management students. In this section, I review the responses to the survey. The overall environmental position of this group is assessed. I highlight common trends but also any peculiarities.

The scale is made up of fifteen questions which is an assessment of pro-environmental values and attitudes. These values and attitudes are deemed necessary to ensure the move towards an environmentally sound society. The theory is that attitude influences behaviour, thus one must have a pro-environmental attitude to embed the philosophy of sustainability. The fifteen questions are designed to assess attitudes to five aspects of environmental sociology:

1. Limits to growth
2. Anti-anthropocentrism
3. Balance of nature
4. Possibility of an eco-crisis
5. The rejection of 'exemptionalist' attitudes

As these questions are primarily concerned with the environment, a sixteenth question was added to assess awareness and attitude towards social justice issues. Social justice issues are the key distinction between mere environmentalism and sustainability. The question asked whether the students believe that fuel poverty and access to fuel and water should concern them as a professional in the construction sector. An internal consistency was demonstrated very clearly by some subjects where agreement and disagreement to alternating questions showed a consistent pro-environmental attitude. Responding in agreement to odd numbered items indicated a pro-ecological view, while responding in disagreement to even-numbered questions would also point toward a pro-ecological view. All nineteen responded and overall, the responses were positive, showing a predisposition to the new ecological paradigm, thus suggesting that attitudes among the students were pro-environment.

The questions outlined below comprise the NEP scale. They are presented here as easy reference for the survey analysis which follows.

1. We are approaching the limit of the number of people the earth can support.
2. Humans have the right to modify the natural environment to suit their needs.
3. When humans interfere with nature, it often produces disastrous consequences.
4. Human ingenuity will ensure that we do NOT make the earth unliveable.
5. Humans are severely abusing the environment.
6. The earth has plenty of natural resources if we just learn how to develop them.
7. Plants and animals have as much right as humans to exist.
8. The balance of nature is strong enough to cope with the impacts of modern industrial nations.
9. Despite our special abilities humans are still subject to the laws of nature.
10. Human destruction of the natural environment has been greatly exaggerated.
11. The earth has only limited room and resources.

12. Humans were meant to rule over the rest of nature.
13. The balance of nature is very delicate and easily upset.
14. Humans will eventually learn enough about how nature works to be able to control it.
15. If things continue on their present course, we will soon experience a major ecological disaster.
16. Do you think social justice issues should concern you in your capacity as a construction professional?

Limits to growth: Q1, 6 and 11

When it comes to the capacity of the earth to continue to support the population, a slight majority believe this is not a problem if we learn how to develop them not clear what them refers to?. It is interesting that the response to this question around resources is either spread evenly or shows a slightly more anti-environmental world view, with 22% being unsure. This is probably the most tangible component of the whole survey as it deals with consumerism and waste and as a construction professional, consumption is something that cannot be avoided.

With regard to question 6, twice as many believe that we will not have a problem if we learn to develop them. This is in line with a HEP world view.

Anti-anthropocentrism Q2/7/12

The majority strongly believe the natural environment should be given respect and over 50% strongly believe plants and animals have as much right to exist as humans. While 62.4% disagree with the premise that 'humans have the right to modify the natural environment for their ends', only 26% agree. This is telling given the profession engaged in by the cohort, i.e. a profession solely focused on changing the natural environment. This would suggest openness to accommodating the natural environment while shelter needs are being met. This would suggest a low impact means of construction is needed. The biggest single cohort was the 60% that strongly agree that plants and animals have as much right as humans to exist.

Fragility of Nature's Balance Q3, 8 and 13

75% believe human interference with nature produces disastrous consequences. A strong majority agree that nature is fragile and man has interfered with disastrous consequences. Again this demonstrates a pro-ecological world view.

Rejection of 'Exemptionalism' Q4, 9 and 14

The majority believe that man is still subject to the laws of nature and will never get to a place where he can control it. Identifying this as a key belief allows for an understanding that we must work with nature.

Possibility of an Eco-Crisis Q 5, 10 and 15

Only 42% strongly agree that there is possibility of an eco-crisis, with 31% strongly disagreeing. Interestingly, this category has the largest uncertain cohort which possibly reflects the abstract nature of the issue. It also showed the strongest consistency of opinion with 50% mildly disagreeing that humans are severely abusing the earth. Over 50% were unsure that the crisis has been exaggerated and 40% were unsure that our present course is leading to an environmental catastrophe.

This category also threw up another anomaly. In regard to Questions 5 and 10, nobody mildly disagreed, whereas in regard to Question 15, nobody strongly disagreed. This is probably one of the most interesting discoveries. Two-thirds believe that humans are severely damaging the earth, only a small majority believe that disaster is pending if we keep on the path we are on and over 50% are unsure.

Question 16

Almost 80% did think social justice issues should concern them in their capacity as construction professionals. However, in one set of data where the subject clearly swung from strongly agreeing to strongly disagreeing on alternating questions consistently demonstrating a clear pro-environmental world view, the subject went on to answer the sixteenth question on social justice issues in the negative in that he/she believed that such issues should not concern them as a professional working in the construction industry.

This suggests a heightened awareness of environmental and sustainable issues and re-affirms the pro-environmental attitudes from the NEP scale. The overwhelming majority scored high on the NEP Scale.

20% did not believe social justice issues should concern them in a professional capacity and of that 20%, 50% agreed and strongly agreed that we were on course for a major environmental catastrophe and strongly agreed that we were approaching the limit of the number of people the earth can support. Both cases showed a strong pro-environmental stance throughout.

Other points of note derived from the analysis

While the majority seems to hold a pro-environmental world view, in four areas, the majority of the group believes there is no issue with resources and the ability of the earth to sustain itself. This first aspect is probably the most relevant question when it comes to both day-to-day living and the construction profession, as it will in part determine attitudes towards consumption and waste.

20% responded 'unsure' for almost two-thirds of the questions and 25% responded 'unsure' for one third of the questions. This is telling, suggesting a certain awareness of the problems but not full understanding.

Hypothesis One: That Third Level students instructed in traditional Construction Studies would have a world view primarily influenced by the Dominant Social Paradigm and consequently have an anti-environmental world view.

This was proven to be incorrect and the NEP survey showed a pro-ecological stance among the students. Also, it is felt that there is a genuine belief among the students involved, that protection of the environment is of utmost importance and that these beliefs are personal. Additionally there is a level of understanding around the need for the construction industry to play a role in Sustainable Development.

However, attitude is not always a predictor of follow-on behaviour. While people believe in something, they may not be able to act upon those beliefs in the field for a variety of reasons, but possibly more telling is the prevalence of what Andrew Jamieson calls 'hubris', prevalent in the attitudes. It may be a tell-tale sign of a more embedded underlying assumption upon which western education is predicated and that is that human ingenuity will always prevail. This is an area for further research but what we may be looking at here is a case of a deeper message being conveyed subtly. While on the surface they are making all the right noises, the education process has gotten its intrinsic message across in that human ingenuity will prevail.

Hypothesis Two: Students would not see it as part of their job to engage with social justice issues.

This hypothesis was also disproven as students showed an overwhelming belief that these were issues pertinent to them as construction professionals. Question sixteen clearly shows openness among the students to engage with environmental issues.

Key Findings

1. The students in the main have a pro-environmental attitude.
2. Students demonstrated a strong belief that social justice issues were pertinent to them as construction professionals.

7.4.6 Survey Two

Following on from assessing attitudes, it was considered appropriate to assess the student cohort for their understanding of SD and also assess their perception of the course with regard to ESD content and methodology.

Table 7: Survey results

Results of a Survey to Assess Understanding of SD Concepts and Programme Assessment.					
Listed below are 8 key themes. Please indicate the relevance, in your opinion, of each theme, to Sustainable Development and Education For Sustainable Development. Rate on a scale of 1-5 where 1 is irrelevant and 5 is very relevant. (SD = Sustainable Development)					
	1 %	2 %	3 %	4 %	5 %
1. Health	0	10	30	40	20
2. Rural Development	0	10	20	50	20
3. Gender Equality/Equity	10	60	10	10	10
4. Environmental Stewardship	0	10	20	60	10
5. Cultural Diversity	20	10	10	40	20
6. Peace and Human Security	10	10	10	40	30
7. Sustainable Urbanisation	0	0	0	20	80
8. Sustainable Consumption	0	0	10	20	70
9. Which of the above themes are the most pertinent to your profession? 20% said all. 10% said None. 20% said Health. 10% said 2, 4, and 7. 10% said 7 and 8. 10% said 8					
10. Do you feel there are adequate trans-disciplinary collaboration opportunities in your training presently?	70% said NO 0% said YES 30% N/R				
11. Do you feel there is enough 'real life' problem solving opportunities/experience in your training presently?	80% said NO 20% N/R				
12. Do you think student generated course content would allow you develop further in your relevant field?	50% YES 40% NO 10% N/R				
13. Is there any area of expertise, outside your own, that you feel if you could draw on, would complement your present skill set? 20% n/r. 10% no. 70% yes. 10% X More site visits. 10% X BIM. 10% X Quantity Surveying. 10% X Project Management. 10% X Options to choose modules.					

Results

1. While none said health was irrelevant, only 20% said health was very relevant.
2. With half stating that rural development was relevant, this is 10% more than health. Only 20% said it was very relevant.
3. Only 10% said gender equality and equity was very relevant while 60% said it was almost irrelevant. 10% said it was irrelevant.
4. While 60% said environmental stewardship was relevant, only 10% said it was very relevant.
5. 20% said cultural diversity was irrelevant and 20% said it was very relevant. 40% said it was relevant.
6. 10% said peace and human security was irrelevant and 30% that it was very relevant
7. Sustainable urbanisation and sustainable consumption; 80% and 70% respectively deemed these very relevant.
8. Sustainable urbanisation and sustainable consumption were deemed very relevant by the most students. This may be because of their labelling.
9. When asked which of the themes were most pertinent to their profession, only 20% said ALL, 20% said health and 20% said sustainable consumption. These were the three highest percentages, suggesting that there is no agreement among the cohort on this.
10. When asked did the students feel there was enough trans-disciplinary collaboration in their training, 70% said NO. 30% didn't respond.
11. Similarly regarding real-life problem solving, 20% didn't reply while 80% said NO.
12. To this question about student generated course content there was an almost even split. The NO's gave explanations like the student does not know enough; the lecturers are better placed to provide the information.
13. In relation to collaboration with other disciplines, 70% felt there were other areas outside their skill set that they could draw upon and made suggestions like BIM, Quantity Surveying and Project Management with 10% suggesting the option to choose modules.

