QUANTIFYING AND MANAGING SCOPE 3 (TRAVEL) CARBON EMISSIONS IN A UK UNIVERSITY

The Higher Education Statistics Agency requires Higher Education Institutes to reporting their Scope 3 (Travel) carbon emissions effective from January 2015 to show leadership in carbon reporting perspectives. This research contribution is to new knowledge and management processes involves the designing and implementing a hybrid environmental management system for Scope 3 (Travel) carbon emissions accountability, developing new quantification tools and reporting by adopting Global Reporting Initiative G4, using Nottingham Trent University as a collaborative case study

A thesis submitted in partial fulfilment of the requirements of Nottingham Trent University for the Degree of Doctor of Business Administration

JULY 2016

Presented by: **Jaya Raj Chelliah**
PGCHE (Distinction) The London Institute of Banking and Finance
MBA (Finance) Manchester Business School
Fellow of the Association of Chartered Certified Accountants

Nottingham Business School

Quantifying and managing Scope 3 (Travel) carbon emissions in a UK university.

A thesis submitted in partial fulfilment of the requirements of Nottingham Trent University for the Degree of Doctor of Business Administration by Mr. Jaya Raj CHELLIAH

ABSTRACT

Purpose	The Higher Education Statistics Agency requires Higher Education Institutes to reporting their Scope 3 (Travel) carbon emissions effective from January 2015 to show leadership in carbon reporting perspectives. This research contribution is to new knowledge and management processes involves the designing and implementing a hybrid environmental management system(EMS) for Scope 3 (Travel) carbon emissions accountability, developing new quantification tools and reporting by adopting Global Reporting Initiative G4, using Nottingham Trent University (NTU) as a collaborative case study.
Research Design and Methodology	The research design methodology evaluates NTU's EMS using qualitative to quantitative semi structured SWOT and mRating evaluation questionnaires. Developing a Scope 3 (Travel) carbon quantification tool using data derived from a travel survey of NTU's staff and students and travel data of overseas students and business travel. Determining a UniCarbon travel sustainability index as a key performance indicator for reporting purposes.
Findings	SWOT and mRating empirical values computations provided the basis for the development and implementation of a new hybrid EMS particular to NTU. The total amount of Scope 3 (Travel) carbon emissions were: staff and student commute (6,656MtCO2e), business travel (2,674MtCO2e) and overseas students (42,312MtCO2e). NTU's Scope 3 (Travel) carbon emissions performance index is 0.49, indicating partial emissions sustainability.

Contribution to new management practices and new knowledge	This research contribution to new management processes providing frameworks for an efficient adoption of EMS practices for Scope 3 (Travel) carbon emissions accountability. The development of quantification tools, enables benchmarking and implementing emissions abatement policies to meeting the HE Sector's 2020 emissions targets of 43% of the base year 2005. The UniCarbon index offers a summative reporting empirical measurement of travel sustainability reporting, enabling comparisons for use within the HE Sector that also could be replicated to other industry sectors.

Keywords: *Carbon emissions, Scope 3 (Travel), travel survey, SWOT, mRating Value Ratings, overseas student travel emissions, environmental management systems, travel sustainability index*

DECLARATION OF ORIGINALITY AND COPYRIGHT

I certify that the research ideas, frameworks, methodologies, data collation, analyses and conclusions presented in this thesis are entirely generated from my own efforts and is, to the best of my knowledge and belief to be original and not previously submitted for any other award, as mine alone. Where appropriate certain information had been used within the body of this research as references and acknowledged using the Harvard referencing system. The research associated with this thesis abides with Nottingham Trent University's ethical guidelines.

I acknowledge that I have read and understood the University's rules, procedures and policies relating to my higher degree research award and to this thesis. I certify that I have complied with these rules.

…………………………
Jaya Raj CHELLIAH

Date : 31 July 2016

Email: n0239712@ntu.ac.uk / jaychelliah@yahoo.com

Preface and acknowledgement

Universities are well placed as foundations of intellectual research to developing new knowledge and management research solutions for the alleviation of today's environmental challenges concerning global warming and climate change.

This Thesis presents a number of reasons for undertaking this collaborative action research with Nottingham Trent University (NTU) as a case study for the management of carbon accountability, quantification and reporting of Scope 3 (Travel) carbon emissions. Firstly, NTU has a large personnel body that uses various transportation modes for transportation purposes for commuting and international travel. Therefore, consideration of how NTU accounts, manages and reports Scope 3 (Travel) permits an evaluation of these processes for both compliance and reporting purposes. Secondly, the Companies Act 2006 (Regulation 2013), The UK Climate Change Act (2008)[c.27, Part 1(1)] have set targets for Scope 1 and 2, whilst the Higher Education Sector's commitment have been set at 43% of the Sector's 2005 carbon benchmark by 2020 and 83% by 2050 for Scope 1, 2 and 3 emissions.

This research is one of the first research undertaken to consider and carry out a detailed assessment into the quantification, management and reporting of Scope 3 (Travel) carbon emissions by NTU and within the HE Sector. This research's contribution to new management processes and knowledge concerns establishing a hybrid environmental management system, developing Scope 3 (Travel) carbon quantification methodologies (including overseas students' travel), developing NTU's travel sustainability index and adopting global reporting initiative G4 as reporting formats applicable to NTU to meeting stakeholder reporting requirements.

I like to thank a few people who had assisted me in developing this thesis. It would have been impossible to write this thesis without the internet. I am especially indebted to my supervisors' Dr Petra Molthan-Hill and Dr Richard Howarth for their advice and constructive comments. Thank you Professor Colin Fisher, Dr Susanne Tietze and Dr Carley Foster for your invaluable guidance. I would like to thank NTU Estates for facilitating the collaborative action research at NTU. I like to thank Mr John Hall at London Business School (via Sconul) to enabling me access to their library facilities and space for writing up this thesis.

I owe a huge debt of gratitude and sincere thanks to my two sons Adam and James for generously giving me the time and freedom to complete this Thesis and supporting me in many other ways. I am greatly indebted to you both.

Whatever Lord Ganesha undertook a task, he undertook with conviction and self-belief. It is this phenomenon that we need to include in ourselves, in the way we work. Any job, if it is worth doing, is worth doing well. Whatever the task you are faced with, face it with courage and conviction and do it to the best of your ability. At the end of the day, you have the satisfaction of knowing that you gave it your best endeavours with all your resources at your disposal (www.hindutemplenebraska.org).

Nottingham Trent University

July 2016

TABLE OF CONTENTS

List of Tables

List of Diagrams

List of Figures

Abbreviation and acronyms

AASHE	Association for the Advancement of Sustainability in Higher Education
ACUPCC	The American College & University Presidents Climate Commitment
ACCA	Association of Chartered Certified Accountants
ARC	Action Research Committee
CCA	Climate Change Act 2008
CCC	Committee on Climate Change
CDP	Climate Disclosure Project
CDSB	Climate Disclosure Standards Board
CRC	Carbon reduction committee
DEFRA	Department of Education and Rural Affairs
EMS	Environmental Management System
EAUC	The Environmental Association for Universities and Colleges
GHG	Green House Gases
GHG - PCARS	GHG Protocol Corporate Accounting and Reporting Standard
GHG - PA	GHG Protocol for Project Accounting
GRI	Global Reporting Initiative
HEI	Higher Education Institute
HES	Higher Education Sector
HECFE	Higher Educational Council For England
HESA	Higher Education Statistics Agency
IPCC	The United Nations Intergovernmental Panel on Climate Change
ISO	International Standards Organisation
KPI	Key Performance Indicator
NGO	Non-Governmental Organisations
NTU	Nottingham Trent University
PDCS	Plan-Do-Check-Act
STARS	Sustainability Tracking, Assessment and Rating Systems
SWOT	Strengths, Weakness, Opportunities and Threats
UUK	Universities United Kingdom
UNFCCC	United Nations Framework Convention on Climate Change
UNEP	United Nations Environment Programmes
WBCSD	World Business Council for Sustainable Development
WRAP	Waste and Resources Action Programme
WRI	World Resource Institute

DEFINITION OF SOME KEY TERMS USED IN THIS THESIS

(A) Sustainability knowledge (Too and Bajracharya, 2015)

Within this thesis, the role of institutions and policies relating to sustainability are described as related to sustainable development. The description of the concept of sustainability knowledge is the interactions of organisations, institutions, environmental policies and sustainable development programmes. Amalgamated with this concept is the interaction of human behaviour with respect to tacit knowledge.

Sustainability knowledge in this thesis is described as the various complementary sharing of knowledge and information within and between the organisation and its participants.

Sustainability knowledge also means the interactions between social and environmental domains. Choudhury and Korvin (p.12, 2001) remarked that "sustainability has therefore come to embody an agenda that extends beyond economic viability and environmental regeneration, reaching deeply into the structure of social organization itself by insisting on the key component of social equity and justice".

(B) Carbon emissions (Weidmann and Minx, 2007)

Carbon emissions are related to the release of carbon dioxide gases from burning hydro carbon products principally petroleum, carbon gases and coal. Following the natural cycle, carbon is usually absorbed by trees and plants. Excessive carbon dioxide is then trapped in the atmosphere thereby increasing the temperature of the world described as global warming. Global warming gives rise to unpredictable weather that translates to business risks to agriculture and manufacturing.

(C) Carbon compliance (Hefce, 2010)

This refers to the measurement process of carbon dioxide equivalents emitted. Carbon compliance refers to the UK Government's carbon target for the education sector. At present the higher education sector has been set at 43% of the sector's 2006 carbon benchmark by 2020 and 83% by 2050.

The carbon compliance is the minimum standard that applies to every higher education institute

(D) Carbon intensity values [2012 Carbon Conversion Factors] (Defra, 2015)

Carbon emissions conversion factors published by DEFRA providing key data concerning emissions factors to be used by reporting entities.

(E) Interpretive approach (Elliot and Timulak, 2005)

Interpretive approach described in this research commences from the position that the researcher's knowledge reality, including the domain of human action within an organisation setting. Interpretive researcher's present the understanding of phenomena by accessing the data results and meanings participants qualitatively assign to them (Scapens, 2008).

(F) What are green house gases [GHGs] (Ghg, 2013)

GHGs are gases pollutants within the earth's atmosphere that inhibiting heat generated from escaping into space. The burning of hydrocarbon fuels, such as coal and oil, and deforestation causes the concentrations of GHGs to be trapped thus increasing the earth's ambient atmospheric temperature. Scientists are of the opinion that the increasing temperatures could contribute to global warming and climate change.

(G) Radiative forcing index (RFI) (Offset, 2015)

Aircrafts flying at altitudes of 9 to 13 kilometres. At these altitudes, GHG emissions are different than that if the aircraft was at ground level. For this reason, there is an anomaly that is still incompletely understood. To tackle this anomaly, scientist have introduced the Radiative Forcing Index (RFI) in the context of airline emissions calculation is usually referred to as the multiplier that expresses any extra warming effects that occurs as a result of the emissions occurring while planes are in the air.

In 1999, the IPCC calculated that the average for full radiative forcing to be a factor of 2.70. Therefore, to estimate the impact of an airplane trip has to include this multiplier, in calculating the CO_2emissions from jet fuel to account for full radiative forcing.

CHAPTER 1. INTRODUCTION

SUMMARY

This first Chapter introduces the principal objectives of this collaborative case study research thesis and explains in broad terms the effects of Scope 3 (Travel) carbon emissions quantification, management, accountability and reporting. The compliance reporting requirements of the Companies Act 2006 (Regulation 2013, Section 414-416), the Climate Change Act 2008[c,27, Part 1 (1-31)] and to meeting the HE Sector's Carbon Target Emissions targets for 2020 for Scope 1 and 2. HEFCE to showing leadership and effective environmental management systems development and carbon reporting perspectives of Scope 3 (Travel) as a contribution to new knowledge for total carbon footprint reporting.

Travel carbon emissions of a Higher Education Institute's (HEI) can be a substantial quantum to the HEI's carbon footprint. HEIs are facing increasing demands from government legislations and from stakeholders to take action on carbon mitigation, by benchmarking their travel carbon emissions and taking actions to improving their environmental management systems and meeting their carbon emissions targets. HEIs as research institutions are able to leverage on their research strategies for guidance for managing and accountability of their travel carbon emissions.

1.0 INTRODUCTION

The Stockholm Declaration 1972 (Sohn, 1973) was the first conference to make reference to Scope 3 (Travel) carbon emissions and sustainability in higher education. This Declaration on the environment, forged a common strategy to addressing the challenges of preserving and enhancing the global environment

(Untreaty1, 2008). The Tallories Declaration in 1990 formed an international environmental consortium comprising of over 350 worldwide HEIs who had consented to include sustainability and environmental literacy in teaching and research at colleges and universities (Ulsf, 2001; Wright, 2011). In 1993, 400 members of the Association of Commonwealth Universities signed The Swansea Declaration, 1993[In Ulsf, p.3, 2001] to developing new process to appropriately challenge and find a balance between economic development and environmental preservation. This was followed by the Toyne Report, 1993[In peopleandplanet, p.2. 2006] that evaluated what knowledge, skills and awareness was required to develop greater environmental responsibility within the Higher Education (HE) Sector. The Toyne Report recommended that HEIs publicise their development and implement carbon management plans that is focussed on the continuous pursuit of environmental sustainability. This was followed up by The Khan Review 1997 (Khan, 2013) that stated the majority of government environmental policies had missed the wider impact of environmental sustainability for the lack of funding for capital projects and accreditation to international environmental audit schemes (Sussex1, 2000). In 2007, the Copernicus Alliance (Copernicus, 2011) was setup on similar lines by the European University Association. These three declarations directly concerned the HE Sector and HEIs were committed to establishing environmental and sustainability targets. Funding and expertise as Alshuwaikhat and Abubakar (2008) argued was lacking by HEIs in establishing a professional and systematic environmental management approach in managing campus operations systems and promoting sustainability. However, Lorenzoni et al (2007) and Florini and Saleem (2011) argued that HEIs have not been able to leverage on their academic research reputation or environmental management skills concerning risks associated with Scope 3 (Travel) carbon emissions and climate change, pre-empting restrictive and costly carbon emissions legislations (Vuuren et al, 2006).

Universities are obliged to become innovative institutions by undertaking successful programmes that minimises their environmental footprints (Berners-Lee et al, 2011and Larsen et al, 2013). In England, there are environmental policy measures and regulations that the Higher Education Funding Council (HEFCE) had tied to University funding by imposing financial penalties for poor environmental performance (Hefce, 2010). However, Scope 3 (Travel) carbon emissions represent the indirect emissions (Diagram 1, p.22) occurred by business and commuting travel by university staff and students could be substantial. The public perception is that, universities are well placed as foundations of intellectual research to present innovative and cost effective programmes for the mitigation of Scope 3 (Travel) carbon emissions (Stephens and Graham, 2010 ; Waas et al, 2010 and Guereca et al, 2013). Guest (2010) stated that the key issues concerning choosing the optimal amounts of carbon emissions reductions must be corresponding to the cost and carbon abatement benefits over a long time frame, since Higher Education Institutes (HEIs) are continuously evolving. Clift (2007) and Hancock and Nuttman (2014) had indicated that organisations had not provided HEIs with guidance for bench marking. As a motivator, HEFCE has implemented policies when distributing public funding that will be correlated to the individual HEI’s carbon footprint. HEFCE intentions are to have a mechanism that act as an incentive for HEIs to meeting the carbon reduction targets of 30% by year 2020 in compliance with the Climate Change Act 2008 (Cas, 2013). To achieve this, strategic guidance is being provided to HEIs with instructions and recommendations for corporate social responsibility for complying with the Climate Change Act 2008[c.27, Part 1(1-13)] (Hefce, 2013).

The UK's Climate Change Act 2008[c.27, Part 1-6(1-88)] (Cca, 2008) had legislated the UK's commitment to the Kyoto Protocol carbon emissions targets of which Scope 3 (Travel) is a major component part (Kenis and Mathijs, 2014). The Act was a landmark, as the world's first legal commitment binding legislations (Cca, 2008) for reducing carbon emissions. The Act made a requirement for HEIs to report their carbon footprints (Ecometrica, 2013 and Lockwood, 2013). Chapter 27, Schedule 8 of the Climate Change Act 2008 (Cca, 2008) had legislatively set the UK carbon targets of at least 80% by 2050 and at least 35% by 2020 against 1990 base line emissions. Lockwood (2013) commented that the Act created major legislature emissions reduction targets to organisations and requiring publication of the organisation's reduction targets during a series of five-year transformation targets but criticised for not securing political commitment or investor confidence with increasing costs to the economy.

Scope 3 (Travel) carbon emissions is principally derived from the combustion of hydrocarbons such as benzene, diesel and liquid gases which results in the release of large amounts carbon emissions and other GHGs which powers the mechanics of our transportation modes (Odeh and Cockrill, 2008 and Ou et al, 2010). As a result, the key aspect of Scope 3 (Travel) ecological impact is the ever increasing GHGs concentrations that have an adverse effect on climate change that can have an adverse ecological, social and economic consequences. The Department of Food, Environment and Rural Affairs (DEFRA) stated that global land temperature since the 1970s, have increased by 0.7 degree Celsius as a consequence of Scope 3 (Travel) and Scope 1, 2 and 3 carbon emissions (Defra, 2010). The United Nations Intergovernmental Panel on Climate Change [IPCC] (Ipcc, 2007) projected that by 2050, world temperatures would raise further between 1 and 6 degrees celsius, together with serious depletion of fossil fuels used for travel (Defra, 2012a). The IPCC, is a renowned body of scientists under the auspiciousness of the UN. This body is scientific and intergovernmental in construct, presenting rigorous and balanced scientific information to decision makers. Governments acknowledge the authority and scientific content of the IPCC. The various IPCC scientific reports are 'policy-relevant and yet policy-neutral, never policy-prescriptive' (Reinman, 2012 and Ipcc2, 2015). Stern (2006) and Schellnhuber (p.12, 2006) stated that rising earth temperatures would be a critical point in the climate eco-system with the "extinction of iconic species or loss of entire ecosystems, loss of human cultures, water resource threats and substantial increases in mortality levels, among others" with carbon emissions as a substantial contributor. A 2-degree increase as Bewribbington and Larrinaga-Gonzalles (2008) stated would cause significant shifts to the Earth's ecosystem. To explain the different scope classification concerning carbon emissions, diagram 1(p.22) describes the sources of Scope 1, 2 and 3 as determined by the World Resource Institute for standardisation (Wri, 2013a) and Carbon Trust (2014) with regards to the carbon emission terms as used through in this Thesis.

Greenhouse gas emissions are namely (diagram 1, p.22) CO2 (Carbon dioxide – 75%), SF6 (Sulphur Hexafluoride), CH4 (Methane – 14%), N2O (Nitrous oxide - 8%), HFC5(Hydrofluorocarbons - 1%), PFC5 (Perfluorocarbons -1%) and SF6 (Sulphur Hexafluoride -1%). Water vapour (1%) although part of GHGs, is not fully understood by scientists as to whether water vapour has a negative impact on the earth's climate [Guardian (2011), Unfcc3 (2015) and Livescience (2015)]. Diagram 1 pictorially describes the emissions sources are categorised as Scope 1 (direct emissions generated by the organisation), Scope 2 (indirect emissions) and Scope 3 (emissions not owned by the organisation). Scopes 1 and 2 emissions have been identified under Schedule 7 of the Companies Act 2006 (Regulation 2013) as reportable emissions by quoted and large organisations. Scope 3 emissions reporting are voluntary but required by HESA for the HE Sector for showing leadership (Hesa, 2014).

Greenhouse gases(GHGs) act as a barrier in two processes. Firstly, GHGs allow visible and ultraviolet light through the earth's atmosphere. On reaching the earth's surface the light is reflected back to the atmosphere as infrared energy or heat and GHGs absorb this heat and increases the earth's temperature (Livescience, 2015). As a consequence, increasing GHG emissions are trapped in the atmosphere that could result in increases in global temperatures. Carbon dioxide CO2, is the most dominant anthropogenic GHG caused by human activities and increasing exponentially since the 1970s (Ipcc1, 2007).