Overall, it seems the nuances and complexity of SD is lost on the students. (This would be in keeping with Nicalaou's findings with regard to engineers). Some students considered gender/equity, cultural diversity and peace and human security irrelevant. Probably the most surprising result is that only 10% consider environmental stewardship very relevant.

Key Findings

1. In general Students don't grasp the nuances and complexity of SD.
2. There is no agreement among the cohort as to the importance of SD to their profession.
3. A large majority of the cohort felt that there wasn't enough transdisciplinary collaboration or real-life problem solving.

7.4.7 Research Review

In this section, I will review papers on three exemplar projects. The papers are based on projects being carried out by both undergraduate and post graduates in the department. The purpose of this is to ascertain the level of ESD practice and methodology and SD thinking in research projects.

The three exemplar projects are:

1. Scenario learning to identify the principal psychological components for WEB based Pedagogy for dislocated students in engineering and construction.
2. 'Sustainable Framed Structures in Educational Buildings: the Benefit of an EAM.'
3. The proposed aim is to transfer the technologies of low cost and no cost remote sensing data capture and 3d parametric CAD modelling for the conservation of traditional African building techniques used in domestic buildings, towns and villages.

Holism is an overriding tenet of sustainable philosophy and unless all aspects of a project or piece of research are not considered in this way, it could be deemed not to be sustainable. It stands to reason that nothing can be partly sustainable. It is either sustainable or it is not. It also stands to reason that there must be a singularly understood meaning of SD which must be adhered too, if society is to reorient itself towards

achieving it and thus these papers are reviewed from the standpoint of internationally understood definitions.

Paper Abstract 1

Scenario learning to identify the principal psychological components for WEB based Pedagogy for dislocated students in engineering and construction.

This paper was chosen as relevant for this purpose because it is focusing on the interface between man and technology and is unusual in this sense. It is not merely about developing a piece of technology.

There is no overt acknowledgement that the researcher is coming at this from a sustainable perspective. This needs to underpin the study in order to focus research and make it part of an overall singular societal objective, meaning Sustainable Development.

Terms like ‘changing mental models’ and ‘overcoming problems by introducing new perspectives’ could be equated with changing how we think and a collaborative approach to problem solving, both key components of ESD. Likewise to “engage with each other in a free ranging exchange of ideas, perception, concerns and discoveries to inspire decision making, generating further reflection, review and revision of plans and outcomes” (Fahey & Randall, 1998). This type of decision making aligns itself with SD principles but the decision maker needs to be socially conscious and ecologically literate to shape their decision making around SD issues.

In this example, terms such as ‘fictional stories, focus group, experts and potential users’ suggest a hypothetical approach to problem solving. The problems (if there are any) on trial are not real problems and therefore the solutions cannot be real solutions. Sustainable Development thinking would suggest that our ideas, energy and resources be applied to solve practical problems which impact upon our lives.

However, this relationship between humankind and technology is becoming more pertinent and needs to be addressed. But it needs to be addressed from a whole-systems perspective. The economic implications need to be considered; the broader societal implications need to be considered; the ecological impact of manufacture, implementation and disposal need to be considered, likewise implications and impact of the remote learning itself.

The decentralisation of education ties in directly with SD philosophy. Students could remain in their communities, engage with issues in their communities and dovetail learning to suit their needs and the needs of their community. A wide range of instructors and thinkers could be tapped into, keeping ideas fresh and vibrant rather than a narrow cohort from one institution.

This ‘scenario learning approach’ needs to be considered in its broadest context. Is it a tool of empowerment? As a pedagogical tool will it cater for utilisation of ESD principles and methodologies? Will the ‘scenarios’ depict or convey sustainable principles? If this research was approached with what Jamieson (2008) calls “the Hybrid Imagination” what would it look like? Would there be a need for it? An argument for the contribution this research will make to SD, as is defined and understood internationally, needs to be proffered.

While the product of this research has application from an SD perspective there does not appear to be evidence of holistic thinking at work or evidence that the author is approaching it from an SD/ESD perspective, however the core idea has potential as a tool for ESD.

Paper Abstract 2

Sustainable Framed Structures in Educational Buildings: the Benefit of an EAM

The key idea in this paper is integral to SD. The implementation of an EAM in full here would be useful is certainly a significant step towards SD and so too are the findings. The author also finds that there is a need for sustainable building methodology to be introduced into the Higher education system in Ireland. In his research, he finds that 26 of 42 respondents presently practicing in the industry did not attach any significance to the importance of materials being sustainably sourced. The whole area of sustainable procurement in the industry is lacking. These are key findings which require serious consideration for further research.

However, it is hard to square the sustainable aim with the method of research. While it is a comparable study, it compares two building materials, steel and concrete, both chosen as sustainable options. Both are unsustainable.

The Feasta definition of SD is one in which a system should continue unchanged and without deteriorating, for hundreds of years. Concrete has a life span of somewhere between 50 and 100 years at best and in some cases, not even fifty years. This is

compounded by the fact that climate change itself will speed up the deterioration process of concrete. Also, GGBS concrete relies on a by-product of steel production to make it ecological. Thus, if the production of steel was to be reduced, so too would the eco-concrete. This is compounded by the problem that GGBS used in Ireland is imported and has pollutant by-products. The embodied energy in the importation and pollutant capabilities must be considered. Furthermore, there is no research required to figure out that making a 'slightly more sustainable' product out of an unsustainable product is unsustainable unless it is a closed recycling loop with no new material being introduced.

However, the health hazard to workers, Portland cement notwithstanding, is that there are merits beyond energy consumption for utilising a local natural resource; he does not cite any of these for example, the local economy. Also, the use of in-situ concrete frame is cited as time consuming. This should be challenged. How important is it, and to whom? The working man and his family would prefer a two year contract over the eighteen month one that the developer is pushing for. This is where the balancing of material choice needs to be assessed in its entirety: impact on environment vs. impact on local economy vs. impact on workers handling the product.

Environment and cost seem to be the only two factors considered here with little or no consideration given to society or community. Whilst health and well-being is catered for in BREEAM, the author makes no reference to it. Also, an analysis of BREEAM through the prism of an understood definition for SD would have highlighted the strengths and weakness of BREEAM from an SD perspective. The overriding defining criteria seemed to reflect a narrow energy conservation focus. Certainly, the three pillars of economy, society and ecology were not given equal importance. The author shows his awareness as he demonstrates in his conclusion that decisions should not be solely based on low financial cost. He explores the importance of low environmental cost in addition but without the mention of the third pillar.

The author does identify that there are differences to be considered between rural and urban settings and the variation of results regarding embodied energy would support the necessity for a specific community-based, problem-focused approach. It would have allowed the entire researcher's energy to be focused on a specific problem considered from all angles, making it more suitable for the community. For example, one could choose a town in the west of Ireland and identify the most sustainable building method for that town.

Overall, the author shows an understanding of SD but does not follow through in his methodology. Also an EAM, as stated at the outset, is a good idea but it only concerns the environment as its name suggests. A new measurement system needs to be more holistic and all-encompassing. Though the author does demonstrate an understanding of SD as being more than just the environmental considerations, the research reflects Nicolaou's (2012) findings with regard to engineering students. The majority of engineering students in Ireland fail to acknowledge the complexity of the concept and focus only on environmental protection.

Paper Abstract 3

The proposed aim is to transfer the technologies of low cost and no cost remote sensing data capture and 3d parametric CAD modelling for the conservation of traditional African building techniques used in domestic buildings, towns and villages.

The rationale behind this research suggests sustainable thinking, meaning being motivated by climate change and identifying with the need to conserve resources and traditional techniques. It also, as outlined in the title, considers cost and the ability of implications of same. Furthermore, it addresses a real issue and proposes a solution to the potential difficulties posed by climate change through the bolstering of community resilience.

However, the project raises a number of questions. The first comes from the title of the research, *Where there is no Engineer*. Attitude is significant in understanding how we got to this impasse regarding climate and resources and also how we should progress from here. *Where there is no Engineer* explores the 'old school' hubris that Andrew Jamieson refers to. It suggests that there is something lacking in communities where there is no engineer and begs the question: how have they survived to date without an engineer? Additionally, the role of the 'expert' coming in from outside needs to be considered. Does he have enough local knowledge? Does she have the skills to mediate and negotiate around relevant stakeholders, vested interests and agendas? Does he/she have the ability to communicate, collaborate, coordinate and facilitate the successful implementation of this software?

It must be asked however, is this a real issue? Who flagged up this 'problem'? These skills and trades have been handed down successfully for hundreds or even thousands of years but are they in danger of being lost? And no doubt over that time

they have continually morphed and adapted to suit available materials, skills, conditions and fashion. Will ‘capturing’ these skills impede the ability and learning of local tradesmen to be flexible and continue to adapt as needed? Tradition is not static. Implied by omission in a study such as this is that there are no engineering degrees or qualified engineers available within this country, which would not be true of any African country these days. A false choice is posited between formal external or expatriate engineering expertise versus regional expertise.

While I am nit-picking, my attention is grabbed by the phrase, ‘traditional African’. Is there one tradition? Africa is a huge continent with numerous countries, traditions, cultures, climates, soil and rock types and consequently building styles and methodologies. A term which suggests clumping them into one group would need to be reconsidered. While it makes no difference to the technology, the users of the software may find this a euro-centric conceptualisation of where they live and how they live. Is the white-washed thatched cottage a traditional European style? Other considerations may be; do these communities wish to continue living this way? We see this debate about customer/occupant choice in Ireland with regard to timber versus concrete build. The customer/occupant has very strong opinions in this regard. This is one of the great problems sustainable builders have to address: how do we build more efficiently, yet maintain high living standards while satisfying the occupant’s perceptions of same? What are the occupant’s perceptions in this case? Do we know enough about the locale to impose western thinking on it and its inhabitants?

It also states that traditional, low embodied energy materials are the obvious choice for communities where resources are scarce. This is the case worldwide. Resources are scarce and becoming scarcer. The only reason they do not seem scarce in the first world is because of first world affluence and the ability to access them. If the available resources were distributed equally to everyone on the planet, how far would they go? This suggests that global warming is just a third world problem. The stark reality is that there is validity in this. It will be the poverty-stricken communities who will suffer most of all. Sustainable thinking would suggest that research, and certainly ‘learning,’ should be carried out in the community within which the institution is based and engage with finding solutions to problems within that community. Are there collaborators on the ground; who are they? Knowledge and understanding of this part of the project is vital.

Beyond this, there is a sharing of ideas which are adapted to a specific locale. The online training for the transfer of ideas is in keeping with sustainable thinking; however, this training must be in line with ESD principles as traditional teaching methodologies are not considered an acceptable means of embedding SD principles.

Key Findings

1. Two of the three papers demonstrated an awareness and partial understanding of SD.
2. Overall there was little evidence of SD, and no evidence of ESD principles, in line with definitions gleaned from the secondary research and proffered earlier in this chapter.

7.4.8 *Informal Interviews and Observations*

1. Informal interviews were held and observations made with members of the faculty and research students on my visits to the college.
2. My perception from these is that there is a strong focus on technology and not necessarily with the aim of resolving resource or climate issues. Where climate issues and resource depletion are concerned or SD is considered, this is only in the light of energy usage and conservation.
3. I feel there is a silo-isation of disciplines which is compounded by competition for funding, with little or no collaboration between disciplines. In fact, I sensed a 'keep your cards close to your chest' philosophy. One lecturer referred to the structure as 'tribal and hierarchical'.
4. It would seem that research is about developing 'product' for the market and is driven by where funding can be sourced. This is often private enterprise.
5. Over a period of three years, I attended three presentations where a variety of post graduate research work from the School of Engineering and the built environment was presented and none of it was SD driven. Research was either market driven and/or theoretically based as opposed to reflecting participatory action research in the community.
6. There is only one female lecturer.
7. There were no female students in the survey cohort.
8. There is one module dedicated to sustainable construction.
9. There is no social justice component in any of the programmes.

10. Overall, there does not seem to be a move towards, or an interest in, Sustainable Development.
11. From general discussions, there did not seem to be an understanding of SD among lecturers in line with definitions in this study.

Similar issues such as, funding, silo-isation and a lack of understanding crop up in the literature review. Also, some of the points made in these observations are backed up by the responses of the lecturers themselves in the following section.

7.4.9 Questionnaire for Lecturers

The purpose of this part of the research was to clarify aspects of understanding around teaching practice. The function of the questions was to gather lecturers' opinions on the implementation of ESD principles.

Q1. Multi-disciplinary collaboration is a core tenet of ESD. Can you envisage multi-disciplinary collaboration with engineers, carpenters, block-layers, plumbers, electricians, architects, among others, as part of a Sustainable Construction programme?

- Such an approach of cross-disciplinary co-operation in education for sustainable development would be desirable – however this is not how programmes are organised in DIT – Trades organise programmes in their department without input from engineers, quantity surveyors etc.

All of the respondents except one seemed to think multi-disciplinary collaboration was a good idea, with one respondent expanding on his/her answer:

Q2. Considering your own department and your knowledge of DIT, how do you think this might work?

- It would require the creation of interdisciplinary projects involving input from different disciplines. The other option is to have optional modules which students from different programmes could take.
- It wouldn't work with current structures as there is not sufficient interdisciplinary activity.
- It would have to involve interdisciplinary projects or the creation of optional

modules which could be offered to students on different programmes. For this to happen there needs to be a cultural change.

The respondents suggest that presently, interdisciplinary collaboration is not being facilitated within the school. Two of the respondents suggest the option of common modules to facilitate inter disciplinary activity is a way forward.

Q3. Can you identify any barriers to same?

- The lack of commitment to interdisciplinary collaboration and the dominance of discipline based cultures. Staff training and understanding of SD and the requirements for interdisciplinary work are also issues.
- Departmental structures of DIT

Department structures and staff understanding are seen as barriers to the implementation of interdisciplinary activity.

Q4. Can you envisage facilitating a cross-disciplinary team who will work on 'real life' problem solving in the community?

- No.
- Yes, I can envisage it but making it happen is a different issue.

Again, these responses reflect the present model as being unwieldy, although whether reflecting culture or departmental structure, is not clear from the responses. One respondent highlights a possible vagueness in the framing of the question.

Q5. Can you identify any barriers to same? / Do you have any comments, questions, around this?

- The responses were all 'NO'.

Q6. Interpersonal skills, critical thinking skills and awareness are considered core skills of the future sustainable builder. Do you think there should be:

One module dedicated to each of them?	0
Considered/graded as a part of technical/skills modules?	0
A combination of both?	0
Other	2

- The above does not exhaust the possibilities. They could be part of a module considering the economic and social dimension of SD. More broadly these competencies should be embedded across the entire programme. Critical thinking is not something students can be taught. They develop it by actively engaging in research activities and doing assessments where critical thinking is valued and rewarded.

This response would reflect the ideal practice as per the literature review, where SD is not implemented through a piecemeal approach or an ‘add-on,’ but rather integrated into the entire programme.

Q7. Part of ESD is to empower and encourage a discerning citizenry who will live sustainable lives. Can you suggest how a student’s personal actions be included/assessed and rewarded as part of the programme / any other thoughts considerations around this?

- This would seem to be a difficult component to assess.
- I don’t agree with this approach. The key issue is how you change systems of production and consumption and provide people with real choices so that they can lead sustainable lives.

The responses reflect the gulf of understanding between respondents about the nature of SD? While one respondent grapples with the complexity of the issue, another has not only a strong opinion but one at variance to the question posed. In effect, three different people (including the researcher) possess three different cognitive start points.

Q8. Social justice issues such as health and well-being; equity /equality in all its forms (e.g., gender, ethnicity, economic); housing affordability/security; water, fuel, food, security; all must be considered as part of a holistic understanding of what it means to build. What are your thoughts on integrating these into the present programme? Should they be

Integrated into each module as part of content/ course material/examples etc.?	1
Distinct modules in their own right?	0
A combination of both?	1
Other	0

- The respondents are split on this issue. The first response is consistent with integrating SD issues across the programme while the second suggests a combination of both, promoting the idea of integration but possibly there may be a need for standalone subjects. The combination of both may be a stepping stone towards full integration.

Q9. The Department of Skills and education has proposed CPD for teachers facilitating ESD programmes. Do you think this is necessary?

- All respondents agreed that this is necessary. This reflects the need for upskilling teachers to facilitate a new way of educating.

Q10. Do you have any thoughts, considerations you would like to add?

- SD is primarily about changing patterns of production and consumption and creating a more equal society in which people have a real say. This requires a wholesale change in the education of technologists.

This respondent is clear about what needs to be done, which is in keeping with the policy documents and leading thinkers in the field. However, it is the only response given to this question.

Q11. As part of ESD methodology it is considered appropriate that students would develop all or part of the curriculum. What are your thoughts on this? How can you envisage this working in practice?

- It wouldn't work with current structures as there is not sufficient interdisciplinary activity.
- It would have to involve interdisciplinary projects or the creation of optional modules which could be offered to students on different programmes. For this to happen there needs to be a cultural change.

The respondents are clear that interdisciplinary activity is required to facilitate this. And again, they reiterate that the present structures do not facilitate this.

Key Findings

1. Present departmental structures and culture do not facilitate implementation of ESD.
2. Interdisciplinary projects are seen as the best way to facilitate student involvement in curriculum development.
3. Upskilling of staff is required to facilitate implementation of ESD.

7.4.10 Email Discussion/Interview

Two of the respondents to the questionnaire were chosen at random and were asked to comment further and an email questionnaire was sent. The primary purpose of this was to ascertain exactly to what extent skills associated with ESD, though not identified as such, were being taught. This reflects back to the suggestion in the informal interviews that skills associated with the Passiv Haus design were being taught though not classified as such.

Q1. In your assessment of students, do you allow marks for, or assess in any other way:

- R1
- a. Debate
 - b. Discussion (**Yes, in some classes marks are awarded for attendance and participation**)
 - c. Communication skills in any form
- If so, what percentage?
(12%)

- R2 a. Debate
 b. Discussion
 c. Communication skills in any form?
 (Yes)
 If so what percentage?
(Part of group based projects in different modules which are worth between 60% and 100% of modules marks. There seems to be a vast difference here between the respondents and how they assess communication skills.)

Q2. Do you allow marks for or assess in any other way?

- R1 a. Critical thinking skills
 (Yes)
 b. Whole systems thinking
 c. General ability to problem solve
 If so what percentage?
(One project is on critical thinking skills; it is worth 40% of all of the marks)

- R2 a. Critical thinking skills
 (Yes)
 b. Whole systems thinking
 c. General ability to problem solve
 (Yes)
 If so what percentage part of group based projects?
(In different modules which are worth between 60 and 100% of modules marks)

There appears to be general consensus on the importance attached to critical thinking. Though again when it comes to ability to problem solve it is not a consideration for one respondent.

Q3. Do you allow marks for or assess in any other way?

R1 a. Team work

(Yes)

b. An individual's ability to collaborate

c. An individual's interpersonal skills

If so what percentage?

(20%)

R2 a. Team work

(Yes)

b. An individual's ability to collaborate

(Yes)

c. An individual's interpersonal skills

(Yes)

If so what percentage part of group based projects in different modules which are worth between 60% and 100% of modules marks?

(Again when it comes to collaboration and development of interpersonal skills there is not consistency.)

Q4. Do you assess students working on real life problems?

R1 Students choose a building that has been completed and provide a technical overview of the building.

R2 Yes.

I would not consider an overview of a building as being what is required in this section. The second respondent says he/she does engage students with real life problems.

Findings

1. There is a lack of consensus among the respondents as to how to evaluate, if at all, the core skills associated with ESD.
2. The core skills are being taught and evaluated to some extent.

SECTION 5 – SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

Chapter 8: Results and Outcomes

8.1 Introduction

The research findings suggest a need for a reorientation of the Construction Management course to instil an understanding of sustainable development, nurture pro-ecological principles and promote a new way of thinking about building. The purpose of this chapter is to provide a comprehensive summary of the research findings and bring together the conclusions from all the data, including the literature review and present related recommendations in light of the objectives outlined in Chapter 1. The chapter closes with recommendations for further research on the topic.

8.2 Findings

The literature review provides an exploration and a clear definition of SD as well as the principles and the state of ESD in Ireland. Through a series of preliminary informal interviews, it was considered that attitude was possibly an area that needed consideration in this study. The survey carried out to this end found that while there was a pro-ecological attitude, there was also a lack of understanding around key issues. An audit of the Institutes of Technology showed there was no Fetac Level Eight course in sustainable building or sustainable construction management.

A key word audit of all of the courses in the School of Engineering showed no course specific to sustainable construction. This is not necessarily negative as adding on extra courses is not optimum. Reorientation of existing courses is considered the way forward.

The present construction management course has only one module geared towards sustainable construction as it is titled but it does not consider the broad definition of sustainable development principles nor give mention of equity or social justice issues. Focus seems to be primarily on the reduction of waste and energy. The development of the critical faculty and interpersonal skills through trans-disciplinary

collaboration and community-based problem solving and whole systems thinking do not seem to be considered.

A random sample of undergraduate and post graduate work recently being undertaken do not consider sustainability in its fullest sense. Discussions and informal interviews with lecturers do not seem to demonstrate inter-school or transdisciplinary collaboration. In fact, there seems to be competitiveness for funding which inhibits inclusivity, promotes segregation and prevents transfers of ideas.