Diagram 1- Sources of emission and their related definitions.
(source - https://www.carbontrust.com/resources/faqs/services/scope-3-indirect-carbon-emissions)

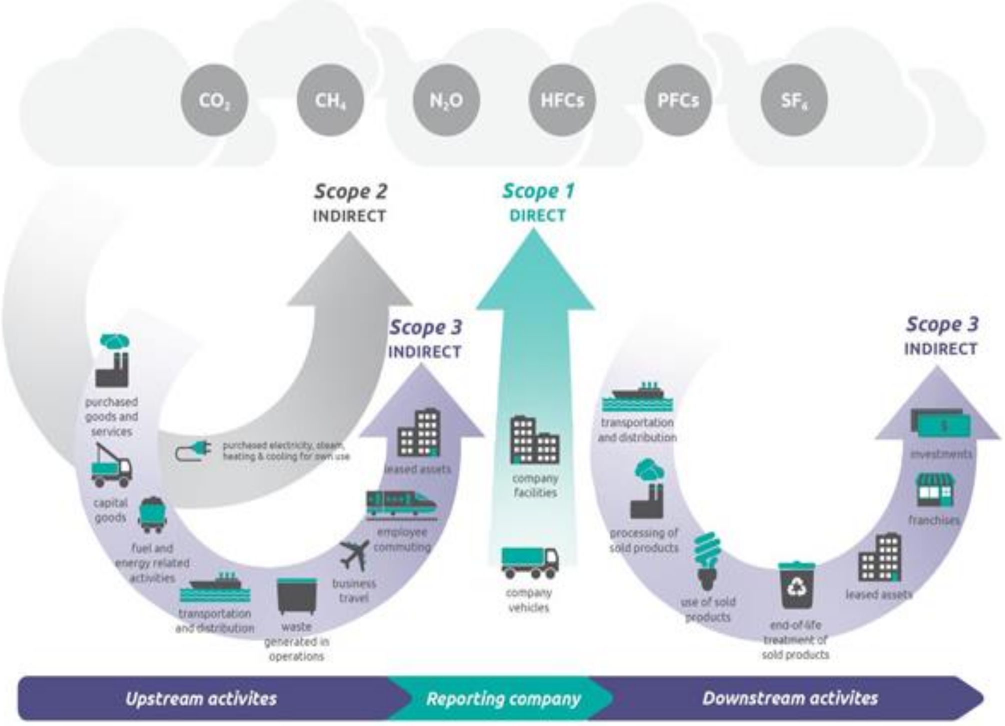
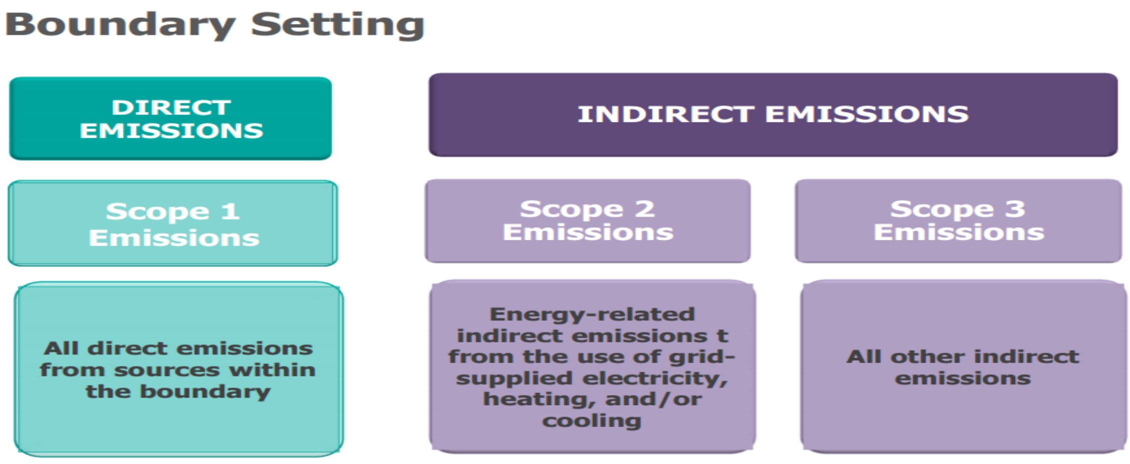


Diagram 1 (continuation) from (p.22), specific GHGs are identified as:

Scope 1 (Direct)	Scope 2	Scope 3 (Indirect)
Purchased Electricity	Emissions from Company facilities and own vehicles	(1) Purchased goods and services (2) Capital Goods (3) Fuel and energy related activities (4) Transportations and Distribution – Marne (5) Waste generated in operations (6)Business Travel (7) Employee Commuting (8) Leased assets (capital items) (9) Transportation and Distribution – Land (10) Processing of solid products sold (11) Procession of products sold (12) End of Life treatments of solid products (13) Downstream leased assets (14) Franchises (15) Investments

https://www.carbontrust.com/resources/faqs/services/scope-3-indirect-carbon-emissions/

To avoid the risk of double counting applicable to carbon trading mechanisms and jeopardising the environmental integrity calculations. The GHG Protocol has indicated that companies should avoid counting emissions in the same Scope group nor claim ownership of the same emissions. A report from the University of Sydney (Sydney, 2013) stated that the optional reporting of Scope 3 emissions, the accountability premise by organisations involves “who has and who can exercise control or significant influence both in and through the relationships of the various entities upstream and should be explicit within its boundary” (Sydney, p.2, 2013). Miller (2008) argued that the issue of double counting of GHGs is problematic due to the absence of appropriate GHG management standards. The GHG Protocol (Ghgprotocol, 2013) have recommended boundary settings as shown below to avoiding double counting carbon emissions



Source Ghgprotocol (2013)

The UK carbon mitigation fiscal and market instruments is the Carbon Reduction Committee (CRC)(Gov, 2014) which is a governmental scheme designed to improve the UK's CO2 emissions by having a compulsorily register of corporations that consume above 6,000 megawatt hours(MWh) of qualifying electricity supplies (Scope 1 and 2 only). The CRC 2nd Scheme (2014-2019) covers emissions not already covered under Climate Change Agreements and the EU Emissions Trading System(EU-ETS)(Gov, 2014). The HE Sector and some public bodies must take part. CRC has three parts (i) emissions reporting requirement (ii) participants 'buy and comply' allowances for every tonne of carbon emission at £15.60 for 2014-2015. The Scheme incentivises corporations, UK central government departments including the HE Sector (Hesa, 2014) for improving energy efficiencies, reducing organisational costs and increasing reputation. The UK CRC registrations scheme was then followed by the EU-ETS: Cap and Trade Scheme (Gov, 2015). Phase II (2014-2019) of this Scheme is in progress but no research information is available.

The Carbon Reduction Committee's requirement for organisations is to register and report their emissions if exceeding 6000 MWh Scope 1 and 2 consumptions. Airlines emissions concern Scope 2, whilst HEIs in this Scheme involve Scope 1 and 2. The HE Sector (p.24) and some public bodies must take part in the CRC registration Scheme if their consumption is above 6000 MWh per annum. This registration framework (p.24) describes that The UK CRC registrations scheme will then be followed by the EU-ETS: Cap and Trade Scheme or the Pay and Comply Scheme. Phase II (2014-2019) is in progress but no information is available at the time of writing this Thesis of its impact on emissions, levies or financial derivative trading in the carbon markets. This research had noted that no airlines or HEIs has made any publications concerning this CRC or EU-ETS consumption reporting to date (2015). The aviation cap is set at 2Million aviation allowances (Ets, 2015).

The carbon footprint by definition is inclusive of all Scopes 1, 2 and 3. The CRC (p.24) is the mechanism of accountability involving Scope 1 and 2 only (Scope 2 for aviation companies). However, HEIs are subjected to the CA2013, CCA2008 as legislative compliance for Scopes 1 and 2 (Figure 1)(p.108) whilst HEFCE for compliances which includes Scope 3 carbon emissions which is a different compliance requirement that require Scope 3 emissions to be reported as part of HEFCE's funding requirements (p.19). Overseas business and students travel emissions are integral to the computation and benchmarking of the HEIs' carbon footprint. HEFCE is taking the ‘lead’ to the reporting of Scope 3 to show leadership (p.63) and (p.66). Scope 3 reporting is fundamental to understanding the benchmarking of the HEI's carbon footprint.

Bebbington and Gonzalez (2008) stated that policy responses to carbon emissions are beginning to gain momentum with increasing stakeholder awareness of the risks of Climate Change and abatement measures. Creating carbon trading markets has been one policy response to Climate Change, which could have an impact on corporations. However, Haslan et al (2014) stated that this process of translating carbon emissions accountability into monetary and economic measurements will require robust quantification techniques, accounting valuation of assets and liabilities and reporting standards.

HEIs can make a significant impact in promoting lower Scope 3 (Travel) carbon emissions, reducing the ecological impacts and communicating empirical carbon accountability information (Kolk et al, 2008 and Riddell et al, 2009). Under those circumstances, Waheed et al (2011) stated that the major problems facing HEIs is ‘how’ and ‘what’ are the mitigation processes for Scope 3 (Travel) carbon emissions abatement. HEI travel emissions could range from 23% to 35% of their total carbon footprint (GreenBiz, 2012).

This Chapter is presented into thirteen sections as described below:

- Section 1.1 presents the research problems present prior to the commencement of this collaborative action research undertaken by this research.
- Section 1.2 describes the research questions and objectives that would focus and direct this research.
- Section 1.3 describes the background to this research as applicable to the higher education sector.
- Section 1.4 presents the collaborative case study research with Nottingham Trent University.
- Section 1.5 presents the environmental management systems as applicable in the higher education sector in England
- Section 1.6 presents Scope 3 (Travel) carbon emissions quantification and reporting in the higher education sector
- Section 1.7 described the Scope 3 Travel Sustainability Performance Index as applied to this research
- Section 1.8 presents the research design, methodology tools and methodologies used in this research.
- Section 1.9 describes the data capture and statistical factor analysis as applied in this research.
- Section 1.10 describes the definition of the term carbon emissions used in this research
- Section 1.11 describes the contribution to knowledge.
- Section 1.12 describes the limitations of this thesis.
- Section 1.13 presents the structure of this thesis

1.1 THE RESEARCH PROBLEM

Why should NTU quantify and manage its Scope 3 (Travel) emissions? Firstly, NTU funding is tied to meeting the HE Sectors emissions target of 43% by 2020 and 83% by 2050 (Hefce, 2010). Secondly, enabling NTU to leverage on its research capabilities to benefit from cost reduction opportunities i.e. (a) identifying resources and energy risks in travel (b) Identifying energy efficiencies and cost mitigation opportunities and (c) recommending staff, UK students and overseas students to reduce their travel emissions (d) to developing quantification methodological tools (e) EMS management processes of emissions accountability and (f) developing a GRI G4 emissions reporting format to stakeholders (Trust, 2015).

Various voluntary and mandatory reporting schemes on Scope 3 (Travel) emissions have multiplied alongside UK Company law, stock exchange rules, rating agencies and reporting guidance from DEFRA, HEFCE, Green House Gas (GHG) protocols, Global Reporting Initiatives (GRI) (Wells et al, 2009 ; Herremans and Allwright, 2002 ; Andrew and Cortese, 2011; Waheed et al, 2011 and Bero et al 2011). There is a plethora of descriptive information, from which there is no Standard describing a quantification tool and management methodologies for the accounting, management and reporting of carbon emissions (Altan, 2010). The Carbon Trust (Trust, 2014) describes Scope 3 (Travel) carbon emissions involves staff, students, businesses and overseas travel arrangements by air, rail, and vehicle transportations Air travel miles is not the distance between to two airports but have specific routing directions that are longer than the distances between two airports. HEIs are uncertain whether to apply the concept of radiative forcing index to uplift their air miles travelled (*see G, p.16*) due to absence of any recommendations. As a consequence, many HEIs are delaying or not undertaking developing quantification, management and reporting methodologies due to uncertainties and confusion (Passey and MacGill, 2009).

From 01 January 2015 (Hefce13, 2013 and Gov, 2013a) all HEIs have a requirement to report their Scope 3 (Travel) and other Scope 3, 2 and 1 carbon emissions. As a consequence, for compliance, HEI carbon foot prints have become mandatory reporting requirements (Abolarin et al, 2013 and Guereca et al, 2013) that are also applicable to NTU. However, universities are in slow mode in developing processes and management systems for adopting Scope 3 (Travel) carbon emissions as part of their inclusive reporting requirements (Altan, 2010 and Ozawa-Meida et al, 2013). Also, Ozawa-Meida et al (2013) stated that universities had to prioritise their budgets and had lower resources of skilled personnel to undertake the quantification, management and reporting of Scope 3 (Travel) carbon emissions. There had been little or no research as Larsen et al (2013) had argued. HEIs are required to develop mechanisms, processes and procedures for carbon data collection and compliances, which are administratively burdensome, expensive and methodologically complex for HEIs to interpret. HEIs also do not have the necessary technical expertise to implement these requirements (Abolarin et al, 2013 and Ozawa-Meida et al, 2013).

The researcher visited De Montfort University on 08 March 2013 to evaluate the Scope 3 supply chains emissions research conducted by the De Montfort and ARUP Partners and had discussions with Mr Karl Letten, one of the authors of a research publication (Ozawa-Meida et al, 2013). The researcher noted that, De Montfort had commenced some initial research theory development concerning Scope 3 carbon emissions accountability, but noted that no research had been undertaken concerning travel emissions. Background research of other universities researching Scope 3

(Travel) carbon emissions were (1) In March 2014, De Montfort University (Dmu, 2012) described travel emissions as part of the university's carbon management plan, but had not provided any details (2) City University (City, 2014) reported travel emissions based on the spent data only (3) Newcastle University (Newcastle, 2015) stated the complexity of calculating Scope 3 emissions, and provided initial figures of the university's 2005 base year values. The above universities had published their carbon management plans and many are at the planning stages for Scope 3 (Travel) carbon emissions accountability for HESA compliance purposes (Hesa, 2014). The academic literature concerning transport emissions within the HE Sector had been limited no HEI had published research concerning the management, quantification and reporting of their Scope 3 (Travel) carbon emissions at the present time.

Scope 3 (Travel) emissions are widely known to be a major contributor GHGs and HEIs' have not been provided with sufficient technical resources and guidance under current HESA carbon footprint protocols (Downie and Stubs, 2013). There has been limited information concerning the accountability of Scope 3 (Travel) carbon emissions, concerning the identification of emissions sources (avoiding double counting), measurement criteria (fuel consumed or distance) and conversion factors. Other factors concern, the lack of guidance of effective management processes concerning HEIs implementing an environmental management system as a management tool for carbon emissions accountability.

Developing a Scope 3 (Travel) quantification tool, can be complex and problematic as this tool requires advanced quantitative model building techniques, qualitative mapping and amalgamating the many stages of complexities involving the different travel modes emissions and their carbon intensity factors (Weidmann, 2009 ; Hesa, 2014 and Ntu, 2014). Consequently, complex practical quantification methodological difficulties have inhibited consistent empirical reporting of HEI carbon footprints (Huang et al, 2009 and Koning et al, 2010). Zhang et al (2012) stated that HEIs are approaching the quantification of Scope 3 (Travel) carbon emissions as a reactive mechanism, as a particular project and in an ad hoc manner that is inefficient, inappropriate and without any focus of achieving carbon reduction targets.

On the whole, carbon quantification methodologies are becoming more complex for its accountability and interconnected with environmental sustainability and climate change (Larsen et al, 2013). Many HEIs do not have the appropriate environmental management systems to manage, collate and quantify their carbon emissions and to providing relevant carbon emissions data that can be used for reporting (Ozawa-Meida et al, 2013).

1.2 DEFINING THE RESEARCH QUESTIONS AND OBJECTIVES

The research questions have been developed from the literature review gap analysis (p.123) which focuses on identifying, managing, quantifying and reporting Scope 3 (Travel) carbon emissions. Research questions have been formulated for the purposes of compliances and management decision making processes (Teles and Sousa, 2014). The management practice research questions relate to determining environmental management practice efficiencies, carbon emissions data collections processes and reporting systems (Khan, 2013 and Bilodeau et al, 2014). The research questions aim is to determining empirically the effectiveness of NTU’s environmental management systems and identifying NTU’s core environmental attributes, identifying their strength and weakness, communicating carbon performances and developing mechanisms for taking responsive actions for Scope 3 (Travel) carbon emissions. The research questions would seek to evaluate the development of the UniCarbon index as a ‘key performance index’ that would summarily interpret in empirical terms, NTU’s Scope 3 (Travel) carbon emissions abatement performance.

Table 3 (pp.122-124) presents the synthesis of the knowledge and management systems gap analysis from the literature review that influences the research questions development framework. Table 3, covers an exhaustive list of research gaps that provided a basis for the development of the five dominant questions as a result of iteration of thorough problem question formulations to seeking answers identified from the gap analysis as presented in Table 1(p.32). The sequencing logic had adopted Sammut-Bonnici and Paroutis (2013) dominant logic, consolidating these gaps as core foundations as how the research questions can be logically sequenced into research questions building blocks. The logic for sequencing the research questions commences with identifying (1) what are the legal requirements for Scope 3 Emissions reporting (2) what are the best current EMS practices by other industries (3) what are the environmental management practices for Scope 3 (Travel) (4) how are environmental management systems used for carbon emissions data accountability and (5) what are the reporting mechanisms for complying to legal and industry practices.

The research objectives evaluate the ‘checkpoints to guiding the researcher’ linked to answering the research questions appropriately and adequately. In Table 1(p.32), the objectives have been developed utilising Patidar (2015) criteria ensuring that the objectives are feasible, relevant, observable, unequivocal and measureable. The objectives are specific solutions achievable from the research questions.

Table 1 - Research Questions and Research Objectives

Research Question Number	Research Questions Sequence Logic (Adopted from Sammut-Bonnici, 2013)	Research Objectives Developed According to (Patidar, 2015)
1	What are HEFCE and legal requirements for the accounting, management and reporting of Scope 3 (Travel) carbon emissions NTU?	To investigate if current HEFCE policies are incentivising NTU to reporting its Scope 3 (Travel) carbon emissions
2	What are the 'best practices' either in the public or private sector concerning Scope 3 (Travel) carbon emissions quantification and reporting applicable to the NTU?	To examine the various schools of thought and theories regarding the developing a quantification tool for the management of Scope 3 (Travel) carbon emissions
3	What are NTU's Scope 3 (Travel) carbon emissions information processes, management systems and procedures that are recommended for complying with HEFCE compliance recommendations that contribute to efficient carbon reduction management?	To identify and assess the current NTU's models and frameworks regarding environmental management systems for Scope 3 (Travel) carbon data collections
4	What and how efficient are NTU's current environmental management systems for Scope 3 (Travel) carbon emissions for the following? (a) carbon emissions management accounting (b) carbon data capture (c) carbon emissions reporting to stakeholders	-To investigate if NTU current environmental management system is effective for the management and collation of Scope 3 (Travel) emissions data. -To offer recommendations on how to make NTU's environmental management system to be more effective
5	What are the Scope 3 (Travel) carbon emissions quantification tool recommendations for adoption by NTU as best practice for the following? (a) carbon footprint accounting (b) tracking NTU's carbon emissions reduction against HEFCE carbon reduction target	To investigate if NTU has the ability and capacity to undertake the development of an effective Scope 3 (Travel) carbon quantification tool.

The research objectives would be including the designing and implementation of a revised new environmental management accounting system enabling the collation of travel carbon emissions data. To meeting NTU's reporting objectives this case study research would be seeking the development of a key environmental performance indicator.

The sequencing of the logic of the research questions relates to the 'chronological order of evaluating the research processes' as part of the 'action research approach' in a planned and structured manner from the 'general' to the 'specific' engaging the research to providing a logical flow of data and research information. Emanating from the 'gap' synthesis of the literature review (pp.122-124), the researcher had formulated the sequencing logic for the research question development in a chronological manner. The sequencing logic adoption had involved three Stages (1) identifying the key research questions for investigation (2) Gathering the data in a logical sequence (3) analysing and interpreting the results. The above sequencing logic used a 'structured holistic approach' adopting the logic framework recommended by (Sammut-Bonnici, 2013) for sequencing the research questions (p.32).

Research questions are specific derived from the synthesis of the literature review. The research questions represent unique engaging questions that enable the synthesising of diverse sources of information into a coherent manner that supports the argument about the research topic. The research question is a clear, focused(specific) and arguable question around which this research is centred that can be answered with the collection of Scope 3 (Travel) emissions data, analysing the data and enabling inferences from the data (2) The research objectives outline the specific goals of what this research plans to achieve when completed.

Objectives are directed to identifying the relationships of different variables, broad statements of the desired outcomes, emphasising what is to be accomplished and how to address this research's long term aspirations and expectations as to what is to be achieved on completion of this case study. The research objectives are mechanisms and frameworks to guiding the researcher to focus on the key components of the research questions to be investigated.

The research questions and research objectives are linked where the objectives present a focused and concise declarative mission statements which provides directions to investigate, identify, describe and measure the key variables of the research questions and to communicate the outcomes of the research. Objectives are highly focused and feasible procedural mechanisms for enabling the researcher to be embarking on the right solutions to answering the research questions

1.3 BACKGROUND TO THIS RESEARCH AS APPLICABLE TO THE HIGHER EDUCATION SECTOR

Over the last decade, the concerns of Scope 3 (Travel) carbon emissions had permeated across all business sectors including the Higher Education Sector (HES) (Huang et al, 2009 and Ozawa-Meida et al, 2013). HES is in a unique position of excellence for significantly responding by research, education and making significant contributions to a lower carbon world (Beringer et al, 2008). Apart from educators, Waheed et al (2011) indicated that the HES is well placed for developing new knowledge and researching solutions to reducing carbon emissions. No doubt, there are challenges for the HES as Clarke and Kouri (2009) and Andrew and Cortese

(2011) had indicated in integrating Scope 3 (Travel) carbon mitigation planning by developing quantitative, qualitative assessment models and environmental management systems for carbon accountability and reporting.