8.2.1 Secondary Research

Key Findings

1. Changing attitudes is the best way to embed SD which is best achieved through orientating the education system.
2. From the recurring themes in the literature I would sum ESD as thus: having aims to build resilience by changing attitudes and associated behaviour, through an education process which produces ecologically literate, socially conscious, technically/practically skilled problem solvers.
3. These findings address objectives 1, 2, 3 and 4 in part of the research:
 - To clearly define Sustainable Development.
 - To identify educational practices aligned with sustainable development.
 - To ascertain the skill needs of the construction industry in this regard (in part).
 - To consider the bias towards technology driven solution.

8.2.2 Preliminary Interviews

Key Findings

1. Language and terminology would have to be clearly defined.
2. The idea that ‘attitudes to the environment’ among building workers was crucial to change. This finding in part addresses objective 3: to ascertain the skill needs of the construction industry in this regard.

8.2.3 Policy Review

Key Finding

1. The Department of Education see it as an imperative that change occurs in the education system in order to develop skills required to cope with climate change and resource depletion.

8.2.4 Most Pertinent Research

Key Findings

1. The majority of engineering students in Ireland fail to acknowledge the complexity of the concept and focus only on environmental protection.
2. Students viewed SD as something that was important to them as professionals rather than an issue of personal commitment.
3. The authors suggest that the curriculum may not be generating this personal commitment. These findings address objectives 4 and 6: to ascertain if such skills are being developed in the education system and to review case studies in industry and education in Ireland.

8.2.5 Audit of ITs for Sustainable Building Courses

Key Finding

1. There is no Sustainable Construction Management Level 8 course being offered in the country at present. These findings address objective 4: to ascertain if such skills are being developed in the education system.

8.2.6 Audit of the School of Engineering and the Built Environment for Sustainable Building Courses

Key Findings

1. That Sustainable Development either as subject matter or way of educating is not embedded in the school.

8.2.7 Construction Management Programme Evaluation

Key Findings

1. There is consideration given to the concept of Sustainable Development, suggesting an awareness of the need for a sustainable approach to construction.
2. Skills being assessed in the Final Project parallel those embodied in ESD. It also

demonstrates that the teaching skill of same is within the department.

3. Less than 25% of the programme demonstrates parallels with either content or methodology as required in ESD. However, the reality could be much less than this. The largest portion of this comes from the Final Project and Workplace modules and there is no guarantee that the learning and knowledge gained will be related to SD.
4. There is no suggestion that there is a whole systems approach to learning which combines content and methodology. These findings address objective 4: to ascertain if such skills are being developed in the education system.

8.2.8 Survey 1

Key Findings

1. The students in the main have a pro-environmental attitude.
2. Students demonstrated a strong belief that social justice issues were pertinent to them as construction professionals.

8.2.9 Survey 2

Key Findings

1. Students do not grasp the nuances and complexity of SD.
2. There is no agreement among the cohort as to the importance of SD to their profession.
3. A large majority of the cohort felt that there was not enough transdisciplinary collaboration or real-life problem solving. These findings address objective 4: to ascertain if such skills are being developed in the education system.

8.2.10 Review of Papers 1, 2 and 3

Key Findings

1. Two of the three papers demonstrated an awareness and partial understanding of SD.
2. Overall there was little evidence of SD, and no evidence of ESD principles, in line with definitions gleaned from the secondary research and proffered earlier in this chapter.

8.2.11 Case Studies

Key Findings

1. The studies reflected a broader understanding of sustainability rather than just energy efficiency.
2. The local economy was being considered through sourcing materials and trades locally.
3. In two of the studies, the aesthetic considerations of the build in its surrounds were given much consideration.
4. Working from home and utilisation of the site for food and fuel sources was considered in at least two cases.
5. An awareness of sustainability issues among clients and builders and an attempt to reduce the global impact of these builds is in keeping to some extent with the literature's definitions of sustainable building.

8.2.12 Questionnaire for Lecturers

Key Findings

1. Present departmental structures and culture do not facilitate implementation of ESD.
2. Interdisciplinary projects are seen as the best way to facilitate student involvement in curriculum development.
3. Upskilling of staff is required to facilitate implementation of ESD.

8.2.13 Email Discussion/Survey

Key Findings

1. There is a lack of consensus among the respondents as to how to evaluate, if at all, the core skills associated with ESD.
2. The core skills are being taught and evaluated to some extent.

8.3 Research Aim

To develop a framework for including ESD in the syllabus for third level programmes in construction in Ireland. Question: are Construction Managers adequately skilled to meet the challenges posed by Sustainable Development.

8.4 Research Objectives

The Aim of this thesis 1 and 2 below were achieved through the following objectives:

1. To determine recommended good practice practices aligned with Sustainable Development.
2. To identify and/or develop concise working definitions for associated terms and propose a concise outline framework or 'transition tool' for educators to utilise when developing new modules and programmes.

The objectives address the research aims. Below is the list of these objectives and an outline of how each one was addressed.

1. To ascertain the skill-based needs of the construction industry in regard to climate change and diminishing resources.

Objective 1 was addressed in Section 2 the literature review through a review of policy document and current construction and education practice. It was also a key question in early discussion with industry professionals and later in questionnaire surveys presented to students and lecturers. It was also the core question in the Qualibuild workshops and case studies.

2. To ascertain if such skills are being developed in the education system.

Objective 2 was addressed in the literature review in a review of leading writers and educationalists in the area of ESD and government policy documents. It was also ascertained through a programme audit of colleges nationwide, a more specific look at DIT School of Engineering and the Construction Management department through surveys of both lecturers and students and informal interviews and observation in the department.

3. To ascertain attitudes towards the environment in the education of construction students.

Objective 3 was addressed through the administration NEP scale survey to 4th year Construction Management students.

4. To audit exemplar projects to identify holistic solutions to climate change or skills deficit etc.

Objective 4 was addressed through the case studies.

5. To consider bias towards technology driven solutions.

Objective 5 was addressed in the literature review.

6. To develop a concise working framework for module development in the industry using ESD in full principles.

Objective 6 was addressed in the one page proposed programme outline in the recommendations. To determine current recommended good practice aligned with Sustainable Development. This was also carried out through the literature review.

Sub Objectives

Dispute bias towards technology driven solution – Achieved through a literature review.

8.5 Conclusions

- The research has shown the need for a clear definitions and understanding of Sustainable Development terminology.
- It has shown that a narrow techno-centric approach is not in line with sustainable thinking.
- It shows that there is no Sustainable Construction Management Fetac Level 8 course being run at any of the ITs in Ireland presently.
- It shows that the present course in DIT does not cultivate a pro-ecological attitude amongst students.
- Crucially, it shows that Construction Managers in DIT are not adequately skilled to meet the challenges posed by Sustainable Development.
- The research has found that skills which are considered important according to ESD definitions are being taught. Communication, critical thinking, real life problem solving. Further research would be required to ascertain how important these skills are considered to the overall development of the student and in relation to ESD. In general, these skills do not seem to be taught within a context of ESD.
- The research shows that lecturers have the teaching skills to develop the core

competencies required for ESD.

- The research shows that there is no trans-disciplinary collaboration or structures in place for same.
- The research shows that social justice issues and empowerment are not of significance in the present educational process looked at here.

8.6 General Observations

A significant finding from this research is that in regards to skills, some of what is called for in ESD is in place, while motivation, holism and course content are not in line. I feel this splitting of hairs is significant and could become either the barrier or the foundation for the implementation of a whole school ESD programme. The foundation, because lecturers have the skills and knowledge to move ahead with an all school approach but a barrier because they may feel that they understand fully what is required and they are in fact implementing it already. This seems to be in line with Corless (2011), who found that there was a lack of a systematic approach to implementation. It also aligns with the Department of Education, Skills and Employment's findings that silo-isation and the departmental structure prevents a holistic cross-disciplinary approach and the need for a whole institution approach. Moreover, the department's finding that elements of ESD are being used as teaching strategies but are not framed as such by lecturers in this study.

The research was unable to answer some of the questions it generated, for example, is it possible to fully consider all aspects of a problem? Are there some aspects that do not require consideration of the social justice component? Will these questions be answered in the future with the development of the Hybrid Imagination? To this end, a research methodology which is contained yet holistic needs to be developed. Additionally, the prevalent approaches to research were limiting and confining.

By its very nature, a holistic approach to any topic concerning sustainability is necessary. However, it is not possible to capture this complexity in one study, thus while the focus is on sustainable education processes; I have set the study in the wider context of the Irish economy with a special focus on the Irish building industry. Throughout, I have attempted to convey the nature and complexity of sustainability.

While sample sizes for interview were limited, valuable information emerged from the discussions which illustrate attitudes and practice on sustainable development within construction education and can point to further future research. There is huge

scope for further research in any one of the fields covered here, attitudes towards sustainability; attitudinal change; sustainable educational processes; sustainable building processes. All of these areas can be further developed and explored, with a focus on the local; regional; social; economic context creating their own unique studies.

8.7 Recommendations

It is considered that we have to change the way we think to engage fully with Sustainable Development and grow resilient individuals and communities best suited to deal with the problems of climate change and limited resources. To do this, we must change how we educate. In practice, this means cultural change and a change in teaching methodologies. This change in the education process requires a whole school approach, designed to encourage community-based problem solving, multi-disciplinary and interdisciplinary collaborations, and a whole-systems thinking approach. There is no dissenting voice around this issue in the literature.

The creation of group projects or modules which accommodate students from all disciplines would be beneficial; an alternative would be a ‘taster year’ where students mix, and gain understanding and appreciation of the function and roles of the different disciplines, across craft, management and design. The departmental structure must be dismantled and fluidity between disciplines must continue while students begin to develop specialised technical competencies.

An embedding of core competencies across the entire programme would also be useful. As highlighted earlier, the integration of sustainable principles is a better approach than ‘adding-on’ sustainable modules which increase workload on both students and teachers. An obvious consequence of this is that some present content is dropped and replaced with new material which covers social justice issues and eco-literacy.

A prioritising of the development of critical faculties by engaging students in real life problem solving issues and rewarding them accordingly as well as the prioritisation of interpersonal skill development and empowerment. Finally, critical thinking and reflection should also come into account.

In effect, each module will be designed to develop technical skills and knowledge that consider economic, social and environmental concerns. The students have voiced an interest through participative action research, critical analysis and collaboration. Below is a framework which collates the information gathered into a simple framework or outline for an ESD programme.