The HE Sector has educational resources, expertise and critical thinking experiences for engaging in research concerning Scope 3 (Travel) carbon reduction and leadership (Andrew and Cortese, 2011) but however are deficient in carbon abatement strategies (Herremans and Allwright, 2000; Wells et al, 2009 and Bero et al 2011). Although, the HES had the academic credentials, there has been no leadership role for Scope 3 (Travel) carbon emissions mitigation or engaging in any management research (Alshuwaikhat and Abubakar, 2008 ; Lozano, 2011 and Wals, 2013). Jain and Pant (2010) and James and Card (2012) had indicated that the HES's emissions accountability and management have not been given as much high priority as it should have. However, some curricula teaching on sustainability awareness had been introduced for carbon emission awareness (Muller-Christ et al, 2014).

Ferras-Balas et al (2008) and Ramos et al (2015) stated that HEIs are in their early stages in developing new environmental management systems for carbon accountability. However, additional carbon emissions accountability research was needed (Brinkhurst et al, 2011) and developing policy instruments to meeting the HES wide carbon footprint and legal compliances (Ozawa-Meida et al, 2013 and Devereux and Fan, 2011). Currently, the HES adaptation of carbon emissions is through carbon policy statements (Holmberg et al, 2011 and Levy and Marans, 2011) rather that emphasis on environmental management systems and carbon accountability (Bero et al, 2011). Jain and Pant (2011) and Suwartha and Sari (2013) stated that the HES is promulgated by legal and stakeholder compliance requirements that are inhibiting for developing an effective response towards carbon emissions accountability and management.

The HES is conscious of their travel carbon emissions and its effects on climate change (Dessai and Slujis, 2007 ; Bebbington and Gonzalez, 2008 and Wachholz et al, 2012). The HE Sector is promoting several travel planning strategies aimed at leveraging staff and student travel behavioural change and wider institutional change concerning travel carbon emissions by promoting alternatives and incorporating carbon emissions savings when calculating alternative travel modes (Hancock and Nuttman, 2014), The HE Sector has not participated the Kyoto Protocol's Clean Development Mechanism due the complexities of choosing carbon neutral projects in different parts of the world, emissions quantification, long time frame and value.

Travel carbon emissions contributing to the effects of climate change, creates systemic risks across the economy, affecting energy prices, national income and the degradation of eco systems (Jones and Solomon, 2013). Under those circumstances, the HES is grappling with the complexities associated concerning travel carbon emissions quantification and adaptation strategies (Hallegatte, 2009 ; Burandt and Barth, 2010 and Mearns, 2010).

1.4 COLLABOARATIVE CASE STUDY RESEARCH WITH NOTTINGHAM TRENT UNIVERSITY

This research is a collaborative case study stemmed from the challenges of the requirements of the Higher Education Funding Council Reporting Compliances for HEIs to adapt to the new requirements for managing and reporting their carbon footprint effective from January 2015. In planning this research, NTU had realised the difficulties the university had encountered to developing new organisational knowledge within their constrained budgets and specialised expertise. NTU had also discovered that due to the complexities, NTU did have the resources and knowledge skills to develop new management and carbon accountability procedures. NTU decided to collaborate with the researcher who had similar research interests.

The researcher was initially involved with Nottingham Trent University and EcoCampus for the development of a Microsoft Excel computational framework for calculating NTU's Scope 3 supply chains carbon emissions determined from NTU's purchases. During this time, the researcher had successfully worked jointly and collaborative with key personnel within NTU. Having, completed this project. The researcher was approached by NTU to expand their collaboration to the quantification of other Scope 3 carbon emissions. The researcher realised that this opportunity could be used as the researcher's action research for the researcher's doctoral thesis submission. This collaborative research aims would be to contribute to NTU's environmental management system, quantification and reporting of Scope 3 (Travel) carbon emissions. This collaborative research had three imperatives of (i) action research problem solving practice initiatives and (ii) to answering the research questions and (iii) developing new knowledge and management practices.

In this collaborative case study research, the researcher (author) is a researcher led enquiry and the primary researcher in executing the entire core research undertakings. Collaborative research had come to afore based on the complexities of the research for the evaluation, implementation and review of NTU's environmental management system and data collection for the accountability, management and reporting of Scope 3 (Travel) carbon emission. NTU is a large and complex institution consisting of numerous layers of management approvals, security and data protection laws for which the researcher would find difficulties to seeking approvals. Inception of this collaborative action research presents a structure and the mechanism to the management of the action research processes (Table 9, p.162 and Table 10, p.165) i.e., collecting data systematically, implementing new processes and applying suitable methods of interpretation and critically reflect on the research situation. In particular, NTU has the computing processing power to facilitate this research's online travel staff and student survey.

The reasons or drivers for this collaboration research concerns the interactive and continuous collaborative process with different expertise, knowledge and experiences contributing to the research solutions based on the researcher's research question (p.32). The action research presents mechanisms that would provide access to new management practices (Mathiassen, 2002). The action research committee (p. 156), design methodologies present the mechanisms for this collaborative research characterised by mutual trust, integrity and informal communications. This collaboration involves the structural level of this committee. D'Amour et al (2005) describes collaboration in relation to factors external to the organisation as systematic or strategic. These are issues embedded in social, cultural and professional systems. Internal factors such as organisational and operational involves workloads, performance efficiencies and organisational cultures. The goals for this collaborative research is to constructively contribute to the divergent range of qualitative and empirical quantitate perspectives presented in this research design. Skills of the researcher and effective consultation are critical to this collaborative research. These mechanisms are confined to interdisciplinary collaboration, Action research committee's role awareness, interpersonal relationship skill sets, to implementing research actions and most importantly obtaining NTU's support.

The action research committee’s attributes to this research study will be centred on ‘problem solving’, shared research objectives and anchoring goals, decision making, and immediate implementation without the need for prior approvals. Responsibility and leadership is the common theme in the discourse of this collaborative research and is also used interchangeably to the researcher solely undertaking this research.

This research had been initiated by the researcher to developing a practical and robust actionable framework for the quantification, management and reporting of Scope 3 (Travel) carbon emissions as part of NTU’s overall carbon footprint.

Nottingham Trent University (NTU) has one of the largest research and academic facilities in the UK (Guide, 2015). In 2014, staff numbers are 4,893 and students are 24,534. NTU commands a unique position, as a place for research and higher learning and has the potential to develop, promote and encourage organisational responses concerning Scope 3 (Travel) carbon emissions reduction (Ntu, 2013). NTU is a large university that has a large commute and business travel requirement that has the necessary characteristics as a case study research for Scope 3 (Travel) carbon emissions management and accountability within its three campus sites (City, Brackenhurst and Cliffton). NTU is currently facing unprecedented Scope 3 (Travel) carbon abatement challenges from HEFCE (Hefce, 2013, : Companies Act 2006 - Regulation 2013, S414-415 and Gov, 2013a) and the Climate Change Act 2008[c.27, Part 1-6(1-88)] (Cca, 2008) for establishing process and systems for the quantification of Scope 3 (Travel) carbon emissions (Ntu, 2014). Under those circumstances, NTU is legally obliged to implement various management procedures, improving its organisational structure and environmental management systems for the accountability and reporting mechanisms concerning Scope 3

(Travel) carbon emissions. This would also be including advancing more sustainability practices (Ferras-Balas et al, 2008) that are also applicable to NTU.

NTU has established many 'green campus initiatives' which have been successful in attracting the best academic students and as an ethically qualified Institution for receiving funding for research and contributing positively towards NTU's prestigious research standing (Shamah, 2012 and Hancock and Nuttman, 2014). NTU has secured accolades from 'people and planet' (Peopleandplanet, 2006) citing NTU's strategic environmental planning targets (2010-2015). As such NTU has the credentials of a preferred case study that can set a benchmark for other HEIs to follow. For NTU to continuingly securing these advantages, environmental information and carbon emissions disclosures, reduction strategies, adaptation activities and achieving carbon reduction targets are key drivers for continually achieving these successes (Karakosta and Askounis, 2010 and Soosay et al, 2012).

NTU's environmental ethos is to strive to become a low carbon university, enhancing bio diversity, executing campus operations that are compatible with the principles of sustainable development (Ntu, 2014). NTU's environmental commitments and accountability strives for a business case that lower carbon emissions are beneficial to all stakeholders.

1.5 ENVIRONMENTAL MANAGEMENT SYSTEM IN THE HIGHER EDUCATION SECTOR IN ENGLAND

The Higher Education Sector (HES) has become aware of the sector's environmental impact and management to stakeholders (Disterheft et al, 2012 and Hoover and Harder, 2014) and the adoption of an Environmental Management System (EMS) is a key requisite for environmental governance (Alshuwaikhat and Abubakar, 2008).

EMS are procedural systems applicable for carbon emissions data management and collection for managing environmental accountability management (Zorpas, 2010 and Jabbour, 2013). The HES has recommended the use by HEIs, The International Organisation of Standard (ISO)(ISO14001) as the preferred EMS as used in other industries (Nguyen and Hens, 2015). Clarke and Kouri (2009) stated that many HEIs are in various stages of this ISO Standards’ implementation for non-profit organisations. However, Lundberg et al (2009) and Halila and Tell (2013) drew attention of the inappropriateness of the ISO 14001 series as being too broad, its frameworks confusing, difficulties in understanding its implementation procedures and uncertainties of the standard’s cost benefits prior to implementation.

The drivers behind HES adoption of an EMS is dependent on each HEI campus’s EMS model that can be considered as being most appropriate and involving a continuous improvement cycle, matching the HEIs’ environmental policies, targets and decision making frameworks (Clarke and Kouri, 2009 and Halila and Tell, 2013)

1.6 SCOPE 3 (TRAVEL) CARBON EMISSIONS QUANTIFICATION AND REPORTING IN THE HIGHER EDUCATION SECTOR

The HE Sector has understood the concept of a carbon constrained reality and the benefits of complying with the Climate Change Act 2008[(c. 27, Part 1(13)] in meeting the UK’s carbon emissions target by 2050 (Hefce7a, 2009). HEFCE (Hefce, 2012) requires the HES to report their carbon foot print. In January 2012, HEFCE and JMP Consultants published guidelines for the measuring Scope 3 (Transport) carbon emissions (Jmp, 2012 and Hefce4, 2012). This publication offered guidance on the adoption of efficient data collections that offered the HES as a useful resource. For the quantification of Scope 3 (Travel) carbon emissions, HEFCE (Hefce4, 2012) had recommended the various protocols recommended by DEFRA (Defra, 2012) and utilising the carbon intensity factors published for the different transport modes and distances travelled.

On 01 October 2013, the UK Companies Act 2006 (Regulation 2013, S414-415) required quoted companies and large organisation (i.e. universities) to report their carbon emissions impact and footprint in their financial reporting statements (Gov, 2013). This Act proposed new reporting guidelines to include Scope 1 and 2 only for the present time. Scope 3 (Travel) carbon emissions are enhanced requirement for HESA (Hesa, 2014) within the HE Sector and segmented with other Scope 3 indirect carbon emissions i.e. waste and supply chains (Corporate, 2013 and Hefce4, 2012). The current state of quantification and reporting of carbon emissions were criticised by The Corporate Citizenship (Corporate, 2013) as purely a compliance exercise without sufficient pertinent data, contributing little to substantive reporting. The HES is not responding to reporting travel carbon emissions and key carbon reduction performance indicators as a measureable quantum to stakeholders as role models to industry (Fadzil et al, 2012). Kuo and Chen (2013) and Stephens and Graham (2010) stated that carbon emissions reporting both internally and externally to stakeholders communicate their current environmental status and progress towards greater carbon reductions with greater transparencies. The HES has not been able to implement carbon emissions reporting procedures at the moment since none of the available reporting tools and carbon abatement performance indicators have not been explicitly designed for the sector (Hoffmann and Busch, 2008 ; Bowers, 2010 and Pazirandeh and Jafari, 2013). Extra resource sources and time are required by the HES to engage with stakeholders (Stephens and Graham, 2010 ; Wang et al, 2013 and Milutinovic and Nikolic, 2014).

1.7 SCOPE 3 TRAVEL SUSTAINABILITY PERFORMANCE INDEX AS APPLIED IN THIS RESEARCH

Environmental sustainability has emerged as a critical policy focus for organisations, governments and the general public. A great deal of attention has also been focussed on climate change, water preservation, air pollution, deforestation and the sustainability of agriculture and fisheries. Stakeholders have been demanding organisations to explain their performance of their pollution control and natural resources management challenges with references to quantitative metrics (Yale, 2008). Quantitative performance metrics enables policy makers to recognise the importance of incorporating analytical information for decisions making, track environmental issues, spot emerging problems, evaluating policy options and analysing effectiveness (Yale, 2014). This research study will be presenting justification for developing a practical sustainability ranking framework that encompasses core attributes of transportation environmental sustainability and will be based on an objectively quantifiable criterion from a widely accepted ranking framework and criteria used in the higher education sector (Shi and Lai, 2013). The main objective of the Index is to improve the data specific for long term environmental protection measures, assess the effectiveness of transport environmental performance and contribute to the organisations environmental management systems (Yale, 2008)

Scope 3 Travel environmental performance index presents a summative empirical value derived from an aggregation of transportation indicators based on efficient fleet transportation, commuting, business travel, supporting sustainable transport and overseas student travel into the UK. Each indicator is weighted within these categories according to the relevance of assessing a given criteria analysis to create a single score value. This index is intended as a diagnostic tool to drive competition for lower carbon emissions by evaluating various metrics concerning sustainable transportation within HEIs (Yale, 2008). The index identifies the scores based on several core environmental policies attributable to transportation and measures how close the index meets the target set by the sustainability tracking, assessment and rating Systems (STARS)(Aashe, 2014). This case study research will be adopting the STARS framework for developing NTU's Scope 3 sustainability performance index in demonstrating leadership to combating climate change, pursuing sustainability, implementing environmental management systems and reporting.

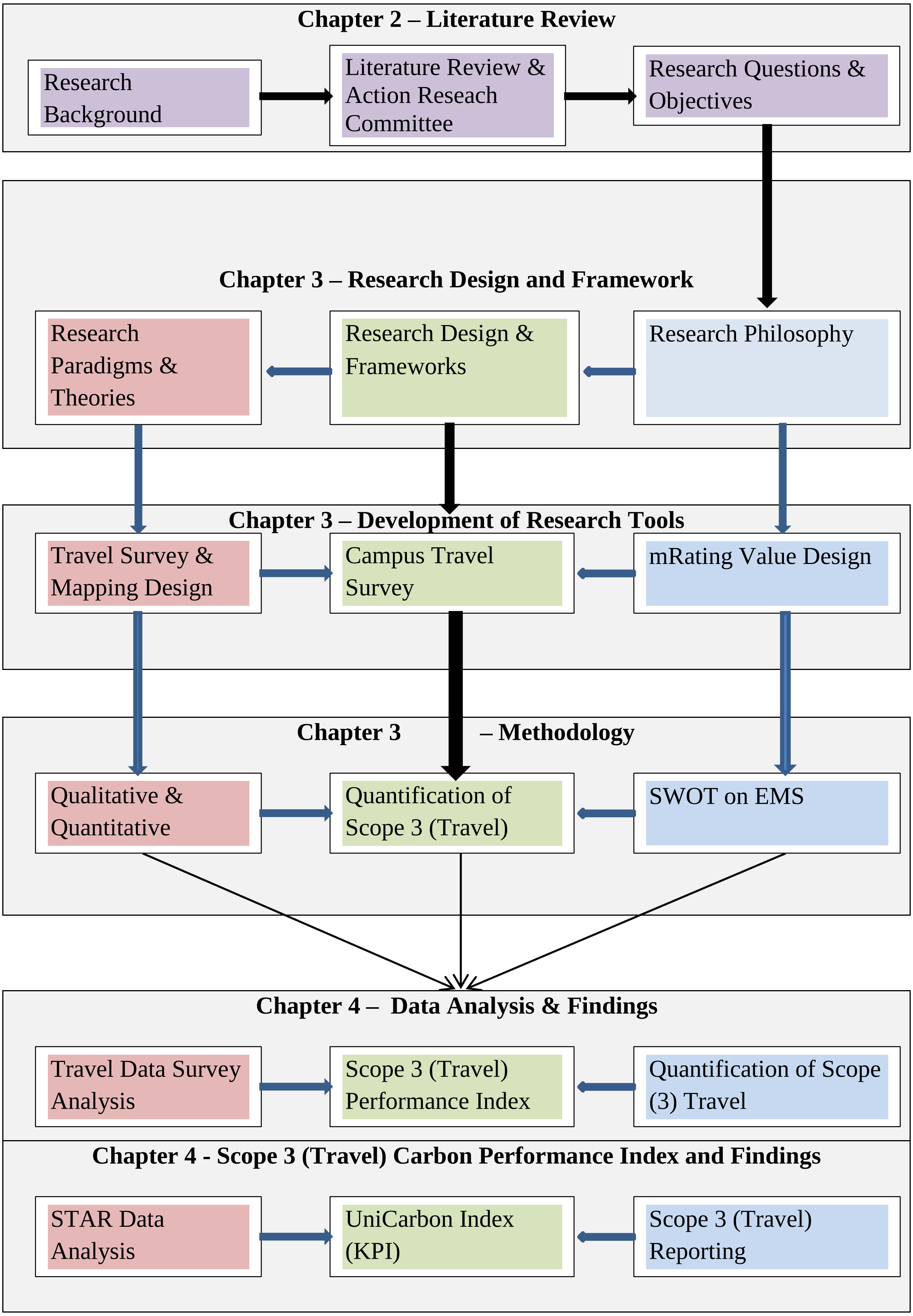
1.8 RESEARCH DESIGN AND METHODOLOGY

This research presents various methodologies available that can be applicable for undertaking this research. The researcher will be justifying and describing the choice of a particular methodology chosen and detailing the procedures and methodologies to be applied for the elicitation of carbon emissions data when investigating the research questions and objectives. The research design would be focusing on the empirical investigation of NTU's EMS efficiencies concerning its carbon emissions management accountability, quantification methodologies and developing a key performance indicator for reporting Scope 3 (Travel) carbon emissions. This research's methodologies will be guided by research approaches developed by Kuhn, 1970 (cited in Hoyningen-Huene, p.481, 1990) involving paradigms of shared beliefs, values and scientific enquiry. This research will be including both qualitative and quantitative methodologies and leveraging on each of the methodology's strengths and weaknesses (Johnson et al, 2007and Tashakkori and Teddle, 2010).

The quantitative methodologies would be involving investigating empirically the SWOT (strengths, weakness, opportunities and threats) and mRating value (Creswell, 2012) from questionnaires developed from the gap synthesis of the literature review (pp.122 - 124) and investigating how NTU's environmental management systems are adapting, changing and implementing new systems and processes towards the new emerging issues concerning the quantification of Scope 3 (Travel) carbon emissions and reporting. An online travel survey had been undertaken in February 2013 from all NTU staff and students requesting information of their travelling modalities and travel distances. Aamaas et al (2013) advocated that online surveys are becoming more practical, cost effective and able to reach a wider and diverse population sample to avoid any bias. For this case study research, the total sample size was chosen (Bryman and Bell, 2007) of all replies have been analysed using NTU's IT Support for the quantitative collection and analysis of the travel data concerning NTU's staff and student commute.

This research will have two phases using NTU as a case study. The first stage is the exploratory stage involving the background of this research study to providing information for the researcher to enable constructing a research framework for the quantification, management and reporting of Scope 3 (Travel) carbon emissions. The second stage involves the quantitative and empirical methodologies. Data collection will be executed on both phases and are interconnected. The mixed methods approach purposefully combines both qualitative interpretive narratives into quantitative empirical values enabling the multi-faceted investigation of NTU's EMS SWOT perspectives and mRating value investigating NTU's EMS efficiencies developed from the Literature Review (Table 3, pp.122-124). This research's design framework is diagrammatically illustrated in Diagram 2 (p.46) below.

Diagram 2 – Research Framework and Key Relationships of Contents within Chapters 2, 3, and 4



The quantitative methodologies would be involving investigating empirically the SWOT (strengths, weakness, opportunities and threats) and mRating value (Creswell, 2012) from questionnaires developed from the gap synthesis of the literature review (pp.122-124) and investigating how NTU's environmental management systems are adapting, changing and implementing new systems and processes towards the new emerging issues concerning the quantification of Scope 3 (Travel) carbon emissions and reporting. An online travel survey had been undertaken in February 2013 from all NTU staff and students requesting information of their travelling modalities and travel distances. Aamaas et al (2013) advocated that online surveys are becoming more practical, cost effective and able to reach a wider and diverse population sample to avoid any bias. For this case study research, the total sample size was chosen (Bryman and Bell, 2007) of all replies have been analysed using NTU's IT Support for the quantitative collection and analysis of the travel data concerning NTU's staff and student commute. Overseas emissions are estimates, as carbon factors are UK based (Defra, 2012c). Overseas travel data are to be summarised into geographical zones as recommended by HESA (Hesa, 2014)

The second stage, will be involving using the STARS methodology for the development of UniCarbon index for Scope 3 (Travel) carbon emissions abatement performance as a key performance indicator for reporting purposes.

1.9 DATA CAPTURE AND STATISTICAL FACTOR ANALYSIS

As previously stated in 1.8 above, Scope 3 (Travel) carbon emissions data had been collected from multiple sources. The other primary data will be principally collected from NTU's online staff and student travel survey. The other primary data concerns UK and overseas business and overseas student travel data. his research is a collaborative action research led by the researcher and NTU estates with the formation of an action research committee (ARC)(p.156). The main focus of the ARC is to enable the elicitation of primary qualitative data sets concerning the Strength, Weakness, Opportunities and Threats and the mRating values rubric concerning the efficiencies of NTU's environmental management systems. The qualitative data sets are subsequently converted to quantitative empirical values as part of this research's data analysis. These data sets are subjected to the statistical factor analysis that reveals the possible existence of underlying factors which give an overview of the data and information contained in a very number of measured variables. The structure linking factors to variables is initially unknown and only the principal factors are important. This presents the research data to be more reliable

Factor analysis enables to simultaneously analyse several tables of variables in a spreadsheet format and to obtain the results in charts for which the data can be analysed to investigate the relationship between the quantitative empirical measurements and the variables within the data tables. Within the data table, factor analysis must be in the same empirical format (SWOT and mRating qualitative to quantitative empirical measurements).

The methodology of factor analysis has two phases of analysis. (1) Each SWOT and mRating empirical data in Table 12 (pp.178-181) are statistically analysed according to the type of empirical variables within the Table. The factor analysis executes a columnar analysis of Table 12, is transformed into a complete disjunctive table. Each indicator variable having a 'weight that is a function of the frequency' of the corresponding category. The weighting of the tables makes it possible to prevent that the tables that include more variables do not weigh too much in the analysis.

The research selection of statistical factor analysis in advance is to minimise data bias when constructing the semi structured SWOT and mRating questionnaires (from the literature review (pp.122-124) to eliciting the appropriate responses for FA to be applied. From the data sets, FA is used to determining which Factors are dominant (based on cumulative percentages) that has most relevance with respect to the other factors being analysed. The selection FA has two purposes. Data integrity and determining the eigenvalue factors 1, 2 and 3 that most influences the data sets. In this research, eigenvalues greater than 1 are accepted (p.51). The SWOT and mRating questionnaires are independent research perspectives and there are no fixed or variables involved in the data sets.

The data sets are NOT conditional to any limitations of reliability or consistency of the respondents’ verbal responses. Reliability or consistency are not considered as the SWOT and mRatings questionnaires are semi structured questionnaires, each question with a different perspective. Factor analysis enables the research to determining the 'key factors' from the data replies that had provided the greatest impact to answering the SWOT and mRatings research questionnaires. Determining the FA eigenvalues enable to determining the cumulative percentage impact of a factor (either F1 or F2) if more than one factor is considered.

If the SWOT and mRating questions were to be undertaken again, replies would produce almost the same qualitative to quantitative empirical values. The primary reason is that the questionnaires in Tables 12 A- D (pp.178-181) are technical in nature, semi structured in specification and can only have one specific answer interpreted by using the rubric measurement (p.185). Hence, there are no requirements for 'consistency' of the responses.

The required primary data collection are as follows:

- The focus group identified from this NTU case study consists of staff and students undertaking their travel survey in February 2013. Data is analysed from the online travel survey over one week and the data is further mapped for the academic year.
- Data consisting of overseas travel journey miles undertaken by NTU staff for business travel. Overseas students and families (for convocation) travelling from their home countries into the UK.

From the qualitative data gathered from the focus group of this case study. The researcher analysed and coded the travel data to identify the different travel modes and the approximate travel miles incurred. These travel miles had been collated as a matrix and analysed according to travel mode used, miles/km journey distance travelled and fuel volume consumption converted to distance travelled and using the DEFRA’s carbon intensity factors for calculating UK emissions only.

The findings from the travel survey emissions quantitative data and other sources of carbon emissions data will be consolidated and the travel mapping model applied to extrapolate the data for a full academic year.

This research’s statistical data analysis uses factor analysis as being the most suitable statistical analytical tool because the empirical data sets from the SWOT and mRating Values were highly co-related between the variables. The qualitative to quantitative data sets can be more credibly accurate with some variable being redundant. The factor analysis will be conducted to identify the underlying constructs. There are inter-correlations from the qualitative to quantitative of the SWOT and empirical conversion values. The principal factor analysis would enable fewer underlying factors from being redundant within the data set collections.

The standardised Cronbach's alpha will be computed for the whole input table. An alpha of <1 means that there is some redundancy among the selected variables and whether the residual correlation matrices allow to verify if the factor analysis model is acceptable or not, and whether the data fails to produce correlations. Cronbach's Alpha is used to determining the internal consistency of the ten questionnaire from (Table 12, pp.178-181) within a scale of each construct. Alpha values of > 0.5 < 0.8 is sufficient to indicate a reasonable level of internal consistency.

The Kaiser Meyer Olkin (KMO) values measures the sampling adequacy when two variables share a common factor with the other variables. Each of the SWOT and mRating Rubric values, are subjected to factor analysis using eigenvalues for the three factors i.e. F1, F2, and F3 as shown in Appendix 3 to 6 (pp.371-398). Eigen values >1 explains the factor variance magnitude. Eigenvalues <1 are ignored. Three factors were extracted per the factor analysis that accounted for over 50% of the total variation in the observed empirical ratings. The eigenvalues >1 and the cumulative variance for each factor are calculated. The eigenvalues in this research had been narrowed to three factors i.e. F1, F2, and F3 as shown in Appendix 3 to 6 (pp.371-398).

The eigenvalues of SWOT Strength were represented by F1, F2 and F3 values with F1 being the dominant factor. The cumulative eigenvalues for the analysis are statistically significant with a 'percentage' bias value based on the average scores of the ten questionnaires evaluating NTU's SWOT and mRatings attributes concerning the important aspects of an efficient EMS at NTU. The eigenvalues of the correlation matrix are positive numbers. The eigenvalues offer NTU to consider the best factor (F1) to undergo further management analysis that are strongly relegated to the possibility of developing new management systems and to ensuring more technical and financial resources are available. The practical aspects of this eigenvalue lies in the relatively small divergence of covariance's matrices from the quantitative values of NTU's EMS SWOT and mRating values (Appendix 3 to 6)(pp.371-398). The factor analysis statistical analysis described above for data reliability and presents confidence on the findings of this research to be more credible and persuasive.

1.10 DEFINITION OF THE TERM CARBON EMISSIONS USED IN THIS RESEARCH

Throughout this research the reference to the term carbon emissions represents the life cycle estimates based on carbon dioxide equivalency (CO2e, i.e. carbon dioxide CO2 (75%), Methane, CH4 (14%) and Nitrous Oxide, N2O (8%), Hydrofluorocarbons, HFCs (1%) and Perfluorocarbons, PFCs (1%) and Water vapour (1%). This expresses the impact of each of the different greenhouse gas in terms of the amount of CO2 that would create the same amount of warming. (Guardian, 2011).

CO2e or carbon dioxide equivalent is a standard unit of measuring carbon footprints. The CO2e is represented by a given measurement of mixture of greenhouse gas, the amount of CO2 that would have a similar global warming potential (GWP) when the fuel is fully combusted when measured over a specified time scale of 100 years. DEFRA (Defra, 2012) advises Organisations reporting voluntarily to use tonnes kg CO2e as absolute emissions (or kilograms per CO2e for comparison purposes) for representing the most comprehensive measurement to reporting the organisations impact; the 'e' in CO2e signifies that CO2 plus the other Kyoto gases in CO2 equivalent are incorporated into the conversion factor value.

1.11 CONTRIBUTION TO NEW KNOWLEDGE

This thesis contribution to knowledge concerns Scope 3 (Travel) carbon emissions are as follows:

- Presenting new empirical measurement techniques concerning the efficiencies of NTU's environmental management systems.

- Presenting new research considerations to including specifically overseas students as inclusive of the quantification of Scope 3 (Travel) carbon emissions (also staff and students commute) as part of the overall NTU's carbon footprint. Presenting reporting formats of carbon emissions originating from different geographical zones as recommendations to the HE Sector that can be adopted by other industry sectors.

- Presenting an extension of the quantification of Scope 3 (Travel) carbon emissions to include the consideration of NTU's environmental management systems for data capture, management and reporting in complying with legal and stakeholder requirements.

- Presenting the quantification tool for the quantification of Scope 3 (Travel) carbon emissions to NTU, one of the UK's larger universities as a 'quantification model' for the HE Sector and also this model can be replicated to other industries.

- Presenting the development of the UniCarbon Index as a summative empirical measurement of Scope 3 (Travel) carbon performance as a key performance indicator and for legal and stakeholder reporting by NTU.

1.12 LIMITATIONS

There are several models concerning carbon accountability, management, quantification and reporting for Scope 3 (Travel) carbon emissions each having its different perspectives and focus. This case study research is limited to those environmental management models, quantification tools and reporting frameworks that are considered to be most appropriate to NTU and the HE Sector.

As this research is limited to using NTU as a case study within the UK HE Sector. There are differences in carbon accountability, regulatory and stakeholder demands that are divergent from the generalisability concerning Scope 3 (Travel) carbon emissions quantification and reporting demanded compared to UK publicly listed companies and the Companies Act 2013 requiring Scope 1 and 2 accountabilities.

The researcher presents below the key principal limitations:

(a) Time and resources constraints have been the major limitation for the Researcher. The collaborative case study research requires coordination of personnel involved and the manpower required for the implementation of NTU’s new environmental management system. There has been a lack of empirical measurements techniques concerning Scope 3 (Travel) carbon emissions data measurements from the demand side of the different travel modes by NTU.

(b) HEFCE, Companies Act 2006 (Regulation 2013) and the Climate Change Act 2008 have different spheres of influence concerning the core principles of Scope 3 (Travel) accountability, carbon reduction policies and reporting requirements. These plethora of compliances has limitations for NTU to meeting these varied compliance requirements much of these are without guidance information.

(c) Action research under taken in this collaborative case study research is best described as a research intervention technique that have limitations to its scope and effectiveness. The limitations involve the investigation of the problem phase not knowing clearly NTU's environmental management problems. This phase requires problem finding techniques that require enormous resources. Also, there is the collaborative action research for the formulation of new environmental management processes and solution phase of the research. Each of these phases once again require technical expertise for designing and implementing the new hybrid environmental management system for Scope 3 (Travel) accountability (Figures 4 - 9)(pp.277-284).

(d) NTU's EMS for Scope 3 (Travel) carbon emissions accountability efficiency tool had been developed using a small proportion of secondary data, a literature review and qualitative interpretive data obtained from the action research committee (p.156). Such data integrity sources that have been characterised by using a qualitative disclosure scoring interpretations into quantitative empirical values. These empirical scoring factors therefore cannot strictly be conforming to meeting the requirements concerning reliability and validity. The researcher countered this limitation and weakness of data integrity through triangulation and subjecting the EMS model using statistical factor analysis to determining data intergrity.

(e) The Scope 3 (Travel) internet travel survey of NTU's Staff and Students travel data and the use of the convenience sampling are limited in scope and limits the applicability of mapping factors, impede the validity the results for a full academic year.

1.13 STRUCTURE OF THIS THESIS

This thesis document is structured into five chapters and appendices and finally with an alphabetical Reference section.

Chapter One provides the background for this collaborative action research, describing the research problem, the research questions and objectives, NTU's EMS, outline of the research methodology, the definition of the term carbon emissions, data capture and statistical factor analysis, ethical considerations, contribution to new management processes, new knowledge and outlining the limitations of this research.

Chapter Two is the literature review concerning the development of the research questions (including SWOT and mRating) and objectives from 'gaps' identified from published literature. Evaluating the merits for a hybrid EMS for NTU. Evaluating the development of quantification tools for Scope 3 (Travel) carbon emissions and the development of a travel sustainability index as a summative measurement for reporting.

Chapter Three explains the research design, paradigms, theoretical constructs, implementation of the collaborative action research methodological tools, applications and the justification of the specific methodologies as used in this case study research and the ethical considerations of this research.

Chapter Four describes the data analysis of SWOT, mRating value, implementing a hybrid EMS for NTU, statistical factor analysis, Scope 3 travel performance index, reporting travel emissions data, discussing the implications of the data analysis obtained and recommendations of this case study research

Chapter Five presents the conclusions of this case study research questions, implications and recommendations, contribution to new knowledge, new management practice, limitations, and opportunities for further research.

This is followed by appendices and a bibliography

CHAPTER 2.0 LITERATURE REVIEW

SUMMARY

Chapter 1 presented an introduction to the Thesis. This chapter 2 examines the definitions and published literature concerning quantification, management and reporting of Scope 3 (Travel) carbon emissions and compliance. This review identifies the key concepts and issues that directly and indirectly related to the research questions and emergent themes key to this research. The literature review analyses and critiques the existing published knowledge on the research focus and extricating any significant knowledge gaps for developing the research questions, SWOT and mRating questionnaires concerning Scope 3 (Travel) carbon emissions, quantification mechanisms, environmental data collation, environmental performance indexes and the relationship of the various components of an environmental management system as applied to this collaborative case study with NTU.

2.0 INTRODUCTION

This chapter presents a literature review and critiques the key research previously undertaken concerning Scope 3 (Travel) carbon emissions quantification, management and reporting by universities in the higher education sector (HE). This literature review focuses on the following:

(i) To identify the key pertinent published peer reviewed literature concerning carbon emissions accounting, environmental management systems and reporting issues within the HE Sector and correspondingly their implication to this case study (Woo et al, 2011).

(ii) To present the key research issues to be undertaken and to demonstrate their relevance to the research questions synthesised from the gaps within the peer reviewed literature (Cleary, 2009)

(iii) To evaluate the key research issues, emergent themes and related issues to this collaborative case study (Flyvbjerg, 2011) with regard to Scope 3 (Travel) emissions

(iv) To develop research questions and design frameworks that are emergent from the literature review (Olsen, 2007) including SWOT and mRating questionnaires

The researcher presents in diagram 3 (p.60) the concept map that describes the relationships between the focussed concepts and objectives of this research. The structure commences with the introduction of the literature review presenting the historical background of sustainable development from the Brundtland Report (Brundtland, 1992) and developing the chronological evolutions of pronouncements by the United Nations, other stakeholders to the Doha conference (Doha, 2012)

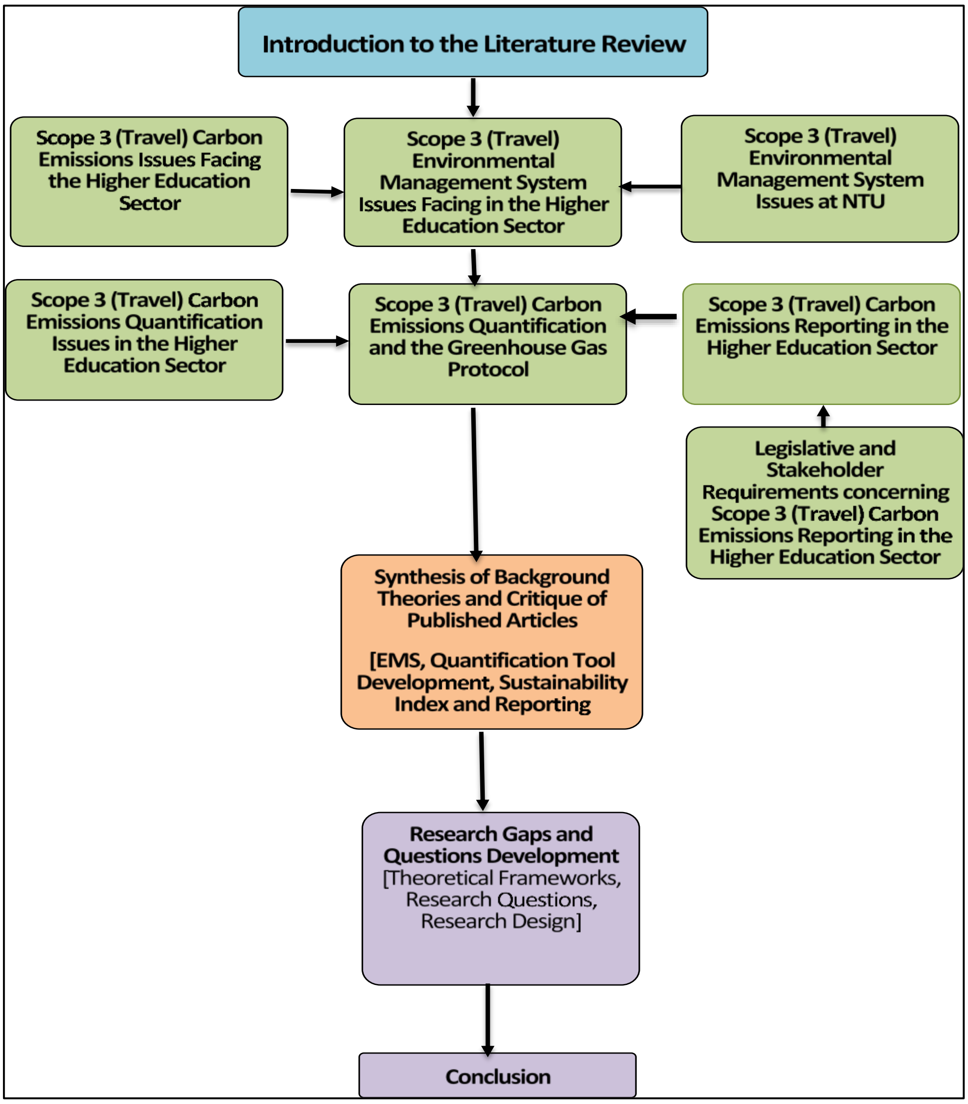
The concept map guides this literature review on the key research issues identified focussing on the research perspectives identified in a preliminary literature search undertaken by the researcher. This preliminary literature search was undertaken on an ad hoc basis by drafting a few initial research questions and undertaking an internet search of published online literature databases using science direct, emerald insight and EBSCO information Services. The researcher undertook analysis of the various published literature and commenced formulating this research's focus. Reiska et al (2015) and Goldman and Kane (2014) suggested that using concept mapping as a relevant tool to conduct a focussed research and grouping the ideas in a series of related sequences as a framework structure.

The researcher identified key background focus disciplines for the literature review (Table 3, pp.122-124). These are (i) Scope 3 (Travel) environmental management systems issues facing the HE Sector, (ii) Scope 3 (Travel) environmental management issues at Nottingham Trent University (iii) Scope 3 (Travel) carbon emissions issues facing the HE Sector (iv) Scope 3 (Travel) carbon emissions quantification issues in the HE Sector (v) Scope 3 (Travel) carbon emissions quantification and the Greenhouse Gas Protocol (vi) Scope 3 (Travel) carbon emissions reporting by the HE Sector (vii) and legislative and stakeholder requirements concerning Scope 3 (Travel) carbon emissions reporting in the HE or other sectors.

The researcher synthesised the various published information within the body of knowledge concerning environmental management systems, management practices, Scope 3 (Travel) carbon emissions accountability, management, quantification and reporting. Based on this synthesis, the researcher was able to formulate the development of the research questions. Natalicchio et al (2014) stated that analysis of the literature review when structured on the main issues strengthens the literature analytical results. This process provides an insight of the literature's knowledge and management systems gaps concerning the research issues and presents the propositions inferred from the characteristics emerging from the synthesis review.

This literature review is a multi-document evaluation of prior research that are relevant to this collaborative case study research, identifying the research gaps and justifying the development of the research questions and objectives. Some published literature may not be directly valid but may have similarities within the HE Sector which are also critiqued, hence strengthening the rational of this literature review.

Diagram 3 – Literature Review Concept Map



Developed by the Researcher (Chelliah, 2015)

The Brundtland Report 1987 (Brundtland, 1992) 'Our Common Future' had convincingly argued to world leaders and communities to placing emphasis on the environment, climate change and sustainability. This report was a 'watershed' report concerning sustainable development and had contributed to much political debate ever since. The report called on the world to governments at both institutional and local levels to promote economic activities that world preserve the earth's resources for future generations. The report focussed on both radical and reformist elements i.e. linkages between environment and development issues were entwined. Robinson

(2004) argued that essentially the Brundtland report proposed integrating the insurmountable issues of environmental deterioration together with the complex issues of human development and poverty. The report recommended that both these fundamental issues must be resolved simultaneously and in a mutually reinforcing way. Post Brundtland, Sneddon et al (2006) stated that the world is a different place, where changes towards sustainable development have commenced. Holden et al (2013) analysed sustainable passenger transportation using the recommendation of this report, stating that more and more public transportation is becoming more sustainable. The Stockholm Conference in June 1972 (Unep, 1972) declared that nations must have a have a common outlook and principles to the enhancement and preservation of the human environment. Mebratu (1998) stated that it was undeniable that sustainable development received a higher prominence with political expediency and development frameworks. Whereas, Bebbington and Gray (2001) stated that there was little definition as to what sustainable development looks like or ever can be produced.