Table 8: ESD Programme Outline

Proposed outline FOR ESD PROGRAMME in construction management or other				
AIM	OBJECTIVE	CONTENT	METHODOLOGY	OUTCOME
To Build Resilience	To develop interpersonal skills	Three pillars Collaboration Practical/technical/skill/ knowledge Communication	Teamwork Multi/trans/inter disciplinary collaboration Real-life situations Communication/presentation	Team player Collaborator Communicator Awareness
	To develop problem solving capacity	Three pillars Whole systems thinking Real-life problems Practical/technical/ skill/knowledge	‘Whole systems’ approach to problem solving Solution focused learning Work on real community based problems Reflect	Critical thinker Whole systems thinker. Reflective Problem solver
	To empower	Three pillars Social justice Community action Real-life situations Practical/technical/ skill/knowledge	Questioning of the orthodoxy Community action	Awareness Discerning citizen Community activist Awareness

Recommendations

- Upskilling of teachers necessary
- Consistent evaluation of core skills across disciplines
- Integration of SD issues across the programmes
- Development of departmental structures and culture that facilitate inter/cross/multi-disciplinary learning
- Standardised evaluation process of core skills

8.7.1 The Role of the Teacher

In an ideal world, the teacher must also live by example, practicing sustainability in their personal daily lives and/or being environmentally active.

8.7.2 Curriculum

It is recommended that sustainable development be embedded in construction education by developing a curriculum (and learning models) that values transdisciplinary co-operation, recognizes that knowledge is provisional and approximate, involves the learner in determining goals and methods, allows for negotiation and flexibility, and promotes local, personal, applied, and first-hand knowledge. The emphasis here is on knowledge that is applicable, practical, inclusive, and self-critical. Evaluation is based on self-evaluation, self-generated indicators, critical feedback and support from others, and assessment that is qualitative as well as quantitative (Sterling, 2001).

8.7.3 The Institution

The literature suggests that the best way to teach sustainability is by action and example, stating that educational institutions themselves should be pursuing a policy of sustainability in every facet from maintenance to energy conservation, to organisational structure. In other words, the institution should be integrated into the community, seeking to solve the problems of that community and its curriculum should be based on the needs of the community and formulated by the students.

8.7.4 The Student/Citizen

Giving the student and community buy-in to the educational process empowers both to control the direction of their lives. This, in effect, political component, is where SD differs from environmentalism.

Learning through experience, participation and reflection is known as transformative education and asks the learner to take responsibility for real issues. Learners are to be encouraged to take their knowledge out into the real world and engage with real issues that impact on our society and other human beings (Mezirow, 1990, 1991, 2000 in Mezirow and Associates).

8.7.5 The Community

Any programme for Education for Sustainable Development (ESD) must be based on local need but devised and implemented with global considerations.

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Appendices

Appendix A (1) Published Papers

The Need for a Paradigm Shift in Construction Education

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ABSTRACT

In order to ensure the success of the drive towards a sustainable economy in Ireland it is imperative that societal change occurs. This paper concentrates on the recently depleted Irish construction sector and the potential for a new direction in the industry based on a sustainable ecological approach. The following hypothesis is presented; that in order to ensure sustainable development a paradigm shift which forms the fundamental attitudes that we hold concerning the environment must take place.

This paper will look at how Education may be the entry point where attitudes can be greatly influenced in parallel with the dissemination of knowledge and skills. While outlining why the construction industry must take a lead role in the change towards a sustainable economy this paper looks at how and why the educational process itself must also change in order to embed sustainable development, its philosophy and ethos in the construction sector.

INTRODUCTION

To sustain the activities of production, distribution and consumption of goods and services of any economic model; the resources and assets upon which it draws its real wealth need to be managed and maintained. Efficient use of materials, energy and waste is key to an efficient competitive economy. This pertains to our minerals, our fossil fuels, our forests, the air we breathe and the water we drink. Sustainable economic growth hinges on the management of these resources.

For example, even in ‘wet’ Ireland, we are inextricably linked into the global water supply. Not only are we over-dependent on imports for fuel and food - approximately 90% and 50% respectively (McCárthaigh, 2008; Sheehan, 2012) but also water. When we consider the embodied energy in treating and distributing water, and the ‘virtual’ or embodied water imported in food, goods and energy. 70% of the world’s fresh water supply is consumed in the production of food alone UNESCO (2013). - Conservation is increasingly becoming an economic and business decision.

In a report compiled by the World Economic Forum (2012), Martin Sorrell ,CEO of the wire and plastic products company WPP, says that we must take responsibility for our consumption as the world’s population increases, our climate changes, and water and natural resources become ever more scarcer.

1.1 Sustainable Economics

Growing our economy sustainably can be a way of future proofing the economy against the vagaries of scarce resources, higher prices, globalisation, transient multi-nationals and competitiveness in the market place. Being, acting and thinking sustainably is about understanding ‘the whole’. It is about looking at all the component parts simultaneously, understanding how they work together and the impact they have on each other. Thus this requires a new way of thinking or a new paradigm within which to think (WEF, 2012). For example, any time we conserve any natural resource, we will tend to conserve all natural resources. Energy conservation and recycling both save water.

Water conservation and recycling both save energy. For example, recycling a single aluminium can saves the energy equivalent of about half that can full of petrol. Thus it would be economically prudent to apply the ‘precautionary principle’. That is to say, that we should, ‘play it safe’ and begin to put in place measures to address these issues now rather than later. Simply put it will be cheaper to engage with these issues and seek to solve them now rather than in the future. But this requires a “new way of thinking or a new paradigm within which to think” (Brown, 2011).

It is becoming ever more apparent that all businesses will need to adapt to a low carbon future and the recognition of the need to use materials and resources efficiently and that a workforce with appropriate skills is required is increasing. A publication on Skills and Employability by the International Labour Office (2011) states that the transition to a low carbon economy is one of the greater challenges facing governments business’, workers and organisations that represent them.

Until such time as economic ‘growth’ as is understood presently, is decoupled from societal development in the policy-makers psyche Ireland will not get clear thinking on this issue. Therefore any measures taken to up skill Ireland’s workforce with a non-holistic approach will not achieve the goal of a sustainable economy (ILO, 2008; EGFSN, 2010).

This paper will look at why the Construction industry as a key player in the economy has to ‘think differently’ to fulfil its role in the drive towards sustainability, why attitudinal change is crucial and the importance of the educational process in bringing about that change. It will also explore the shift the construction education system itself has to make to be a real instrument of change in order to up skill our crafts people and embed sustainable economic growth.

THE NEED WITHIN EDUCATION FOR A SUSTAINABLE APPROACH

With global awareness of the need to develop sustainably it has become universally acknowledged that, like health and dietary issues, etc., that the path to embedding sustainable development is best achieved through education.

Sterling (1996) and Hopkins and Mc Keown agree that education is the key to change. Sterling says it has to be at the centre of the task both as ‘subject and agent’ i.e. not only is the content important but also the methodology. While Hopkins and Mc Keown (1999) are unambiguous about the fact that “our current path” will not bring about transition to a sustainable society and therefore we must take another approach using education.

Sterling (1999) citing his long experience of thirty years involvement in environmental and sustainable education says he has come to the conclusion about the need for a complete overhaul of the education system or as he says a paradigm shift is needed to change how we view the world in order to embed an environmental ethos

Hopkins and Mc Keown (1999) state that in effect it is about teaching people not only skills and knowledge but also perspective, and values, which will allow them to live sustainably. And further research bears this out, with some researchers believing that knowledge alone is not adequate to produce a change in behaviour. In other words, knowledge does not provide citizens with the skills to combat environmental problems (Clifton et al., 1998).

The UK produced document Nudge, Think, Shove (2010) states that the traditional information provision’ approach is unable to take into account the entire

social, political and institutional factors that form attitudes and behaviours.

When one considers that the present education system may be having quite a detrimental effect on the environment a paradigm shift is of the utmost importance. Presently we are being educated to ‘compete and consume’ rather than ‘care and conserve’ (Mc Nerney & Deakin 1996). Indeed, most educational theory and practice still supports unsustainable practices. A UNESCO report (2002), notes that a “new vision” and a deeper way of thinking about education is needed because the current education system falls short of what is required to bring about a sustainable future

This paradigm shift in education would create a citizenry who would apply sustainability principles to their everyday lives, thus enabling society to become more sustainable (Hopkins & Mc Keown, 1999).

Furthermore, as sustainable education by its nature embeds itself in the local community where it has based its teaching methodologies and curriculum will be tailored to the needs of that community thus increasing awareness, community integration and social adhesion while equipping the student to live in a sustainable way within their environment and community.

But no community is isolated and self-sustaining and thus people need to have a broader understanding of the wider economy, the more complex globalised economy and society and the impact their personal actions can have on the environment both locally and globally.

THE CONSTRUCTION INDUSTRY TODAY

While seen as “dirty, dangerous and old fashioned” (Myers, 2004) the construction industry has been identified as having a crucial role in the move towards sustainability - mainly because it encompasses more than any other sector the three corner posts of sustainability: economics and environment and society. But while being a positive force for economic growth its impact on environment and community are more often than not negative

As we move towards a low carbon society, the construction industry has to lead the drive towards sustainability (World Economic Forum, 2012). And to be part of this drive the construction sector must incorporate issues of social justice and wider concerns such as food, fuel and water security and sovereignty; future proofing against poverty; while considering the general wellbeing and future needs of its occupants and the community within which its situated.

Barriers to Change in the Industry

The Construction Industry as it stands is seen as fragmented; inefficient; dogged by short-term thinking; fractious cross-disciplinary relationships and slow to change with little or no regard for both its employees and communities. It is a sector, which operates through bringing together disparate components, professions and personalities to work for a short time, often under financial and time constraints, on a specific complex project. It is the single biggest drain on resources and is seen as highly wasteful. Myers (2004) states that it has a devastating effect on the environment and is responsible for the use of large amounts of resources and the generation of large amounts of waste.

The ILO (2006) state that lack of environmental awareness among stakeholders in the building process is a significant factor in constraining green building.

Moreover, in what has being termed ‘the circle of blame’ none of the key drivers in the construction industry accept responsibility for lack of sustainable practice in the industry and due to the fragmentation of the industry no one wants to make the first move. Myers (2004) says this is a product of ‘mindset.’ Builders argue that they can only build what they are asked for; developers say there is no demand and investors won’t take the risk. Resolving inherent inefficiencies in the build process is seen as crucial in ensuring sustainable development.

3.2 Sustainable Building

Sustainable building on the other hand: through a holistic approach; integrated design and build processes; long-termism; checks on negative environmental impact and wastage; concern for occupants and community, prioritises efficiency. This efficiency which underpins sustainable philosophy and as found in Sustainable building parallels that which economists, capitalists and the industrial sector continually strive for and is often referred to by Sustainable thinkers as the ‘triple bottom line’ or ‘win-win-win’ (Myers, 2004). Such is the result when solutions that solve more than one problem simultaneously are found.