In the UK, The Environmental Protection Act 1990, Chapter 43 provided powers to local authorities to enforce air pollution controls (Gov, 1990). Between 3 and 14 June 1992 at Rio de Janeiro, Brazil, The United Nations Conference on Environment & Development established Agenda 21(Rio, Section II, Chapters, 20-22, 1992)(Rio, 1992) for member nations to have environmentally sound management principles and target for the prevention of hazardous emissions and effluents. Spangenberg et al (2002) stated that, Agenda 21 is expected to take over a variety of tasks in order to promote sustainable development by introducing measurement matrices. Smardon (2008) and McDermott (2009) research had indicated that Agenda 21 had a profound agenda with major corporations concerning sustainable development. Brandt and

Svendsen (2013) stated that Post Agenda 21, was at a slow pace with much political wrangling on sustainable targets. Shelton (2008) stated that Agenda 21 remains the international environmental programme and general guidance for governments. This was followed in March 1994 with The United Nations Framework Convention on Climate Change (Unfcc1, 2014) concerning member countries to sharing information, policies, strategies and adaptations on greenhouse gases.

The Kyoto Protocol established in December 1997 and adopted in February 2005 (Kyoto, 2014) committed member nations to establish internationally binding carbon emissions reduction targets. Manne and Richels (2000) stated that the Kyoto Protocol represents a milestone in climate policy concerning emissions reduction targets and at the same time contentious to its application by member nations. Grubb (2000) stated that the Protocol was a complex and far reaching agreement that presents member nations to define their basic structural elements to tackling the global efforts of climate change. Grubb also stated that the agreement was environmentally too weak and lacked quantifiable commitments from the developed and developing countries. This was followed by the Doha Amendment in 2012 for agreement for all members to comply with their commitments from for 01 January 2013 to 31 December 2020 (Doha, 2012). The Economist (Economist, 2012) reported that the Doha Agreement was still pursuing ratification by the major western nations to ratify the Kyoto Protocol and had no new agreements to limit greenhouse gas emissions and no commitment of funds to assisting poorer nations. Doha had formally brought “loss and damage” caused by climate change into the negotiations but lacked ‘legal teeth’, whilst richer nations did not accept any agreement for the basis for compensation claims. New deals will be sought during the December 2015 conference in Paris, France for agreements that will come into force in 2020.

The UK as a signatory to the Kyoto Protocol legislated the principles of this Protocol into the Companies Act 2006 (Gov, 2006) and later established the amendments in October 2013 to include new carbon emissions reporting rules by quoted companies and voluntary reporting by large public organisations. Chivers (2007) stated that The Companies Act 2006 enshrined the first ever statute of directors' duties in respect of the environmental and social impacts of the companies' business. The Climate Change Act in 2008 (Cca, 2008) had set out the UK legal requirements for large companies to reduce their carbon emissions by 30% by 2020 to the base year of 1990. The Act boasts the world's first legally binding GHGs reductions by the UK to meeting the Kyoto Protocol Objectives (Defra, 2011). This legislation legally commits the UK Government to cut national greenhouse gas emissions by 80% by 2050 with respect to 1990 levels and to support adaptation (Cca, 2008)

This Chapter is divided into seven sections as follows:

- Section 2.1 Scope 3 (Travel) carbon emissions issues facing the higher education sector in England
- Section 2.2 described the Scope 3 (Travel) environmental management systems and higher education sector
- Section 2.3 describes the Scope 3 (Travel) environmental management systems issues at Nottingham Trent University
- Section 2.4 presents the Scope 3 (Travel) carbon emissions quantification issues in the higher education sector
- Section 2.5 describes the Scope 3 (Travel) environmental performance index issues in the higher education sector
- Section 2.6 describes Scope 3 (Travel) carbon emissions reporting issues by the higher education sector
- Section 2.7 describes the research gaps and questions development
- Section 2.8 describes the conclusion derived from this chapter

2.1 SCOPE 3 (TRAVEL) CARBON EMISSIONS ISSUES FACING THE HIGHER EDUCATION SECTOR IN ENGLAND

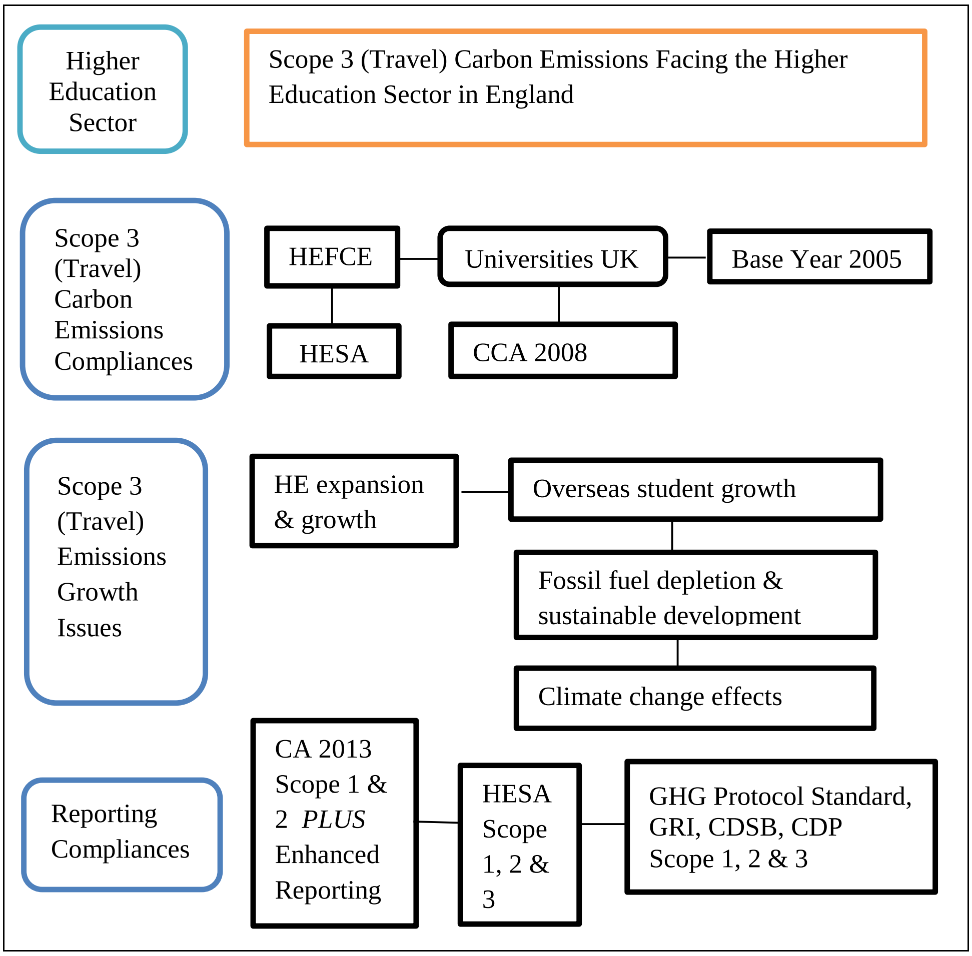
This sub chapter presents the literature concerning the impact of Scope 3 (Travel) carbon emissions within the context of universities in England. The literature review will be focusing on investigating HE Sector's carbon accountability in meeting the carbon emissions targets jointly set by HEFCE (Hefce2, 2009) and Universities UK (Uuk, 2013). The Climate Change Act 2008[c.27, Part 1-6(1-88)] had stated that HEIs and the HE Sector carbon emissions should be at 43% of the Sector's 2005 Carbon Benchmark by 2020 and 83% by 2050.

HEFCE as a statutory organisation entrusted by the UK government to evaluating the consequences of its policies on areas such as the financial funding of HEIs and the administrative and bureaucratic impact of its programmes, polices and initiatives towards carbon emissions, sustainability and combating climate change in the HE Sector (Hefce2a, 2009).

The base year 1990 was originally decided by the IPCC when publishing The Kyoto Protocol (Ipcc, 2007) and the UK reciprocated this Protocol within the Climate Change Act 2008 (Chapter 27, Part 1.1.2) (Gov, 2008). Specific to HEIs, the base year was changed to 2005 after HEFCE embarked on consultations during 2008 - 2009 (Pearce, 2006 and Hefce8, 2010) for bench marking. In 2010, HEFCE (Hefce, 2010) and GuildHE (Hefce6, 2010) and later in 2013 by Universities UK (Uuk, 2013) pronounced a collective sector level strategy to limit carbon emissions by 83 per cent against 2005 levels by 2050 and at least 43 per cent by 2020 (Parry et al, 2008 and Rogelj et al, 2009).

As shown in Diagram 4 (below) Higher Education Institutions play and important role in transforming societies and nations. In this contexts, Scope 3 (Travel) carbon emission issues are an integral part of the institutional framework for promoting campus sustainability and carbon emissions accountability (Ramos et al, 2015). Scope 3 (Travel) Carbon Emissions Compliance issues are driven by HEFCE, Universities UK, HESA, CCA 2008 requirements and carbon footprint emissions are referenced to the 2005 base year. Carbon emissions growth issues are related to the growth of the HE Sector in the UK, growth in overseas student population, sustainable development and climate change issues. Reporting issues concern the CA 2013, HESA and GHG Protocol Standard, GRI, CDSB and CDP.

Diagram 4 – Summary of Scope 3 (Travel) carbon emissions issues facing The Higher Education Sector in England



Developed by the researcher (Chelliah, 2015)

The HE Sector consists of research based Institutions who have a unique position in influencing their graduates concerning the adverse impacts of carbon emissions (Burandt and Barth, 2010). Many UK universities have developed comprehensive carbon mitigation strategies (Levy and Marans, 2011) as a response to stakeholder demands (Huang et al, 2009 and Yang and Zou, 2014). HEIs carbon footprint management are a business risk concerning overseas student revenues (Lash and Wellington, 2007) and as a reputational risk as a research grant receiving body (Bebbington et al, 2008). HEIs have a significant social, environmental and economic impact and have a responsibility for demonstrating leadership in carbon mitigation, environmental management and overall carbon footprint abatement (Abolarin et al, 2013 and Altan, 2010).

In 2010, HEFCE had initiated a carbon reduction target and strategy for the Higher Education Sector in England (Hefce15, 2010) in association with Universities UK and Climate Change Act 2008 for strategies to meeting the HE Sector's emissions target. As a result, HEIs' had to identify the size of their carbon footprint, establishing management systems and "demonstrating meaningful change" (Hefce15, p.4, 2010). Klein-Banai and Theis (2013) stated that there are many factors that affect carbon emissions with respect the HEI's size and establishment missions that directly contribute to the HEIs' carbon emissions quantum. However, HEFCE (Hefce15, 2010) failed to categorise the types of carbon emissions Scope 1, 2 or 3 targets, identifying the magnitude of the carbon abatement challenges nor recommend any supporting carbon reduction strategies.

Presently HEIs, are being subjected to compliance challenges from the Higher Educational Statistic Agency (HESA) (Hesa, 2014) for reporting their carbon footprint. Legislative compliance as Zang et al (2011) argued, are complex, difficult to manage and control. In order to manage these challenges, Ozawa-Meida et al (2013) and Skelton (2013) proposed that HEIs should be seeking to develop best practice methodologies adopted in other Sectors. Noeke (2002) and Altan (2010) proposed that carbon emissions management are key management priorities which can be subjected to endure financial risks from HEFCE (Roy et al, 2008 and Hefce, 2010). HEIs are placing limited resources as Sterling and Scott (2008) stated concerning environmental and sustainability strategies due to HEIs' deficiencies in technical skills concerning quantification and environmental management.

HEIs have large populations and are significant contributors to Scope 3 (Travel) carbon emissions that have become one of their core mitigation tasks (Pulselli et al, 2008 and Lozano, 2011). HEIs are education establishments with a different ethos and have limited environmental management skills in carbon emissions accountability (Lundin and Morrison, 2012 and Chambers et al, 2014). As a consequence, there has been no research as Saadatian et al (2013) and Larsen et al (2013) had indicated concerning the environmental management and quantification of carbon emissions.

The accountability and management of Scope 3 (Travel) carbon emissions by HEIs is a relatively new challenging phenomenon. HEIs are autonomous bodies with complex management structures which are different from other organisational structures of similar size (Hefce2, 2009 and Hotton et al, 2010). A large percentage of HEIs do not have the specialised environmental technical and management skills (Ferras-Balas et al, 2008 and Lander et al, 2011), organisational structure nor financial resources (Klein-Banai and Theis, 2011).

In fact, HEIs are not leading the way to finding solutions to the crucial phenomena of carbon emissions management and accountability (Bangay and Blum, 2010). HEIs are not utilising corporate social responsibility reporting by leveraging their campus carbon mitigation strategies, attracting quality student applications, securing third party investments and research grants (Hopwood et al, 2010). HEIs' capital budgeting and costs of adaptation for lower carbon emissions are becoming serious HEI policy issues in meeting the HE Sector carbon target by 2020 (Boston and Lempp, 2011).

Scope 3 (Travel) carbon emissions reductions can be considered a derivative of sustainability (Waas et al, 2010). However, this phenomenon offers much less flexibility when it concerns HEIs' travel operations and complying with HEFCE carbon targets (Hefce7a, 2009). The transition of carbon emissions accountability for HEIs can be a very complex process (Lilley, 2009) and requires HEIs to shift their priorities and perspectives for greater transparencies (Hefce2, 2009). HEIs must invest in technical skills development and acquire qualitative and quantitative perspectives for carbon data analysis (Lander et al, 2011 and Ascui and Lovell, 2012). Furthermore, (Waas et al, 2010 ; Hotton et al. 2010 and Uuk, 2013) indicated that for effective carbon emissions mitigation requires an efficient environmental management system that would assist HEIs to implement carbon abatement strategies and meeting carbon emissions targets set by CCA 2008 and HEFCE.

The UK has a long history for higher education excellence and research and a preferred choice for high calibre international students (Walsh, 2010). The HE Sector in England has in recent years experiencing increasing overseas student numbers especially from China and India (Bennell and Pearce, 2003 and Altbach, 2007). The

World Resource Institute (Wri, 2013a) stated that carbon emissions from overseas student travelling has become increasingly significant and should be accountable within the carbon footprint of HEIs. Upham and Jakubowicz (2008) suggested that overseas students' travel related carbon emissions do raise issues for universities, particularly when universities are attempting to integrate their environmental objectives and also complying to meeting their emissions targets by 2020.

There is no specific standard or generally accepted practices for the methodological accountability of international student travel into England. HEIs have not established any resource planning concerning the distances involved, the cities from which students started their journeys, emissions from air and non-air travel to their UK designated campuses, uncertainty that overseas students returned home at least once a year, and uncertainty that flights originating from Europe were short haul and the rest of the world long haul.

The HE sector is a growth industry with increasing overseas student intake, resulting in greater Scope 3 (Travel) carbon emissions and increasing travel costs from travel mode providers (Rauch and Gronalt, 2011). Overseas students are a major HEI revenue earner (Finlay and Massey, 2011) and any carbon cap might restrict HEIs enrolling overseas students as a result of the Climate Change Act 2008 and Universities UK (Uuk, 2013) carbon targets. One possibility for UK universities would be to establishing overseas branch campuses to mitigate Scope 3 (Travel) carbon emissions and to continue to benefit from this educational export. Upham and Jakubowicz (2008) in their research with Manchester Business School has made a suggestion, that for overseas students could purchase clean development certified mechanism offsets, if these offset certificates are available for sale in the future.

However, this mechanism is in the initial stages of implementation. This presents a growing recognition for the need for a more efficient approach to the management of Scope 3 (Travel) emissions derived from transport that would be meeting the HE Sector emissions targets of 43% of the 2005 base year target by 2020.

HEFCE has taken a lead together with the Climate Change Act 2008, and argued that the HES should show leadership in sustainable development through research, developing EMS and developing Carbon Management Plans (De Montfort, 2011). De Montfort University had stated that Scope 3 (Travel) carbon emissions were subjected to “large uncertainties” (De Montfort, p.25, 2011) associated with staff and student commenting, travel surveys involved estimations and skewed to certain specific mode of transport have an impact on HEIs internal carbon reduction policies.

Reporting compliances of Scope 3 (Travel) carbon emissions by the HE Sector are complex, confusing and subject to interpretation. The CA 2013 omitted Scope 3 reporting, however the directors’ enhanced reporting of the HEI’s carbon emissions impact on sustainable development was not clear but the researcher is of the opinion that clarity of non-financial data was still demanded by stakeholders. Reporting requirements by HESA (Hesa, 2015) and the GHG Protocol Standard, GRI, CDSB, CDP offered HEIs reporting guidance. However, Downie and Stubbs (2013) stated that there was a clear lack of methodology to define which carbon emission source is to be included the GHG assessment, lack of clear and comprehensive guidance inhibiting organisations to pursue cost effective carbon mitigation strategies. HEFCE (Hefce4, 2012) Scope 3 (Travel) carbon emissions lacked definitive recommendations as to which scope 3 travel emissions should be included in an HEI's Scope 3 travel carbon reporting boundary and what information is to be used for the most efficient, effective and accurate manner about emissions.

2.2 SCOPE 3 (TRAVEL) ENVIRONMENTAL MANAGEMENT SYSTEMS ISSUES FACING THE HIGHER EDUCATION SECTOR

Many terms have been used to describe environmental management systems over the last decade attributable to HEIs, including ‘systems’, ‘programs’, ‘policies’, and ‘frameworks’ (Bero et al, 2011). The following definitions was offered by Bero et al (2011) derived from their research concerning the designing and implementing of a campus environmental management systems.

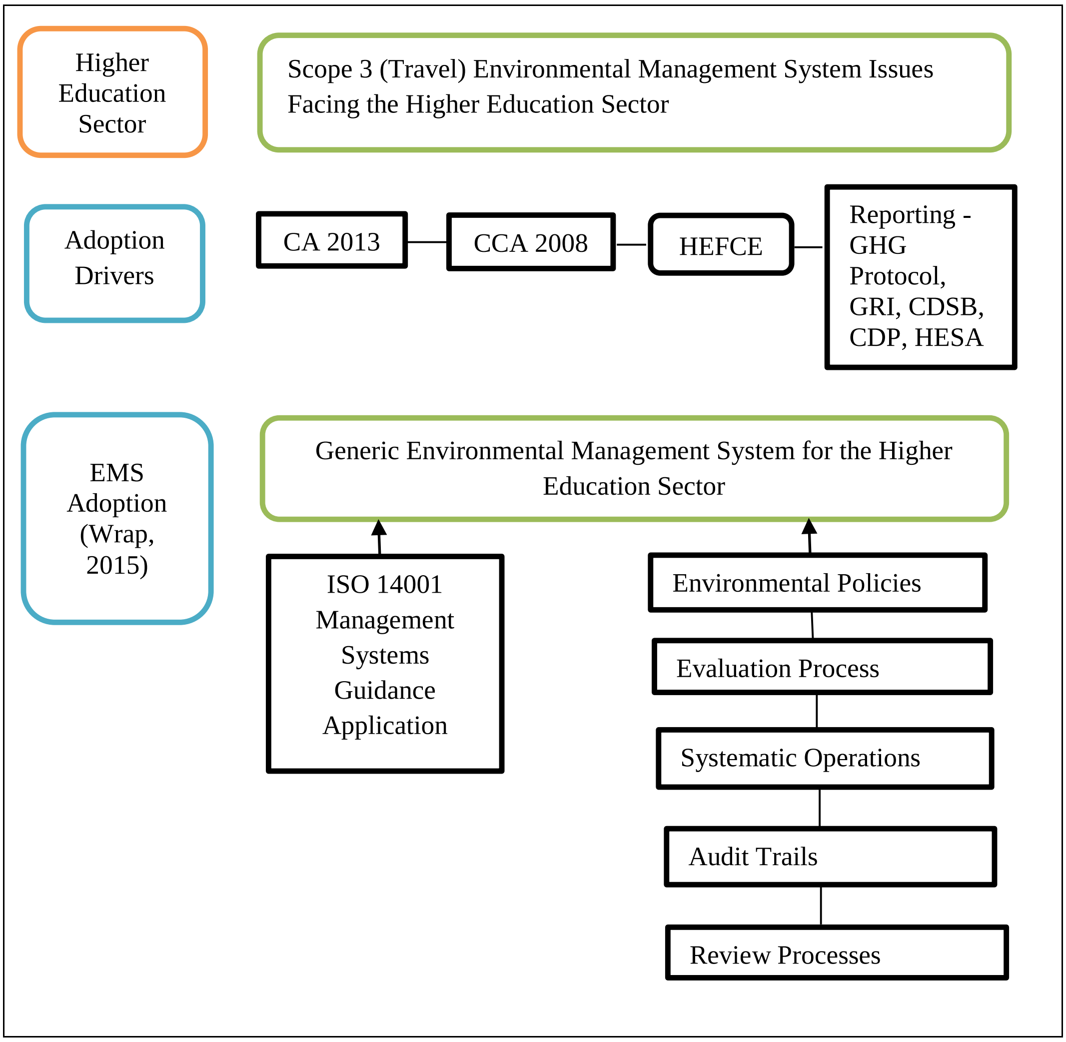
‘*An EMS is the applied, practical systems and processes including documentations for recording and assimilating carbon emissions data’*.

There are two strategies available to HEIs wishing to implement a formal EMS as recommended by the Waste and Resources Action Programme (WRAP)(Wrap, 2015) : (i) designing, developing and implementing a specific EMS applicable (ii) follow the guidelines of ISO 14001 and certification. The advantages to HEIs are (i) increases commitment to quality management procedures concerning Scope 3 (Travel) accountability (ii) certification ensures credibility of management and organisation. Clarke (2006) in her research at Dalhouse University, Canada, based on a fifteen-year case study proposed that there was relevance and advantages of an EMS, to securing campus environmental management targets. Clarke and Kouri (2009) and (Bero et al, 2012) highlighted campus EMS sustainability transformation to reducing the ecological impact but indicated its development difficulties due to profound heterogeneity in campus infrastructure, management policies, limited data accessibility and legacy data which are often incomplete or inaccurate.

The EMS in theory follows a flow of environmental management information sequentially beginning from Scope 3 (Travel) environmental policies, abatement strategies and reviews (Clarke, 2006). It is a formalised, co-ordinated procedural process for environmental management involving campus carbon emissions accountability, data collections and assessments. It is a system that is considered essential to meeting environmental objectives and enable compliances with environmental standards (Spellerberg et al, 2004). Bero et al (2012) stated that HEIs are large enterprises with complex management structures that have difficulties in managing their carbon footprint and analysing its environmental performance data at source. In retrospect, Bero et al (2012) also stated campus EMS is grossly underestimated on how complex diverse datasets collections are within HEIs

Diagram 5 (p.73) presents the summary of the Scope 3 (Travel) environmental management systems facing the Higher Education Sector. EMS adoption drivers are the Companies Act 2013 to report Scope 1 and 2 and HEIs for stating an enhanced directors' report on non-financial data of the HEI's environmental impact and sustainable development. The Climate Change Act 2008 and HEFCE have mandated that large HEIs to benchmarking their carbon emissions (set at 2005) and implementing carbon abatement strategies to 30% of the HEI's benchmark level. Other influential drivers for the adoption of EMS comes from the carbon emissions reporting requirements in compliance of the GHG Protocol, Global Reporting Initiative G4 and HESA. The adoption of a Scope 3 (Travel) carbon emissions EMS is a synthesised generic EMS model developed from the Waste and Resources Action Programme (Wrap, 2015). This generic EMS draws significantly from ISO14001 EMS elements and amalgamated with environmental policies, evaluation processes, systematic operations, audit trails and review processes.

Diagram 5 - Summary of the Scope 3 (Travel) Environmental Management Systems issues facing the Higher Education Sector



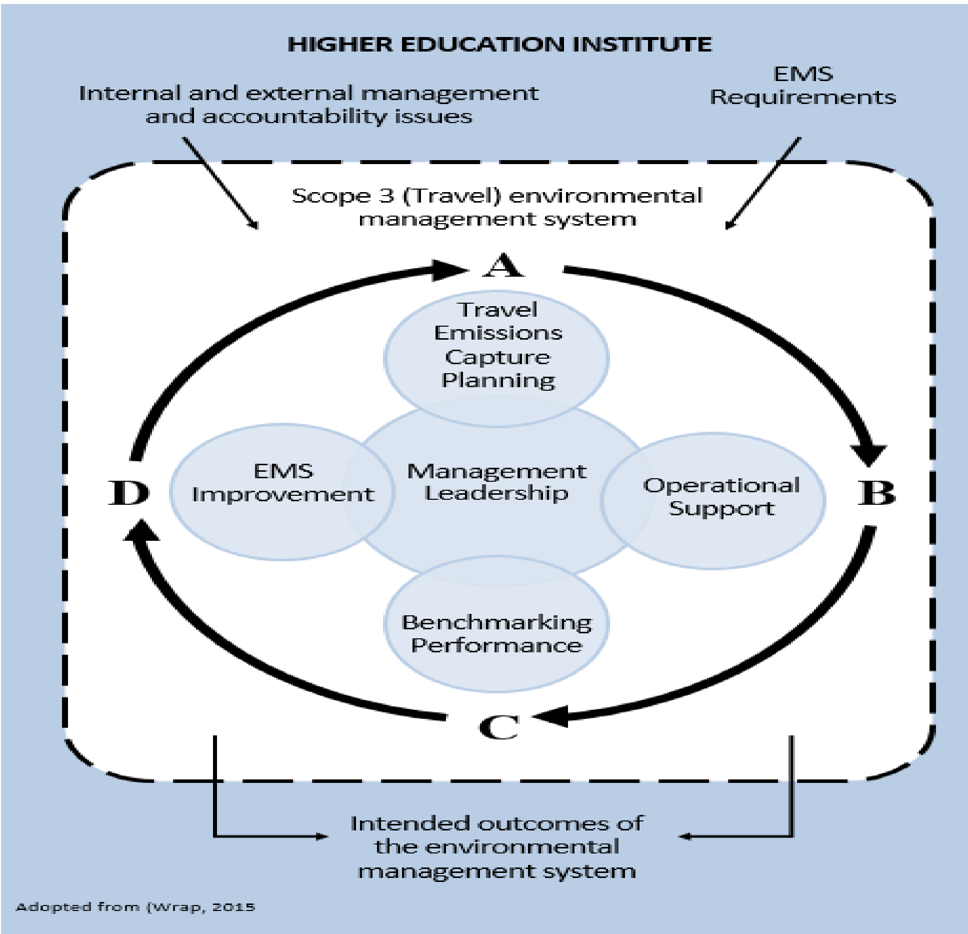
Developed by the researcher (Chelliah, 2015)

Disterheft et al (2012) research with European HEIs stated that, successful EMS initiatives must explicitly address EMS challenges through realistic emissions planning, choice of software technologies, design of system architecture, and administrative commitments. Jain and Pant (2010) research at TERI University New Delhi, researched the steps of implementing an environmental management system initiatives had led to carbon footprint calculations and how much this can be reduced.

Detailed insights from the above are described in Diagram 6 (p.74) presents the generic environmental management systems elements detailing the procedural requirements for Scope 3 carbon emissions management and accountability model. These procedural EMS have been synthesised from the recommendation of The Waste and Resources Action Programme (WRAP)(Wrap, 2015) that is typical and that can be applicable to the Higher Education Sector.

An EMS is a systematic procedural management approach in managing the campus environmental impacts and managing its environmental performances. Implementing a campus EMS offers stakeholders a level of confidence that the campus environmental risks, impacts, environmental performances and legal compliances are managed efficiently (Nicolaides, 2006 and Wrap, 2015)

Diagram 6 – Generic Environmental Management Systems Elements



To developing and measuring the effectiveness of an EMS, campuses will require adoption of an EMS template (Herremans and Allwright, 2000) most notably adopting the recommendations of ISO 14001. Clarke (2006) research at Dalhousie University indicated that there was overlap adopting the environmental policies, planning and implementation phases with feedback loops for implementing an emergent EMS framework. Similarly, Clarke and Kouri (2009) research with campus EMS had also proposed involvement in a continued improvement cycle that matches environmental policies that match decision making structures.

There are increasing pressures on HEIs concerning the growing awareness for the governance of Scope 3 (Travel) carbon emissions which, has resulted with some HEIs implementing environmental management systems (EMS) for carbon emissions management and accountability. An EMS can be described as part of an organisation’s management accountability system that is used for managing its environmental management systems, data collection for carbon accountability, abatement policies and reporting to stakeholders of the HEI’s commitment to a lower carbon environment (Morrow and Rondinelli, 2012 and Harris and Bahmed, 2013).

EMS can be described as procedural systems and processes (Disterheft et al, 2012) ensuring that HEIs’ have the necessary management information infrastructure for their carbon emissions management (Clarke, 2006 ; Jain and Pant, 2010 and Bero et al, 2011). Clarke (2006) and Sammalisto and Brorson (2008) case study research in universities described an EMS for use in the HE Sector as follows:

> EMSs are an essential infrastructure procedure mechanism for carbon emissions risk assessments, accountability and management of carbon policies. EMSs provide the necessary management information infrastructure

offering credible incentives to manage the effective regulatory underpinning of carbon emissions and contribute to achieving carbon policy goals

HEIs are required by stakeholders to be accountable for their carbon emissions management (Bowen and Wittneben, 2011 and Climate Change Act 2008[(c. 27, Part 1(13)]. Compliance to this requirement demands an integrated environment management system for addressing the multi-disciplinary complexities of carbon management, accountability, implementing abatement strategies and reporting by HEIs (Lazarus, 2008). Granly and Welo (2014) research in the metal industry that could be applicable to the HE Sector had indicated that an EMS was a valuable business tool with a suite of management accountability advantages. In another research by Hudson and Orviska (2013) regarding experiences by Asian and European organisations, had inferred that using international environmental management standards could in parallel bring benefits to HEIs in terms of benchmarking, data collection, setting targets and reporting their environmental impacts. Ferreira et al (2006) had also indicated that EMS is a management information infrastructure that offers credibility for the planning, implementation and maintenance of the individual HEIs' carbon policies and strategies.

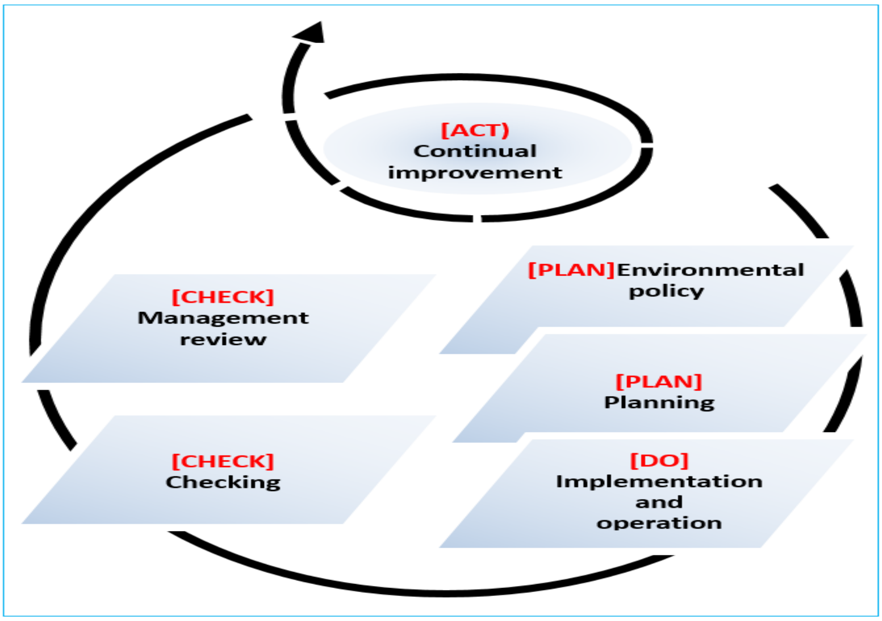
HEI carbon management can be considered to be a complex management system, managing numerous environmental considerations (Roy et al, 2008). Researchers such as Clarke and Kouri (2009) and Herremans and Allwright (2000) had emphasised that the introduction of EMS for carbon emissions management can be a complex and difficult process. Bero et al (2011) and Halila and Tell (2013) argued that HEIs are only taking limited advantages of the workings of an EMS and not addressing the carbon emissions risks assessments, carbon abatement planning, and carbon monitoring, disclosure communications, carbon performance reporting, reviewing carbon policies and executing appropriate decisions concerning carbon reduction targets.

An EMS comprises of guidelines offering HEIs with a structured format of procedures and processes (Granly and Welo, 2014) and supportive operational tools, focusing attention to their carbon emissions governance (Bero et al, 2011 and Disterheft et al, 2012).

The International Organisation for Standardisation (ISO) developed the 14000 series in 1996 and later revised to 14001 in 2004 representing the only recognised Standard that meets the quality and rigour of an environmental management system (Rondinelli and Vastag, 2009 ; Gomez et al, 2014 and Iso, 2014). Following the Rio Conference on Climate Change in 1992, compliance to ISO 14001 international standards had become important, and HEIs could adopt, to show their commitments to environmental management (Gomez et al, 2014). Adopting ISO 14001 is indicative to stakeholders that HEIs are meeting the challenges of regulatory and competitive pressures in managing carbon emissions (Noeke, 2002). Managing Scope 3 (Travel) carbon emissions requires HEIs to integrate their environmental management practices into a coherent framework by adopting ISO 14001 compliance principles. Other proponents (Darnall et al, 2007 ; Nawrocka and Parker, 2009 and Boiral and Henri, 2012) had claimed that adoption of ISO 14001 would be assisting organisations to reducing their operational environmental impacts, increasing awareness of carbon reduction amongst personnel and establishing a strong image of corporate responsibility. Also, Nawrocka and Parker (2009) argued that since ISO 14001 is a systems approach providing organisations with adaptation flexibility, increasing stakeholder confidence and having a competitive advantage over other organisation who are not certified can be adopted by the HE Sector.

Diagram 7 below presents the recommendations of the ISO 14001 environmental management that can objectively be audited for credibility. The Standard specifies requirements for an EMS and offers guidance for the development of environmental policies and objectives implementation for stakeholder compliances that the organisation is able to “control and manage” (Iso, p.1, 2009). This requirement is based on the Plan-Do-Check-Act (PDCA)(Iso, p.vi, 2009). PDCA procedures are (i) Plan – defining the organisation’s environmental policies and objectives (ii) Do - executing the delivery of (i) above and (iii) Check – auditing and measuring (iv) implementing targets and compliances (v) Act – implementing actions for continuous improvement of the EMS efficiencies and complying with management goals.

Diagram 7 – ISO 14001 environmental management systems elements



Copyright ISO 14001(Iso, 2009)

The PDCA provides a simplified effective structured approach for an EMS adoption (Hse, 2015). Critiques like (Bright, 2015) had stated that PDCA is an oversimplification of an improvement process and its methodologies have an inherent reactive nature. Taylor et al (2013) research in health care using the PDCA, critiqued that the theoretical framework presented complexities of the different procedures and the underpinning knowledge required for its correct application.

Some UK Universities have achieved ISO 14001 Certification: University of Glamorgan in 2002 (Price, 2005) and most recently University of East Anglia in 2015 (Uea, 2015) both stated that certification enabled them to control the management of their environmental impacts as well as ensuring legal compliances. Fisher (2003) research at a New Zealand College stated that ISO 14000 series are recommended tools when reviewing or contemplating adoption of an EMS. Taddei-Bringas et al (2008) research at a Mexican university stated that, although adaptation of ISO 14001 based EMS is beneficial for campus sustainability efficiencies but requires adaptation to improve its efficiencies for implementation in HEIs.

The implications of EMS developments for HEIs were discussed by Halila and Tell (pp. 85-92, 2013) after researching a sample of universities are summarised as follows:
"The ISO 14001 are a set of guidelines by which HEIs can establish or strengthen its environmental policies, identify environmental aspects of its operations, define environmental objectives and targets, implement a program to attain environmental performance goals, monitor and measure effectiveness, correct deficiencies and problems and review its management systems to promote continuous improvement".

ISO 14001 Standard (Iso, 2014) consists of five major EMS categories of guidance information applicable to different organisations and therefore not industry specific (Rondinelli and Vastag, 2009).

The five major categories are:

- the development and adoption of an environmental policy that organisations are able to achieve and are committed to undertake.
- establishing an evaluation process that is able to identify the environmental aspects, legal and reporting requirements and carbon reduction strategies and management.
- a systematic operations system that has clearly defined processes of accountability for environmental management, evaluation and analysis within the different departments, audit and documentation, systems for operational controls of environmental evaluation and reporting to stakeholders.
- audit trails and systems and reporting procedures that highlight corrective action including empirical measurement for reporting non-conformance.
- a management review process to ensure the effectiveness of the EMS and there are mechanisms for continuous improvements at appropriate intervals.

Critics of ISO 14001 (Bansal and Bognor, 2002 ; Potoski and Prakash, 2005 and Rondinelli and Vastag, 2009) had argued that ISO Standards are not a panacea for environmental accountability towards lower carbon emissions. ISO 14001 certification as Geng et al (2013) and Saizarbitoria et al (2013) had pointed out, do not provide procedures for the measurement of carbon performances of carbon emissions.

EMS are key management tools for HEIs and stakeholders (Alshuwaikhat and Abubakar, 2008) as successfully applied in other Sectors (Morrow and Rondinelli, 2012 and Boiral and Henri, 2012). Unfortunately, HEIs have not managed to harness the ISO 14001 procedural processes nor adapting for its potential benefits (Bero et al, 2012 and Prajogo et al, 2012). Stafford (2010) had emphasised that campus size, financial strength and navigating the complexities concerning carbon emissions had been significant factors in campus adoption of an EMS. ISO 14001 guidelines are too broad for adaptation that would be suitable for a HEI’s EMS requirements.

Critics like (Balzarova and Castka, 2008 ; Rondinelli and Vastag, 2011 and Boiral and Henri, 2012) had contended that HEIs’ adoption of ISO 14001 seemed to be out of necessity rather than offering benefits. Balzorova and Castka (2008) had argued that some organisations are adopting ISO 14001 certification for marketing and public relations purposes without any real procedural benefits for managing carbon emissions. Marsh (2014) stated that the ISO Standard has weaknesses (i) there is lack of transparencies to stakeholders apart from stating environmental policies rather than its environmental impact to climate change (ii) certification can be extremely costly for small to medium sized businesses (iii) the Standard does not provide tools and techniques to problem solving and managing environmental targets (iv) there are no linkages between the Standard to legislations or performance standards.

The limitations of implementing ISO 14001 is very costly, time consuming and takes many years to implement to securing an ISO 14001 Certification. ISO 14001 accreditation requires continuous monitoring, audit trails, document flow and skilled manpower for which NTU had not considered.

2.3 SCOPE 3 (TRAVEL) ENVIRONMENTAL MANAGEMENT SYSTEMS ISSUES AT NOTTINGHAM TRENT UNIVERSITY

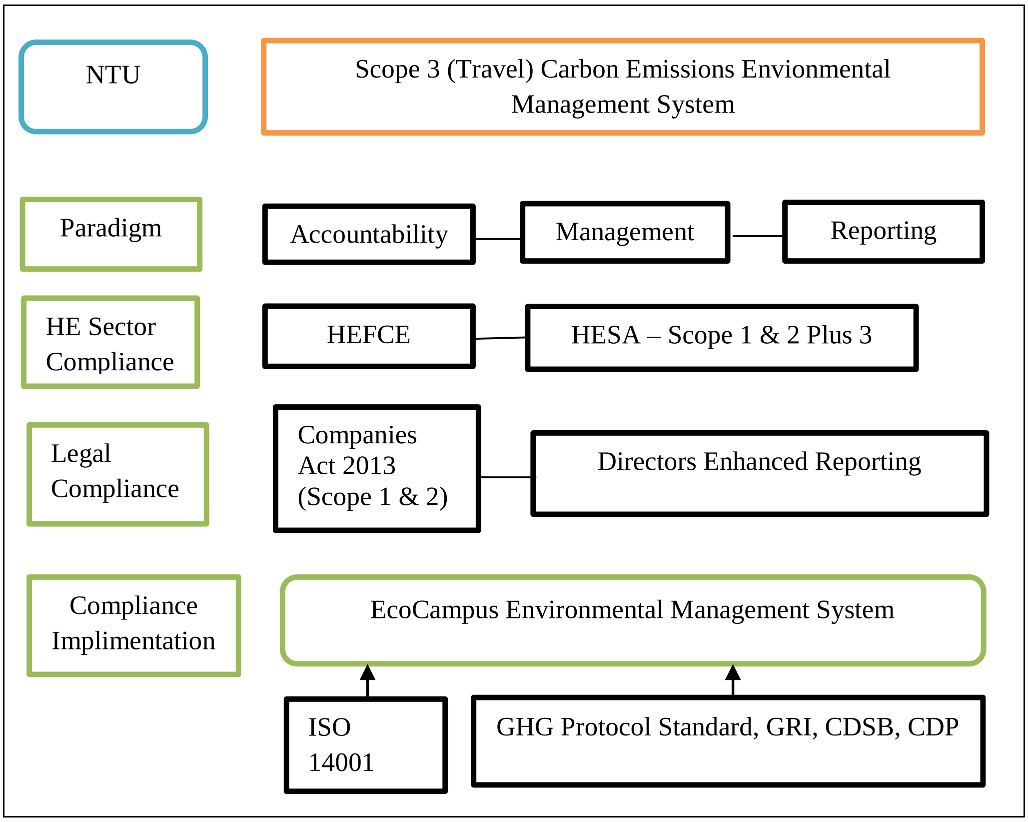
NTU’s carbon footprints are major environmental factors that NTU needs to be concerned when developing an effective EMS (Ntu, 2014). This has been exemplified by Finlay and Massey (2011) and Bero et al (2012) research in North American Universities. They indicated that an EMS is essential for carbon emissions management which similarly can be applicable to NTU. Clarke and Kouri (2009) research drew attention that the developments of EMS at other universities had been focusing strongly on an EMS for appropriateness and risk assessment. Provellio (2011) research at Wolverhampton University stated that with the rapidly expanding HE Sector in England, many HEIs are reviewing their procedures that are inclusive of an EMS towards carbon emissions reductions including Scope 3 (Travel).