Sustainable Building is broader in scope than traditional building practice and includes integrated design build processes, and a social justice component. In other words it considers the impact the building and the building process will have on the society and community within which it is being built. Thus the definition of building must be broadened to incorporate an awareness of the built environment and the impact it has on occupants and the wider community.

CHANGING MINDSETS

Due to the complex nature of Sustainability, achieving sustainable development is not as easy as providing people with a particular set of practical skills because one cannot cover all the variables i.e. the combinations and permutations of potential problems that may arise. Thus each individual must be equipped with a new paradigm to enable them to think critically and assess and make decisions for themselves but decisions, which are grounded in sustainable principles. Lyle (1994) states that coming to understand ecological process is not just about learning another subject but fundamentally changing the way we view the world.

One obstacle to achieving the sustainable building approach is the compartmentalisation of disciplines within the building industry. What is needed is a process that brings together the work of various design and engineering management and craft disciplines. An idea which is gaining currency in commercial building is the Integrated Design Process. This brings together the whole team to ensure quality and efficiency of the build. This process is the beginning of viewing the building as a whole unit or single system. It reduces friction between the disciplines and makes for a more efficient building process.

4.1 World View, Attitude and Actions

Our personal attitudes, which determine our actions are based on an all-encompassing worldview, or 'model of thinking' which is a product of our society, our families, our communities, our education system. Thus changing attitudes is a complex task and understanding and changing them in the context of sustainability is even more complex and an in depth analysis of attitude formation is beyond the scope of this paper. However, it is through underlying perceptions, assumptions, and cultural mores that we filter all our decision-making. And the present world-view is not necessarily pro-sustainability and in fact is often anti-sustainability.

Over the last three hundred years, a world view which regards the cosmos as a nurturing living organism and treated nature with respect has been gradually eroded and replaced by a world view which regards nature to be dead and can be exploited (Huckle, 1996).

The present world view (Modernity) considers the environment as a commodity (Huckle, 1996) and there for man's disposal. This overarching view underpins much of the reasoning behind why the environment has been exploited, both as a generator of

wealth and a waste disposal unit. Lyle (1994) states that our present attitude towards the earth dates back to the renaissance and is not only out of date but dangerous.

This is the worldview that presently underpins the education system and which our leaders, our managers and our future builders engage the world with. This is the worldview that most of our decision-making is based on. It impacts on our politicians, policy makers, analysts and strategists and educators and consequently on how well the system does or doesn't work.

4.2 Opposing World Views

Dunlap and Van Liere (1978) identified two fundamental paradigms: 1/ the Dominant Social Paradigm (DSP) which outlines the world view that guides our personal and policy decision making presently and 2/ the New Environmental Paradigm (NEP) which they envision is to replace the DSP in order to move society towards an environmentally friendly stance. Simply put, the present world view is anthropocentric and places man at the centre giving him the right to manage his natural surrounding as he wishes, while the NEP is an ecocentric worldview which values all life-forms equally (Grenstad et al., 2006).

From an economic point of view the main difference between both worldviews can be summed up as priority for economic growth and development and focus on short-term or immediate prosperity versus priority for ecosystem viability, focus on long-term sustainability.

This dichotomy encapsulates the different approaches to the economy out of which comes two different sets of goals / policies and thus two different economic systems. One which will maximise growth at the cost of pollution and the other which aims to reduce waste and avoid pollution even at economic cost.

The NEP prioritises societal wellbeing over wealth generation at all costs. It emphasises foresight and planning to secure a bright future rather than reliance on markets to spur economic growth. It emphasises personal growth rather than material wealth. It focuses on horizontal structures that maximise interaction and learning as opposed to hierarchical and authoritarian models. It promotes, encourages greater personal and local responsibility. It recognises the need for holistic/integrative thinking as opposed to simplistic cause/effect thinking and narrow expertise. It emphasises co-operation, partnership and egalitarianism as opposed to competition domination and

patriarchy. It places humans in an ecosystem context as opposed to subordinating nature to human interests.

The DSP is still guiding the way we think thus implementation of sustainable actions and achieving the goal of sustainability and a sustainable economy is impeded.

4.3 Attitudinal Change

Rogerson et al. (1996) state that business people politicians and policy makers now accept that patterns of behaviour have to be modified in order to bring about change. There is a diverse range of views on how to stimulate this attitudinal change. Ranging from the use of legislation to enforce compliance; economic instruments such as tax breaks or grants and consciousness raising be it through the provision of information to the general public via ad campaigns or education (Department of Enterprise, Trade and Investment, 1996).

The U.K. report titled 'Nudge, think or shove? Shifting values and attitudes towards sustainability' (2010) states that the goal is to find the optimal mix of these three strands, nudge think and shove, to bring about change in social values. But it is considered that the 'think' approach or deliberate action, which brings about attitudinal change, is more effective over the long term.

Our society approaches the issue of sustainability presently with a 'bolt-on' attitude. E.g. Bolting on a solar panel for instance or introducing technological solutions without considering the whole i.e. from the whole build system process through to the lifestyle of the occupants. Likewise it is not good enough to add-on 'sustainable' modules onto traditional education courses. In essence a whole new educational paradigm centred around four pillars; holism, systemic thinking, sustainability, and complexity is what's needed (Mc Nerney & Deakin, 1996).

4.4 Education for Sustainable Development

Education for Sustainable Development (ESD) differs from traditional teaching methodologies in that it uses a whole-school multi-disciplinary approach with curriculum developed in conjunction with and by the students and based on the needs of the region/community within which the learning centre is based (Hopkins & Mc Keown, 1999). Huckle (1999) is in agreement with this suggesting that communities and educational systems need to work together towards a sustainable outcome, the community setting sustainability goals and the education system modifying its

curriculum to underpin support and reinforce these goals.

Due to its complexity and holistic nature an interdisciplinary approach must be taken to its teaching. Such an educational approach will require the help of many disciplines focusing on interconnections between the natural and built environment, and the economic and political forces that influence the world around us (Mc Nerney & Deakin, 1996). Thus traditional methods of education based on compartmentalisation of subjects needs to be dismantled. A multidisciplinary approach, which utilises a variety of educational tools such as case-based collaborative learning, problem-based learning, community focussed education, service learning and an extant body of knowledge from across the disciplines to draw on must be engaged. Such an approach in itself leads to an educational process, which develops other core skills such as systematic thinking, communication, teamwork and interdisciplinary understanding. Sterling states that people should be engaged in a ‘critical pedagogy’ or participative action research (Huckle, 1999). These skills are crucial in solving complex environmental and social problems in the real world - a big part of which entails building relationships and understanding the needs of all involved. This fulfils what Steven Sterling calls putting the relationship back into learning.

To meet the demands of a low carbon sustainable economy and society I propose that change needs to occur in the educational process in order to bring about change in the building industry.

I have shown that fundamental attitudes based on an outmoded world view need to change to embed this new way forward and that education is key, not only as a tool to facilitate the dissemination of knowledge and skills but also to changing these attitudes. I propose that the present education process itself has to change in both method and content by introducing a ‘holistic systems thinking’ approach, in order to bring about this fundamental change; equip our builders with the necessary problem solving skills and promote a greater understanding of the relationship between building, habitation and society.

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Appendix A (2): Published Papers

The Singular Focus On Operational Energy Usage; The Techno-Centric Approach To Sustainability And The Recent Introduction Of The ‘Assigned Certifier’ Do Not Facilitate The Irish Construction Industry In Achieving Internationally Defined Sustainable Development Goals.

- Conor McManus, Dublin Institute of Technology, Dept. of Construction Management, Dublin, Ireland.
- Maurice Murphy, Dublin Institute of Technology, Dept. of Construction Management, Dublin, Ireland.
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ABSTRACT

This paper considers how the focus on operational energy consumption of buildings and the recent introduction of the ‘assigned certifier’ move the Irish Construction Industry further away from achieving Sustainable Development goals.

Keywords – Sustainable Building; Occupant; Local; Operational Energy; Technocrats.

INTRODUCTION

This paper examines how the singular emphasis on technology, the introduction of the ‘expert’ into the domestic building process and the narrow focus on operational energy conservation raises questions about Ireland's present path towards Sustainable Development. It will provide clear definitions for ‘sustainable building’. It will outline the significance of the 'local' and the ‘occupant’ in the sustainable building process. It will highlight conflicting sustainable philosophies and examines why the Irish construction industry has to go beyond Part L in order to align itself with Sustainable Development goals.

BACKGROUND

The World Economic and Social Survey

2013: Sustainable Development Challenges found that the vision of Sustainable Development, which it defines as, *promoting economic and social well-being while protecting the environment*, has not been achieved. It reiterates the premise that the key problem facing the planet is man-caused climate change and threatens to lead to irreversible changes in global ecosystems. The document outlines the areas which need to be tackled: land-use; food security; employment creation; transportation; infrastructure development; biodiversity conservation; water conservation; renewable energy sourcing; waste and recycling management and the provision of education, health care and housing. The report makes three key points (a) that sustainable development is crucial to the eradication of poverty, (b) we must promote an integrated approach to our development goals and ecosystems, (c) we must focus on systematically changing consumption and production patterns in all countries.

METHODOLOGY

The methodology consists of a review of the literature. Considerable time is given over to clarifying what is and what is not Sustainable building. The paper considers Irish building legislation and how it merges with or digresses from the Sustainable Development paradigm and particularly Sustainable Building as defined by the UN, leading writers in the field and International certification bodies. Key to this research is a brief comparative analysis highlighting the difference between, narrow operational energy focussed assessment methods such as Passiv Haus and broader sustainability qualification criteria utilised by LEED and the Code for Sustainable Homes.

DEFINING SUSTAINABLE BUILDING

The construction industry encompasses, more than any other sector, the three corner posts of sustainability: economics, environment and society. The industry has been identified as having a crucial role in the move towards global *sustainability* (World Economic Forum, 2012). Maiellaro (2001) states its contribution can be realised through the design and development of sustainable communities, construction and technology. Kibert (2012) defines 'sustainable construction' as a subset of Sustainable Development and addresses the role of the built environment in the overall vision of

sustainability. He says sustainable building should be viewed as a tool to achieve Sustainable Development.

Change in the industry is slow due in part to a myriad of social interests and different philosophical stances (Fernandes, 2013). Lack of understanding and entrenched assumptions in the industry (Jamieson, 2009) combined with lack of understanding among educators (Hopkins & Mc Keown, 1999) in the broader community have in part hindered the development of an environmental literacy and a social conscience within the industry.

While some of the approaches and skills required to build sustainably are present in the Industry, they don't go far enough.

LEAN, for example, is about streamlining the construction process. A number of authors agree (Wills, 2009; Gordon, 2001; Zokeai et al., 2013) that 'Lean' and 'Green' go hand in hand with philosophical and structural similarities between both. But LEAN on its own is not enough. While philosophically based there is no consideration given to society or the environment.

IDP (Integrated Design Process) utilises whole systems thinking and emphasises communication and team work all of which feed into sustainable building but it does not necessarily give priority to the environment and broader society and as a system it can be used without the consideration of broader social dimensions.

Moving the industry towards sustainability is also hampered by the misuse and / or misunderstanding of terminology. Kibert (2012) and Wholley (2000), Fox (2000), and Connte and Monno (2001) all agree that words like 'sustainability' and 'green' are used interchangeably and often misused. The word 'sustainable' is used to label solutions which do not consider the three pillars of sustainable development i.e. economy, environment, and society. Kibert (2012) distinguishes between 'green building' which he defines as referring to the actual structure - built using sustainable building principles and methodologies while 'sustainable construction' refers to the ecological, social and economic issues of a building in the context of a community. He also states that buildings of themselves cannot be sustainable but can only be designed to support sustainable patterns of living within a given community.

Rogers (1998) defines 'sustainable building' as "A holistic approach to design that combines social, economic and environmental objectives and that evaluates against their local and global impact." In other words, 'sustainable building', considers the impact the building and the building process will have on the society and community

within which it is being built and also the wider world and not just the immediate ecosystem. Davis (2000) states that building is fundamentally a social enterprise. Thus, the definition and understanding of what it means to build must be broadened to incorporate the general wellbeing of workers and occupants and the community within which it is situated and also deal with issues of wider concern such as fuel poverty; access to inexpensive nutritious food and access to inexpensive clean water and issues of global justice, such as access to affordable housing (Hargreaves, 2008).

2.1 The significance of 'the Local' and its role in Sustainable Building

The 'local' plays a vital role in how we deal with problems arising from global warming and peak oil. The ability of a community to assess, respond and adapt to difficulty is known as 'resilience' and is seen as a vital component in dealing with the problems posed by climate change and peak oil. UNEP'S recent *Emissions Gap Report* (2014) speaks of the need to protect communities from the 'intensifying impact' of climate change. While communities will need external funding it will ultimately be up to each community to solve problems specific to themselves with resources and knowledge specific to that community in a way that meets the needs of that community.

Douthwaite (2001) highlights the conflict between regionally appropriate building practices within a global economic context. He is critical of the European model of governance which he says is maintaining an unsustainable way of living. He states, that the process of European integration, as part of globalisation, is dismantling the powers of the nation state - the only unit capable of carrying out policies for the common good and is contrary to 'Localism', a key tenet in Sustainable philosophy. The problem with this policy is that a solution will not be geographically, socially or culturally specific. The homogeneity brought about by national and international policy and trends eliminates local distinctiveness, which operates on an accessible scale and helps to bind and empower communities as opposed to the alienation brought about by 'Big Government' and 'faceless multinationals' (Fox, 2000).

In a survey carried out to assess the state of Austrian building regulation one respondent replied that by focussing solely on energy efficiency the EU missed an opportunity to promote the broader concepts of sustainability. He states that government regulation was often contradictory and counterproductive to aims and objectives of sustainable construction. He states that BREAM or LEED could be used as tools to create a new way of thinking about building (Austria Country Report, 2014).

Wholley (2012) and Nanda (1999) are concerned about homogenisation and globalisation. and Nanda criticises architectural practice and a building industry that are subject to what he calls '*a global culture of commodification and homogenisation*' and who dismiss local skills and knowledge in favour universal building materials and systems that ignore the regional resource base and aesthetic. Fernandes (2013) gives three reasons for the use of local materials: reduced building cost; reduced embodied energy; promotion of local economies. The first two of these are in accordance with Vittrup's findings (see below). Cooper (2003) states that sustainable construction through use of local resources helps ground communities giving them direction and underlines local identity. He states that a bioregional approach to material choice and usage, which incorporates cultural, social, economic, physical and geographical considerations, is the most comprehensive approach to truly sustainable construction.

Hines (2003) who acknowledges the need of global interconnectedness but distinguishes between Globalisation, which he says is solely designed to eliminate trade barriers and manipulate workforces for profit, and Internationalism, which he defines as the flow of ideas, technology and information across borders for the betterment of local communities. This transference of beneficial ideas needs to be considered in such a way as to not compromise local or regional appropriateness (Gann, 2003).

2.2 The Significance of 'the occupant' in Sustainable Building

The recently introduced Building Control Amendment Regulations, 2013, require an assigned certifier to sign-off at key stages of the build process. This should ensure higher build quality and compliance but has associated cost financial terms.

'Bringing in the experts' raises issues regarding what Oliver calls, "ethics of intervention in vernacular architecture." Referring to the global context Oliver (2006) says that by mid-century the world's population will have grown by 3 billion and asks who will house these people. This building boom raises the spectre of huge environmental and social impact with the only answer being a green holistic solution. He concludes, part of the answer is to empower the communities through education, to build their own homes and buildings themselves. Connte and Monno (2001), Nanda (1999) and Oliver (2006) feel present practice of bringing in an outside expert often results in disempowerment of the dweller and breakdown of community and family. Barucco's (2013) contention that builders must communicate with the inhabitants who are informed and concerned about the environment, supports this.

Brand and Karvonen (2007) define what they call an ‘expertocracy’ with the power to shape society. These ‘technical experts’, engineers are one example, are specialists in their discipline with the consequent narrow field of vision not suited for addressing complex sustainability issues. Their knowledge base is abstract and reductionist and separates man from nature, and contrasts with indigenous knowledge, which is holistic, territorial and concrete. Impersonal, quantitative precision, clashes with local, tacit, real life experience.

Connte and Monno (2001) declare an 'expert' will be necessary and suggest the only difficulty is trying to strike the balance between the experts involved and the occupants. This, they say, will require an appreciation of the local by the expert and an awareness of his or her own biases.

2.3 Technology and Nature: Opposing Views

Barucco (2013) and Fernandes (2013) see the advent of technology and cheap oil as the cause of the shift away from traditional solutions and the development of a society and a way of living that is based on consumption of natural resources and consequently, something that cannot be maintained indefinitely.

Techno-centric environmentalists believe that environmental problems can be solved by innovation and control of the environment through techno-economic change, with science and technology providing the solutions (Fox, 2000). Woolley (2012) is critical of 'technocrats' who write policy and seek solutions through technology and the drive for efficiency and he says there is still and over reliance on what he calls, ‘synthetic petrochemical based technocratic solutions’, and often dictated by industry with an increasing influence over the construction research agenda. Woolley (2012) states that many of the assessment methods arise from this influence and the quest for easily measurable standards or – what he calls, the “holy grail of mathematical systems of environmental assessment,” and they lack any ethical or moral direction i.e. a social justice component which considers local and global impact.

Eco-centric environmentalists base their approach on a more holistic framework, prioritising man and his relationship with nature, which recognises the interactions, networks, and interdependency of all facets of the enviro-socio-economic matrix. Light (2003) believes the restoration of man’s reconnection with nature is needed. Vittrup (2007) concludes his study by stating that “a more holistic permaculture approach is

necessary” and in a final definitive statement says, “A *fractionalised approach will never secure the aim of Sustainable Development.*”

Fernandes (2013) and Stephenson (2006) with regard to technology and nature conclude that the optimum is the usage of modern technology and techniques to maximise local resources. In order to achieve new standards while balancing the socio-economic needs of the occupant on the one hand with technical-environmental issues on the other.

WHY WE NEED BROADER QUALIFICATION CRITERIA

3.1 DEAP and Passiv Haus

Passive Haus and Part L are similar in their overall narrow focus on operational energy use. The ultimate goal of Part L is to achieve carbon neutral buildings but this is only in relation to operational energy usage. DEAP focuses on a combination of the energy efficiency of the building and renewable energy sources. While Passiv Haus leaves more emphasis on Energy conservation through attention to building design and detail and less on heat source.

3.2 Passiv Haus

Crawford and Stephan (2013) set out to show that the embodied energy in building material for Passiv Haus purposes is miscalculated and that not only is embodied energy higher than a conventional house but it is higher than was previously believed. They find that a Passiv Haus can use more energy over 80 years than a similar conventional house mainly due to materials required to achieve high operational energy efficiency levels. They call for a widening of Passiv Haus criteria to include embodied energy measurement.

Holladay (2011) suggests the lack of a cost/return analysis as part of Passiv Haus standard can make it unnecessarily costly to achieve the standards both in resource terms and financial terms. He suggests, for example, that the benefit of excessive insulation in the base is negligible and states that seven houses with two inches of insulation is a more efficient use of resources than one with fourteen. Here his thinking is holistic and is considering resources in their totality and how they should be used. Halliday says that, the measurement tool does not alert you to when the thickness of insulation stops being cost effective and can actually be wasteful. Bringing this argument to its logical conclusion raises some questions like; Are there enough

resources if every house was built according to present Passiv Haus standards? Do we actually know? Has this been considered?

The measurement criteria of Passiv Haus also fail as it is easier to get a better result on a bigger house by virtue of its 'envelope' to 'floor area' ratio. He suggests we need to start measuring energy consumption per occupant. He also states that PPH does not consider different heat sources. He asks, if one had access to renewable fuel why would one have to consume resources needed to achieve high U- values?

In the UK Passiv Haus has been touted as a solution for fuel poverty, which is in line with sustainability goals. However, an issue highlighted at The UK Passive House 2014 Conference was that landlords were impressed with the Passive Haus model as it would allow them to charge higher rents while developers could look forward to value being added to their assets if they built and refurbished to Passiv standard (Passive House Plus, 2014). This would negate any economic benefits for the occupant from reduced energy bills.

This side-effect is not the fault of Passiv Haus model but a misuse and abuse of a building practice in an unregulated market and highlights the disconnection from any holistic housing strategy that would ensure affordable homes. Jones (2014) states that the family home is one of the main determinants of health. She says it is impossible to maintain health without an affordable home and she says we need a different housing strategy one that connects housing and health. This thinking would be in line with UNESCO's definition of Sustainable Development.

May (2010) states that the introduction of Passiv Haus as a process of building has the potential to further remove the occupant from the building process thus further disempowering the citizenry as it removes any control they may want to exercise over how they want to live. The disjoint between the occupant and the build process are compounded by the added cost incurred by hi- tech goods and expert's fees making access to a home more difficult which can result in disempowerment and alienation. Vittrup (2007) highlights this struggle between, the controls over one's life that individuals feel they need and 'the market' and points to the trend in Denmark where straw bale construction has become a means by which owner-builders can become financially independent.