Pun et al (2002) identified that environmental management systems involve the process of identifying the organisation's environmental strategies, accountability and reporting requirements and determining the various processes that align these core requirements. Spellerberg et al (2004) in their research of universities in New Zealand stated that EMS may be considered essential of HEIs enabling them to meeting the HEIs' environmental objectives, enables systematic co-ordination and assisting in the meeting of regulatory compliances.

The University of Osnabruck developed the 'Osnabruck Environmental Management Model for Universities' that had evolved to become the Environmental Management and Auditing Scheme Directive of the European Union (Viebahn, 2002 and Nash, 2009). In the USA, Barnes and Jerman (2012) developed an EMS for a multi-university consortium specially geared towards the needs of higher education. Savely et al (2013) noted that both these campus EMSs' used guidance similar to ISO 14001. EMS is a management tool (Zobel, 2008 ; Ambila and Sohal, 2009 ; Lozano, 2011 and Granly and Welo, 2014) providing universities with the necessary systems, processes, procedures, monitoring data in managing their campus environmental accountability, policies and targets.

Diagram 8 (below) presents the Scope 3 (Travel) EMS. The Paradigms applicable for NTU's EMS adoption processes are accountability, management and reporting. The EMS Practices Planning Framework are primarily derived from HEFCE requirements for the accountability of Scopes 1, 2 and 3 carbon emissions as part of HEFCE leadership in reporting HEIs' carbon footprint. The Companies Act 2013 required the reporting of Scope 1 and 2 and further non-financial information of the companies' environmental impact reporting is part of the enhanced directors report. NTU's EMS Implementation Planning Framework involves the adoption of EcoCampus EMS. This adoption framework will be integrating the various perspectives of ISO 14001 and the reporting requirements of The Greenhouse Protocol Standard, Global Reporting Initiatives, Carbon Disclosure Standards Board and The Carbon Disclosure Project (see Diagram 8, below)

Diagram 8 – Summary of Scope 3 (Travel) Carbon Emissions Environmental Management System for NTU



Developed by the researcher (Chelliah, 2015)

There are increasing scepticisms concerning unsubstantiated ‘green credential’ claims by universities of good campus environmental practices (Ozawa-Meida et al, 2013 and Robinson et al, 2015). To ensure transparency and credibility The Companies Act 2006 (Strategic report and directors’ reports, Regulations 2013, S414-415) requires that organisations’ reporting its carbon footprints must be independently audited. With this legal requirement, EMS has become a major factor for the evaluation of emissions data and quantification integrity of NTU’s carbon accountability management. The Environmental Association of Universities and Colleges (EUAC) (Ec1, 2015) stated that EMS is a framework for tracking, evaluating and communicating environmental performance ensuring that major environmental risks and liabilities are identified, minimised and managed. Stakeholders are demanding that HEIs strives to lower its carbon emission by demonstrating its environmental stewardship by adopting an efficient EMS (Sullivan and Gouldson, 2012 and Stephens and Graham, 2010) that is also applicable to NTU. To achieve this, requires NTU adoption of an effective EMS to managing its Scope 3 (Travel) carbon emission impacts, prioritise NTU’s carbon reduction management strategies and determine effective appropriate actions concerning carbon reductions. Sammalisto and Arvidsson (2005) research with Swedish Universities stated that driving forces for HEIs to implement an EMS appeared to be initially internal but external legislative compliances had been the major force. They also indicated that EMS implementation had been slow due to the lack of management commitment, lack of resources and low priority. Other hindrances, had been the extrication of environmental data and the systematic process issues of ISO 14001 implementation.

However, the coupling of ISO 14001 to an EMS to HEIs has not been explored to be a cost effective strategy to complying with stakeholder demands as happened in other sectors (Zhang et al, 2014 and Halila and Tell, 2013). The development of a hybrid EMS for the particular requirements of NTU has not been researched.

The appropriateness of an EMS for monitoring emissions data, reporting mechanisms and ability to take remedial actions are key drivers towards environmental stewardship behaviour (Ferreira et al, 2006 and Hoover and Harder, 2014). Times (2010) and Head (2011) stated that there are grim threats to UK universities with the risk of financial penalty by HEFCE (Hefce, 2010) if these EMS practices are not deployed for the collation of accurate environmental data and reporting. Other researchers had expressed concerns for HEIs that have parallel sentiments towards NTU (Clarke and Kouri, 2006 ; Sammalisto and Brorson, 2008 and Zhang et al, 2014) stated that application of ISO 14001 Standards are a prerequisite.

One of the widely used HE Sector programmes to addressing environmental issues has been the implementation of systems and processes developed by EcoCampus (Eco, 2013). EcoCampus has been setup at NTU’s Clifton campus technopark as a response for the development of an EMS to meeting the specific requirements of NTU that has been replicated in over eighty universities in the UK (Eco, 2013). EcoCampus is voluntary and is not a recognised standard (Disterneft et al, 2012).

NTU has adopted EcoCampus, an EMS providing frameworks and tools for managing environmental responsibilities by integrating campus operations and objectives that complies with HEFCE management requirements (Hefce1, 2011 and Eco, 2013). EcoCampus consists of an operational structure for management and operational practice procedures with a focus of the main frameworks from ISO 14001. Integrating EcoCampus EMS had provided NTU with a systems operational structure for carbon emissions management accountability (Eco, 2013).

Finlay and Massey (2011) had pointed out, that using the EcoCampus EMS within the HE Sector by UK Universities has advantages. Principally, the EMS has common frameworks with ISO 14001, such as carbon emissions management and data collection procedures (Savely et al, 2007; Clarke and Kouri, 2009 and Bero et al, 2012). Other beneficial features include (internal audit, review and document management, corrective and preventive actions) which serves to reinforce NTU's management credibility and rigor to carbon governance (Ntu, 2014). Disterheft et al (2012) research with universities EMSs argued that there has been no research concerning an effective EMS that can measure empirically the efficiencies and effectiveness which would be essential for carbon management planning (Noeke, 2002). A feature that is also applicable to NTU. The empirical measurements are key drivers for carbon reductions planning and management. Bero et al (2012) were more forthright indicating that EMS development at campuses can be difficult due to complicated carbon management policies and carbon data collation that are often incomplete or inaccurate.

Implementing EcoCampus EMS procedures can be complex, requiring skilled personnel for utilising the software's capability of a campus EMS (Eco, 2013). Procedures and systems of EcoCampus require adaptation by NTU to meet the carbon footprint reporting requirements to HESA. The main constraints identified with EcoCampus were, the lack of planning tools, application and implementation of a campus EMS in accordance to environmental measurement and reporting that required expert intervention. These challenges and opportunities similarly applicable to NTU were found in the research by (Evangelinos et al, 2009) at Greek Universities. Apart for the identification of these constraints, there has been limited or no investigation to analysing the distinct carbon emissions data information flow within a carbon reduction management system (Evangelinos et al, 2009 and Liou, 2015).

2.4 SCOPE 3 (TRAVEL) CARBON EMISSIONS QUANTIFICATION ISSUES IN THE HIGHER EDUCATION SECTOR

The principles of transparency are key drivers for campuses to provide clear and understandable carbon emissions information (Abolarin et al, 2011). The Global Reporting Initiative G4 (GRI) (Gri, 2015) defines transparency as the complete disclosure of information concerning carbon emissions and indicators (via quantification) as essential information to stakeholders. The quantification of Scope 3 (Travel) carbon emissions provides HEIs' with an empirical value and a numerical goal which can assist in abatement strategies (Vasquez et al, 2015). Quantification procedures underline all aspects of emissions and reporting to comply with The Companies Act 2006 (Strategic report and directors' reports, Regulation 2013, S141-415)(Gov, 2013b) and HESA (Hesa, 2013).

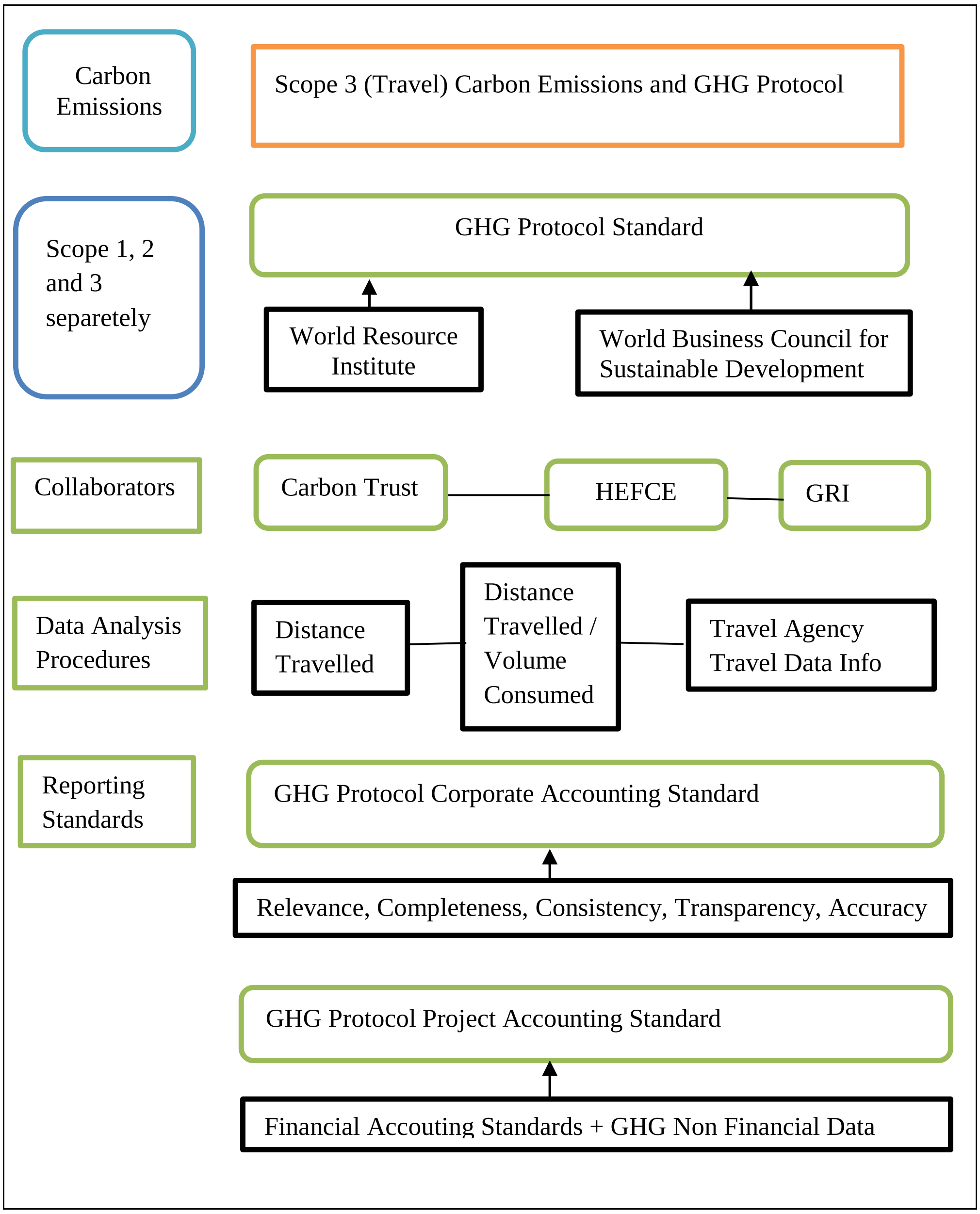
The global nature of Scope 3 (Travel) carbon emissions impacts demands new measurement procedures for combating climate change (Girod et al, 2014 and Goulden et al, 2014). Quantification requires new carbon emissions data collections, carbon accounting, instituting guidance procedures for transparency, accountability, developing policies and abatement strategies (Schaltegger and Csutora, 2012) and some empirical quantum measurements (Bowen and Wittneben, 2011). Ozawa-Meida et al (2013) included Scope 3 emissions related to business travel and staff and students' commuting based on journey distances and annual travel surveys respectively. HESA (Hesa, 2014) requires HEIs to quantify and report their carbon footprint effective from 01 January 2015 and Scope 3 (Travel) quantification is part of the overall HEIs' carbon foot print. These quantification procedures contribute to better environmental management as Schaltegger and Csutora (2012) stated, for efficiently managing total carbon footprint and contributing to increasing eco-efficiencies when using transportation. The quantification provides a framework for HEIs to negotiating the challenges concerning uncertainties in carbon management, managing the cost benefits of carbon reduction policies and reporting as already applied in other Sectors, i.e. within the NHS (Bowen and Wittneben, 2011). However, Callon (2009) argued that there are carbon quantification complexities and challenges with regard to its measurement accuracy, consistency and certainty that have applicability to NTU's Scope 3 (Travel) carbon emission quantification.

In January 2011, HEFCE (Hefce1, 2011) requested to Ove Arup and Partners Ltd (Arup) and De Montfort University to assist in measuring Scope 3 emissions (for water and waste) for HEIs in England (York, 2012). However, HEFCE has made no commissioning for research concerning Scope 3 (Travel) carbon emissions within the HE Sector. Instead, HEFCE (Hefce1, 2011) offered recommendations for the quantification of Scope 3 (Travel) as a guidance statement. "That HEIs establish a prudent and consistent methodologies with appropriate explanations for determining the quantification of Scope 3 (Travel) carbon emissions" (Hefce4 12, p.1. 2012). Effectively, there are no definitive guidelines for HEIs to implement any procedures nor mechanisms for the measurement of Scope 3 (Travel), benchmarking and abatement management of carbon emissions.

The Greenhouse Gas Protocol (GHG Protocol) (Ghg, 2013) together with the World Resource Institute (WRI)(Wri, 2013a) and the World Business Council for Sustainable Development (WBCSD)(Wbcsd, 2014) had launched a broad technical recommendation for the quantification of Scope 3 (Travel) carbon emissions from opinions of various stakeholders, businesses, non-governmental organisations and governments. The WRI and WBCSD are foundation institutions funded by donors that offer research pronouncement concerning stabilising climate change and supporting sustainable development (Wri, 2013a). The GHG Protocol was developed as a standardisation framework for quantification and reporting GHG emissions to limit double accounting of Scope 1, 2 and 3. According to Vasquez et al (2015) research at a Chilean University Campus, Scope 3 (Travel) carbon emissions had been significant, as a result of reliance on personal vehicles for commuting. The GHG Protocol quantitative measures involve carbon quantification accounting information via procedural supporting frameworks. However, Andrew and Cortese (2011) had indicated that the protocol fell short of being comparable, understandable, and reliable. They also stated that the protocol's information recommendations are voluntary and was substantial to meeting stakeholder requirements. Eccles et al (2012), stated that there are quantification issues that are failing to disclose material information for comparable purposes and have hidden risks to investment portfolios and capital markets concerning investment exposures to climate change impacts.

Diagram 9 (p.90) presents the summary of the GHG Protocol reporting framework for Scope 3 (Travel) carbon emissions reporting. The Greenhouse Protocol Reporting requires reporting Scopes 1, 2 and 3 separately (Ghg, 2012). Apart from the WRI and WBCSD, the other major collaborators and recommenders of the reporting standards are the Carbon Trust, HEFCE and GRI. For the purpose of this research, Scope 3 (Travel) carbon emissions data analysis procedures are based on distance travelled, monetary value spent and travel data analysis compiled by travel agents as part of the travel industry requirements to users. The GHG Protocol Standard are divided into two sub-standards (i) GHG Corporate Accounting Standard and (ii) GHG Protocol Project Accounting Standard. These encompass the GHG Accounting and Reporting Principles in accordance with Financial Accounting Standards Board Reporting and Non-Financial Reporting and part of Corporate Governance Reporting (Fonseca et al, 2014).

Diagram 9 – Summary of Scope 3 (Travel) Carbon Emissions and The Green House Gas Protocol



Developed by the researcher (Chelliah, 2015)

WBCSD are a coalition of 175 International companies committed to providing business change for sustainable development based on business leadership, policy development, promoting the business case, best practice and having a global outreach (Ghg, p.145, 2012). The WRI is an environmental 'think tank' to meeting the global challenges to reverse damages to the ecosystems, collaborating in environmental decisions, averting climate change activities and sustainable development (Ghg, p.145, 2012). The WRI and WBCSD produce pronouncements called the Green House Protocol. The main focus of the GHG Protocol is to develop internationally accepted greenhouse gas (GHG) accounting standards, quantification tools and to recommend adoption of these Standards for carbon accountability worldwide (Ghg, 2013). Lovell and Liverman (2010) indicated that the use of GHG Protocol Standards ensures that organisations' carbon emissions quantification accounting practices are based on the best practice available. Standardised quantification procedures as MacKenzie (2009) and GHG Protocol (Ghg, 2013b) proposed for carbon emissions would ensure consistencies concerning organisational reporting practices that has relevance for HEIs to adopt. Rauch and Newman (2009) stated that adoption of the GHG Corporate Standard (Ghg, 2012a) would provide credibility and also adhere to the recommendation from The United Nations Framework Convention on Climate Change (Unfcc1, 2014) and conforming to The Kyoto Protocol (Unfcc2, 2014) concerning achieving agreed carbon emissions targets attributable to the UK HE Sector.

HEFCE (Hefce, 2010) had also adopted the quantification standard recommended by WRI and WBCSD (Ghg, 2012b) within their guidelines. The GHG Protocol Standard provides guidance quantification on how HEIs should prepare their Scope 3 (Travel) carbon emissions footprint representing a 'true and fair account' of the HEI's travel carbon emissions by adopting the standardised recommendations and principles (Ghg, pp.42-43, 2012b). The Standard recommends simplifying procedures, reducing the costs involved in compiling and calculating carbon footprints and reporting appropriate carbon emissions and environmental information for building effective strategies to managing and mitigating Scope 3 (Travel) carbon emissions.

In April 2013, The GHG Protocol together with the Carbon Trust (Trust, 2014) released the first internationally accepted method for companies to account for travel and commuting carbon emissions by personnel for business related activities incurred by vehicles owned or operated by third parties such as boats, aircraft, train, buses and passenger vehicles (Ghg, 2013c and Ghg, 2013d). These guidance notes are summarised below that are applicable to the HE Sector as follows:

- Tracking of distance travelled by different travel modes accounted by a travel agency or other travel providers
    - ➢ Calculating the journey travelled by car, train and motorcycle from point to point in the ordinary course of travel in kilometres or miles
- Tracking of distance travelled by different travel modes accounted by an internal expense and reimbursement systems from travel receipts/fares submitted.
    - ➢ Calculating the monetary value spent on the mode of transport. Bus and tram fares are used. These should then be converted to distance travelled.
- Annual surveys/questionnaires of employees' habitual and intended travel.
    - ➢ Details of miles, modes, fares, overseas travel and business travel from appointed travel agents in the UK to provide travel data for both domestic and foreign travel distance journeys segmenting the mode, distance travelled and geographical zones as recommended by HESA (Hesa, 2014).
- Partnering with travel agency providers (e.g., transportation companies, hotels) to provide detailed GHG emissions data.

- Travel emissions data prepared by travel agents, hotel carbon footprint and other related carbon information concerning UK/Overseas travel.

Downie and Stubbs (2013) indicated that there was a lack of research concerning carbon emissions quantification that had inhibited organisations to pursuing any definitive cost effective mitigation strategies that can be applicable to HEIs.

The Greenhouse Gas Protocol (GHG Protocol) has established itself as the most credible and commonly used international carbon emissions accounting standard adopted by organisations, governments and businesses to understanding emissions accountability, quantification and reporting greenhouse gas emissions to stakeholders (Ghg, 2013). The GHG Protocol (Ghg, 2013) offers guidance on carbon reporting standards concerning Scope 1, 2 and 3 carbon emissions.

The GHG Protocol comprises of two separate but inter-related standards:

• GHG Protocol Corporate Accounting and Reporting Standard (GHG – PCARS)
This standard presents detailed guide notes for organisations to use when quantifying and reporting their GHG emissions (Ghg, 2012a).