3.3 Broader assessment criteria and how they compare with Passiv Haus and the narrow parameters set out in the DEAP.

An on-line review of LEED and the Code for Sustainable Homes (DEC 2014) demonstrate the broad scope and holistic approach required to achieve good sustainable building practice, while highlighting the narrowness and inadequacies of a build process which focuses solely on operational energy consumption.

LEED's main credit categories shows that 'energy and atmosphere' the category which would cover Passiv Haus criteria, comprises only two of the twelve categories which comprise the LEED assessment criteria.

Category 3, 'materials' considers the materials used and their sourcing under the term 'responsibly sourced' this can cover: distance travelled; impact of production on employees and environment. Passive Haus design has no requirement to consider the impact of the manufacture process of the materials on their environment on the people employed in their manufacture or any social issues connected to the manufacture of materials or the build process.

Category 5, of the Code for Sustainable Homes, 'waste', not only considers household waste but also considers site waste. With category 8 'management' considering site management best practices during the build.

Possibly one of the most expressive categories from a sustainable point of view is the points allocated for 'bicycle storage'. This demonstrates long term visioning and a whole systems approach inherent in the code and the impact travel to and from the home can have throughout the duration of occupancy. It also accredits the provision of a room that can be set up as a home office - demonstrating and in this case a low cost facility for self-employment or a work-from-home option which cuts travel. LEED also encourages this with its 'location and linkages' credits by promoting living within walking distance of work, shops and public transport.

LEED's category adaptable design, multipurpose usage and its 'neighbourhood development' 'regional priority credits' reward awareness of the specific locale. Passive Haus does not consider the impact of the house, on the landscape and local ecology. It does not consider the impact a build will have on a community nor does it outline how to build for community, considering public/private spaces communal living etc., which, a holistic sustainable approach would consider.

In a comparative analysis of two passive houses, one built from straw bale, the

other from lime and sand block with EPS insulation Vittrup (2007) shows that not only is the passive house of LS/EPS dearer to build but also may have a greater environmental impact as it did in his study. LEED, he says, gives a broader assessment and safe guards against a situation arising where; if energy efficient buildings, using materials with a negative environmental impact, could be built cheaply, they would proliferate with detrimental consequences.

The accessibility and voluntary–use nature of these tools is another significant difference between them and the DEAP. These tools are designed to educate and empower the occupant / builder and give them ‘buy in’ into the building process. Again, this idea of personal empowerment for the owner / occupant is central to developing sustainably.

Du Boisson (2014) in a comprehensive article, considering the Irish context, compares the Passive House standard and the DEAP to other methods of measurement and certification such as LEED, The Code for Sustainable Homes, BREEAM, DGNB, and the Living Building Challenge (LBC) and suggests that there is room for an ‘Irish BEAM’ (Building Environmental Assessment Method) which reflects the Irish context and the Irish construction industry. Du Boisson quotes the Irish Green Building Council (IGBC) who state that there is merit in the introduction of similar scheme for the Irish residential building sector and want to implement such a scheme by 2015.

CONCLUSION

This paper has shown that our present path does not align itself with the path towards Sustainable Development that The World Economic and Social Survey advocates.

The present approach is focussed on reducing operational energy usage through technology while failing to consider our eco-systems and broader Sustainable Development goals. When compared to the goals and objectives of LEED, or the CSH our present direction is based on a very narrow set of criteria. It fails to address the issue of poverty or access to housing in fact the opposite is the case – the hi-tech approach separated from the broader social context and introduction of the expert will alienate occupants, increase rents and move owning-your-own-home out of the reach of a greater number of people, contrary to Sustainable Development principles.

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Appendix A (3): List of Participants in Preliminary Interviews

Mary Ryder

Dominick Donnelly

Brian Flood

Brian Curran

Ruth Fortune

Jeff Colley

Gareth Keenaghan

Maurice Murphy

LEED - Leadership in Energy and Environmental Design is a rating system devised by the United States Green Building Council (USGBC)

BREEM - BRE is the trading name of Building Research Establishment Limited.

Registered in England and Wales under number 3319324.

Registered address Bucknalls Lane, Watford WD25 9XX

Appendix B: Audit 1

Audit of Third level educational institutes for sustainable training programmes.

Sustainable Construction

1. Sligo IT: BSc Advanced Wood and Sustainable Building Technology Level 7
2. Dundalk IT: NONE
3. Letterkenny IT:
4. Athlone IT: BSc in Sustainable Construction (ab initio) Level 7
5. DIT: NONE
6. IT Tralee: Bachelor of Science in Advanced Wood Technology and Sustainable Construction Level 7
7. Waterford IT: NONE
8. Carlow IT: NONE
9. Cork IT: NONE
10. Limerick IT: Sustainable Building & Renewable Energy Level 7

Engineering

1. Sligo IT: NONE
2. Dundalk IT: NONE
3. Letterkenny IT: NONE
4. Athlone IT: Postgraduate Diploma in Green Engineering Level 9 - 1 year part time
5. DIT: NONE
6. IT Tralee: NONE
7. Waterford IT: BEng (Hons) in Sustainable Civil Engineering Level 8 - Add-on BEng (Hons) in Sustainable Energy Engineering Level 8
8. Carlow IT: NONE
9. Cork IT: Sustainable Energy Engineering (BEng Honours Degree)/ Level 8
10. Limerick IT: NONE

Construction Management (As we know it Ted)

1. Sligo IT: BSc in Construction Management (Level 7)/Level 7 BSc (Hons)
Construction Project Management (Level 8)
2. Dundalk IT: NONE
3. Letterkenny IT: NONE
4. Athlone IT: NONE
5. DIT: BSc (CONSTRUCTION MANAGEMENT) Level 8
6. IT Tralee: Bachelor of Science (Hons) in Construction Management/Level
8/2YR ADD-ON
7. Waterford IT: BSc (Hons) in Construction Management & Engineering/LEVEL
8. Carlow: BSc in Construction Management / Level 7
9. Cork: Construction Management (BSc Honours) Level 8
10. Limerick: Construction Management - BSc (Honours) (Level 8)

Sustainable Construction Management

1. Sligo IT: NONE
2. Dundalk IT: NONE
3. Athlone IT: NONE
4. DIT: NONE
5. IT Tralee: NONE
6. Waterford IT: NONE
7. Carlow: NONE
8. Cork: NONE
9. Limerick: NONE
10. Letterkenny IT: Bachelor of Science (Honours) in Sustainable Construction
Management Level 7, 1 year add-on.

Appendix C: Student Survey 2

Form Title: Masters Research Survey –

M.Phil. School of Construction Dept. of Construction Management

1. Health

1 2 3 4 5

2. Rural Development

1 2 3 4 5

3. Gender Equality/Equity

1 2 3 4 5

4. Environmental Stewardship

1 2 3 4 5

5. Cultural Diversity

1 2 3 4 5

6. Peace and Human Security

1 2 3 4 5

7. Sustainable Urbanisation

1 2 3 4 5

8. Sustainable Consumption

1 2 3 4 5

9. Which of the above themes are the most pertinent to your profession? Please list by number or state 'none' or 'all'.

10. Do you feel there are enough opportunities for transdisciplinary collaboration in your training presently?

Yes € Option 3

No

11. Do you feel there is enough 'real life' problem-solving opportunities/experience in your training presently?

Yes

No

12. Do you think student generated course content would allow you to develop further in your relevant field?

13. Is there any area of expertise, outside your own, that you feel if you could draw upon, would complement your present skillset?

Appendix D: Questionnaire to Lecturers

Lecturer Survey Questionnaire

1. Multi-disciplinary collaboration is a core tenet of ESD. Can you envisage multi-disciplinary collaboration with engineers, carpenters, block layers, plumbers, electricians and architects, among others, as part of a Sustainable Construction programme?
2. Considering your own department and your knowledge of DIT, how do you think this might work?
3. Can you identify any barriers to same?
4. Can you envisage facilitating a cross-disciplinary team who will work on 'real life' problem solving in the community?
5. Can you identify any barriers to same? Do you have any comments, questions, around this?
6. Interpersonal skills, critical thinking skills and awareness are considered core skills of the future sustainable builder. Do you think there should be:
 - One module dedicated to each of them?
 - Considered and graded as a part of technical/skill modules?
 - A combination of both?
 - Other:
7. Part of ESD is to empower and encourage a discerning citizenry who will live sustainable lives. Can you suggest how a student's personal actions are included or assessed and rewarded as part of the programme? Do you have any other thoughts or considerations around this?
8. Social justice issues such as health and wellbeing, equity/equality in all its forms (e.g., gender, ethnicity, economic), housing affordability/security, water, fuel, food, security, all must be considered as part of a holistic understanding of what it means to build. What are your thoughts on integrating these into the present programme? Should they be:
 - Integrated into each module as part of content/course material/examples etc.?
 - Distinct modules in their own right?
 - A combination of both?
 - Other:

9. The Department of Skills and Education has proposed CPD for teachers facilitating ESD programmes. Do you think this is necessary?
10. Do you have any thoughts or considerations you'd like to add?
11. As part of ESD methodology, it is considered appropriate that students would develop all or part of the curriculum. What are your thoughts on this? How can you envisage this working in practice?
 - Option 1

Appendix E: Follow-up Questions to Lecturers

1. In your assessment of students do you allow specific marks for or assess in any other way

- a. debate
- b. discussion
- .communication skills in any form

If so what percentage?

2. Do you allow specific marks for or assess in any other way

- a. critical thinking skills
- b. whole systems thinking
- c. or general ability to problem solve

If so what percentage?

3. Do you allow specific marks for or assess in any other way

- a. Team work
- b. An individuals ability to collaborate
- c. An individuals interpersonal skills

If so what percentage?

4. Do you assess students working on real life problems.

Appendix F: Employability Skills and Discipline Skill Set

Build Up Skills Ireland is a project under an EU wide initiative which aims to upskill craft workers for the construction sector in Ireland.

Date attended: 24th of October 2014

Location: Cork

Employability skills

- A sound practical and technical knowledge of sustainable materials and methodologies.
- Ability to work in a team
- Ability to collaborate across professions/trades.
- Ability to problem solve
- Ability to communicate

Disciplines skills training

- Practical and technical knowledge of sustainable methods and materials.
- Comprehensive understanding of sustainable development in theory and practice.
- Ability to facilitate interdisciplinary collaboration.
- Ability to facilitate students to design all or part of curriculum.
- Ability to guide the student as active citizen
- Ability to facilitate whole systems thinking.
- Ability to facilitate learning through experience, participation and reflection.