- The principal requirements are relevance, completeness, consistency, transparency and accuracy (Ghg, p.7, 2012b).

• GHG Protocol Project Accounting Standard (GHG – PAS) (Ghg, 2012b).

- This standard is applicable to Clean Development Mechanism(CDM) initiatives derived from the Kyoto Protocol offsets. Reporting GHG the type of projects with their qualifying time frames, quantifying GHGs, reasons for offsets, geographical locations (Ghg, p.80-82, 2012b).

The GHG – PCARS accountability of GHGs is the most comprehensive and policy neutral accounting tool that had been derived from a two-year dialogue among business, NGOs, academics, environmental and government experts led by WRI and the World Business Council for Sustainable Development (Ghg, 2012). The GHG - PAS (Ghg. 2012a) recommends specific offset programmes for organisations to embark as an emissions offset mechanism as part of the CDM as recommended by the Kyoto Protocol (Unfcc2, 2014). The Project Accounting Standard provides guidance to corporations on the specific principles, concepts and accounting boundaries methodologies for the quantification and reporting GHG project reductions. The Project Protocol "aligns to the Corporate Accounting Standard" (Ghg, pp.5-8, 2012) with the GHG Corporate Standard (Ghg, 2012a). The Corporate Accounting Standard recommends Standards and accounting guidance for companies to prepare their "GHG emissions inventory at the Organisational level" (Ghg, p.8, 2012).

Although, the Corporate Accounting Standard and Project Protocol have different objectives, goals, regulatory frameworks and GHG accounting concepts. Both these Standards are linked through the use of common accounting principles. These include the principles of relevance, completeness, consistency, transparency and accuracy as applied in their appropriate contexts (Ghg, p.8, 2012). The GHG assessment boundaries include all primary and significant secondary emissions that affect the organisation (Ghg, p.12, 2012). Organisational boundaries must be determined by corporations to undertake operational controls. Young (2010) stated that determining organisational boundaries are becoming challenging for emissions accountability. The application of these principles are intended to ensure the credible accounting of both corporate GHG emissions and project-based GHG reductions as follows : (i) recommend credible and transparent methodologies (ii) standardising the accountability through generally accepted international accounting standards (iii) harmonising of the different accountability initiatives (iv) third party verification of the organisations quantifications in a transparent manner (v) development of sector specific protocols for different industries. Andrew and Cortese (2011) stated that carbon related emissions disclosure information would not meet the long standing financial accounting requirements of prudent accounting principles, reliability, comparability and questioning the value of information for decisions making.

GHG Protocols can be adopted to providing HEIs with a ‘reporting tool’ that can be subjected to independent audit, review and reporting. This increases the overall accountability and assurance levels for the carbon emissions values presented by organisations’ reporting statements. Olson (2010) had indicated that the global trend for reporting GHGs is increasing, along with a higher level of independent assurances and audit reporting compliances for increased credibility for stakeholders.

2.5 SCOPE 3 (TRAVEL) ENVIRONMENTAL PERFORMANCE INDEX ISSUES IN THE HIGHER EDUCATION SECTOR

The Intergovernmental Panel on Climate Change (IPCC) have made pronouncements concerning the science of climate change (Ipcc, 2007). This had been followed by UN backed climate change declarations like the Kyoto Protocol in 1997 (Vuuren et al, 2006) to the Doha Conference in 2012 (Economist, 2012). Although, these UN pronouncements had put sustainable development in the global environmental agenda, there is still a lack of global consensus for what measureable procedures are to be implicated. These UN Protocols are widely drafted advisements, with no references to targets or empirical metrics for the measurement of environmental performances (Hsu et al, 2013). Agenda 21 (Rio, 1992) stated that the world is deficient of policy relevant environmental indicators, as well as the data to construct them. The climate change abatement strategies and development of environmental accountability management systems are not gaining pace within the HE Sector (Altan, 2010 and Ozawa-Meida et al, 2013). In response to this slow pace, the HE Sector has recognised this deficiency and is responding to the environmental challenges from the unique perspectives that HEIs are able to show leadership to society (Lozano et al.2013 and Shi and Lai, 2013). HEIs are responding to these challenges by adopting sustainability assessment frameworks. North American Universities have already adopting a more data driven empirical metrics concerning environmental sustainability performance (Aashe, 2014). Lozano et al (2013) stated that many HEIs have been making declarations, green charters and carbon management plans for the advancement of sustainable development and climate change accountability, but none have made any pronouncements concerning environmental metrics. Stakeholders and environmental policy makers are demanding quantitative metrics for executing decisions making concerning EMS and carbon abatement strategies (Yale, 2010).

The main objective of the sustainability index is to improve the aggregation of the empirical data over a long period of time for improved analytical assessments. In 2015, the UN General Assembly formally accepted 17 measureable sustainability development goals as a successor to the 8 Millennium Development Goals (MDG) set in 2000 (Sustainable, 2015). While, Goal 13, of the MDG called for each country to achieve environmental sustainability, the Goal did not prescribe any relevant indicators (Hsu et al, 2013). This case study research concerns the development of the Scope 3 Travel environmental performance index that is a credible analytical complement to the UN backed initiatives, MDGs and is a complement to the UN Sustainability Development Goal Number 13 as follows (Sustainable, 2015):

13.1 – Strengthening the resilience and adaptive capacity for climate change

13.2 - Integrates climate change measures into policies, strategies and planning

13.3 - Raising awareness of human and institutional capacity to climate change mitigation, adaptation and impact reduction

13.a - Implementing meaningful mitigation actions and transparencies

13.b - Promoting mechanism for effective climate change planning and management. Environmental sustainability has emerged as major critical focus by the IPCC,

In response to the requirement for environmental performance and sustainability indicators. The Yale Centre for Environmental Law and Policy and the Centre for Earth Science Information Network at Columbia University had been developing environmental performance indices (Sedac, 2015). The United Nations, Governments and Stakeholders are increasingly requesting countries and organisations for explanations of their performance on carbon emissions and natural resources management challenges with reference to quantitative metrics (Yale, 2010), that can also be applicable to NTU and HE Sector. Empirical data driven approaches would be enabling policymakers to better manage environmental strategies, early detection of environmental problems, evaluate trends, policies and identify best practices (Waheed et al, 2011). Environmental performance indexes provide a summative empirical measurement values concerning how efficient are the organisations targets to predetermined targets and goals, particularly useful when monitoring the HE Sector carbon emissions goals and meeting the requirements of the Climate Change Act 2008. Environmental performance indexes as Yale (2010) had indicated that indexes provide a quantification framework, systematic processes and a mechanism that can be independently verified offering greater credibility and trust for wider policy cooperation within the HE Sector.

Scope 3 travel environmental performance index is constructed as a composite summative index based on best practice aggregating other indicators which are weighted differently and assessed against absolute targets (Diagram 23, p.200). The primary objective of the index applicable to NTU and HE Sector is to enable long term objective measurements of environmental improvement measures and the development of an EMS for analytical assessments to meeting the HEIs' goals.

The index enables a ranking perspective with an indicative perspective sense of which HEIs' are doing best in managing the environmental challenges and reporting disclosures that the HE Sector faces (Hefce2, 2009). From an EMS and environmental abatement strategies perspective, greater analytical value can be obtained from drilling down into the constituent data to evaluate and analyse specific environmental abatement issues. This analytical framework would assist decision makers to better manage environmental issues, policies and enabling management in better understanding the index's constituent categories and monitor environmental management progress. Shi and Lai (2013) stated that composite index conveys complex information is a comprehensible and meaningful way for easy understanding. They also stated that the constituent attributes should be carefully constructed within a credible scientific framework and baseline measurements.

In 2005, North American Academies set up the Association for the Advancement of Sustainability in Higher Education (AASHE)(Aashe, 2013a) and presently having over 1,000 member institutions with a commitment for the advancement and collaboration of environmental sustainability in the HE Sector. In 2006, AASHE developed the Sustainability Tracking, Assessment and Rating System (STARS) which would enable HEIs to evaluate all dimensions of sustainability and campus operations within a rigid rating systems (Shi and Lai, 2013). In 2005, The Green Report Card (GRC) was developed by the Sustainable Endowments Institution and existed till March 2012 (Endowment, 2015). The GRC had focused on policies and practices using the A to F grading system.

In 2006. The American College & University Presidents Climate Commitment (ACUPCC) was formed for the HE Sector to become carbon neutral within 20 years (Ecoamerica, 2015). In 2009, Second Nature (Secondnature, 2015) became the lead supporter of ACUPCC and seconded by AASHE.

The above three sustainability ranking frameworks consists of different bases. Green Report Card and STARS used the credit scoring rationale to awarding credits based on the HEI's sustainability attributes in comparison to the recommended standard. ACUPCC had a specific framework focussed on emissions inventory and a time frame to meeting the carbon neutral target. Shi and Lai (2013) researched these three frameworks and stated that STARS covered the most comprehensive criteria applicable to the HE Sector at 68% compared to ACUPCC at 19% and Greed Report Card at 33%.

Criticisms concerning the use the environmental performance index remains as (Shi and Lai, p.59, 2013) had stated as "controversial and underutilised", primarily based on the fact to the subjective concepts and had not been widely used as a framework outside North America. Core themes concerning Scope 3 Travel sustainability performance index will have to be standardised and structured in a concise manner to remove the uncertainty of double counting within a chosen category. Gandhi et al (2006) research of corporate environmental performance stated that a performance index is a powerful tool putting environmental decision making on firmer analytical footing, promoting systematic assessments, reporting, EMS planning and enabling an alternative to productivity for measuring environmental progress.

2.6 SCOPE 3 (TRAVEL) CARBON EMISSIONS REPORTING ISSUES BY THE HIGHER EDUCATION SECTOR

The HE Sector has understood the concept of a carbon constrained reality and the benefits of complying with the Climate Change Act 2008[(c. 27, Part 1(13)] in meeting the UK’s carbon emissions target by 2050 (Hefce7a, 2009). As a result, carbon reporting by the HE Sector is becoming increasingly relevant by quantifying and managing the HEIs emissions (Cdp, 2010). Brown and Fraser (2006) and Hopwood (2009) had indicated that multiple reporting drivers to stakeholders are increasing the importance of carbon reporting by HEFCE (Hefce2, 2009), Mandatory reporting to HESA (Hesa, 2014) should include Scope 1, 2 and 3 and additionally Scope 3 emissions for Water Supply and Treatment (Hesa, 2015). Other Scope 3 emissions for supply chain procurement, travel and waste are to be reported from 2015 by all HEIs for the empirical quantification of the HEIs carbon footprint to meeting emissions targets. Contrasting this reporting requirements, Scope 3 (Travel) emissions reporting is not mandatory but increasingly becoming voluntary and recommended practice due to stakeholder pressures (Alshuwaikhat and Abubakar (2008 : Bebbington and Gonzalez, 2008 and Alonso-Almeida, 2015). The

Environmental Association for Universities and Colleges (EAUC)(Ec, 2015) UK commissioned work to assisting HEIs to measuring Scope 3 emissions to establish (i) the HE Sector base line emissions from supply chain procurement (ii) produce definitions for Scope 3 emissions at institutional level for use by HESA from 2013 (Hefce4, 2012). HEFCE commissioned work to JMP Consultants (Jmp, 2012) whose recommendations are applicable to the 'travel sector' as follows (Hefce, 4, 2012):

(i) Include a good practice guidance recommending HEIs adopting an efficient and effective data collection practices.

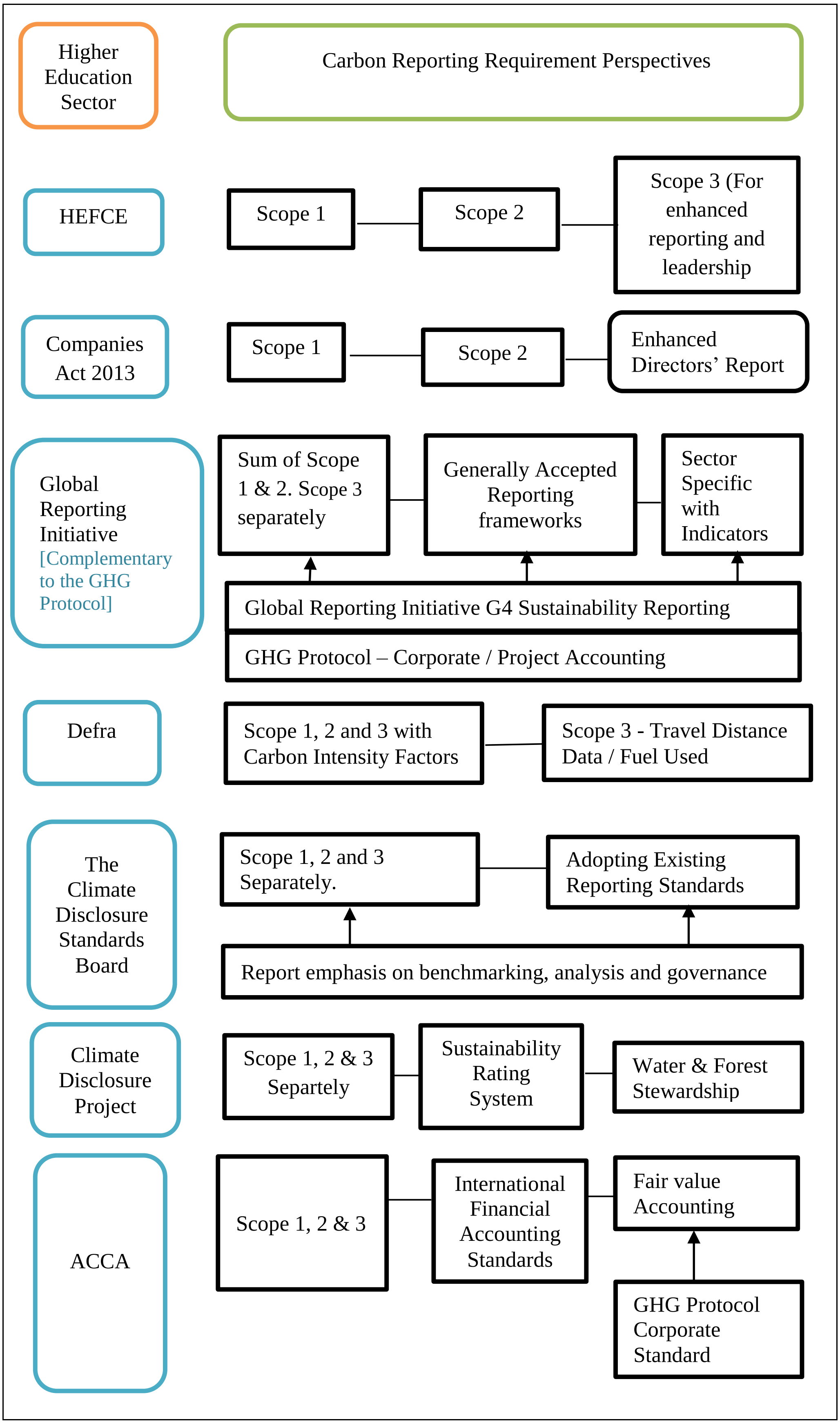
The reporting recommendations are for ensuring there are encouragement for HEIs reporting their Scope 3 (Travel) carbon emissions recognising the potential challenges, resource requirements for data capture and analysis. HEFCE (Hefce4, 2012) stated that the reporting mechanism and information, had facilitated HEIs to manage Scope 3 emissions for Scope 1 and 2. Reporting emissions also demonstrates HEIs' management efforts concerning carbon accountability, embarking on abatement strategies and demonstrating these efforts to stakeholders. Bebbington and Gonzalez (2012) stated that reporting carbon emissions are beyond accountability but also to communicating the risks and uncertainties of climate change.

The HE Sector is not exempt from the challenges to meeting their carbon footprint reporting requirements by HESA from 2015 (Hesa, 2014), Companies Act 2006 (Regulation 2013, Section 414-416) and legal reduction targets by 2020 set by the Climate Change Act 2008[(c. 27, Part 1(13)]. In 1997, The Kyoto Protocol's Clean Development Mechanism (CDM) (Unfcc2, 2014) was established to assisting countries and organisations achieving compliance concerning their quantified greenhouse gas (GHG) emission commitments and reporting their carbon footprint (Ellis et al, 2007 ; Egenhofer, 2007 and Caro et al, 2014). Mazhar et al (2012) and

Ozawa-Meida et al (2013) in their research at De Montfort University proposed a strategic carbon management reporting mechanism for HEIs in achieving their carbon reporting requirements. As explained in their research, the reporting starts with the understanding of De Montfort's carbon emissions, processing efficiencies using alternative energy sources, regulatory aspects, environmental impacts, stakeholder perceptions and analysing carbon's potential impact on DeMonfort.

Diagram 10 (p.103) draws from the dominant reporting guidelines for Scope 3 (Travel) carbon emissions reporting apart for the GHG Protocol which had been discussed previously. HEFCE required Scope 1, 2 and 3 reporting. The Companies Act 2013 required Scope 1 and 2. DEFRA provided the mechanism for reporting Scope 1, 2 and 3 recommending its published carbon intensity factors. The Global Reporting Initiative G4 requires the sum of Scopes 1 and 2 reported together and Scope 3 separately. Whilst The Carbon Disclose Standards Board and The Carbon Disclosure Project required Scope 1, 2 and 3 to be reported separately (Liesen et al, 2015). The ACCA reporting requirements consolidated carbon emissions reporting and non-financial reporting using Financial Accounting Standards, Fair Value Accounting and GHG Protocol Corporate Standards. All the reporting standards taken together proposed that the minimum reporting requirement concern Scope 1 and 2 carbon emissions as a consequence of each organisation's activities. Whereas HEFCE, GRI, CDSB and CDP have recommended Scopes 1, 2 and 3. HEFCE (Hefce4, 2012), the Carbon Disclosure Project and frameworks developed by the Institutional Investors Group on Climate Change (Institutional, 2015) who are industry collaborators with HEIs, encouraging more climate change risk information.

Diagram 10 - Summary of the Scope 3 (Travel) Carbon Emissions Reporting By the GHG Protocol Compared with Other Legislations



Developed by the researcher (Chelliah, 2015)

Carbon emissions reporting is a branch of accounting that accounts for the carbon emissions of HEIs by presenting empirical measurements and environmental information to stakeholders (Jones and Solomon, 2013 and Alwan and Jones, 2014). Emissions reporting should be part of corporate governance (Sullivan and Gouldson, 2012 and Apergis et al, 2013). Taking into account the stakeholders' wider requirements, Barako et al (2006) stated that environmental reporting can be interlinked with financial and environmental performances.

HEIs are well placed from a teaching and researching perspective to delivering corporate accountability (Lodhia, 2006 ; Baumgartner, 2009 and Hefce, 2010). Lozano and Huisingh (2011) argued that environmental reporting relates to emissions data that is compiled from carbon accounting systems, classified, measured and subsequently disclosing externally their environmental impacts.

Ozawa-Meida et al (2013) omitted in their case study research at De Montfort University's Scope 3 (Travel) carbon emissions accountability, as there was no compliance requirement until the end of 2014. However, (Bracci and Enrico, 2013 ; Townsend and Barrett, 2015 and Alonso-Almeida, 2014) had stated that reporting was in tandem to carbon quantification and benchmarking which would be enabling empirical forecasts of carbon emissions accountability.

Several researchers who had investigated carbon disclosure practices within HEIs (Lee, 2008; Haigh and Shapiro, 2012 and Yam, 2013) who had made references that carbon reporting acts as triggers for better management of carbon reduction strategies. Haigh and Shapiro (2012) stated that there have been no disclosures concerning Scope 3 (Travel) carbon emissions related disclosure practices by HEIs.

Kolk et al (2008) and Haque et al (2010) had stated that there are increasing stakeholders and investor activism for governments and stakeholders to be working collaboratively on GHG emissions, carbon risks, opportunities, strategies and carbon footprint levels. Reid and Toffel (2009) stated that there are theoretical and practical challenges faced by organisations concerning with their carbon emissions reporting that would be needed to be overcome. These measures would effectively change the carbon reporting social contract between stakeholders and organisations commitment to addressing their carbon footprints (Weidema et al, 2008 ; Kolk et al, 2008 and Matthews et al, 2008). This can be applicable to the HE Sector. Bowen and Wittneben (2011) and Sullivan and Gouldson (2012) pointed out that there has been a shifting stance on reporting carbon emissions by virtue from competitive pressures. This phenomenon can be applicable to the HE Sector to prompting the development of carbon emissions governance and reporting.

Olson (2010) and Haigh and Shapiro (2012) had indicated that, there were barriers to developing a carbon emissions reporting agenda due to limited management involvement, organisational structure, limited funding, technical training and skilled personnel and the limited availability of environmental policies. Equally important however, as Indrani and Purba (2010) and Cuevas (2011) stated that there was a need for clarity to defining carbon emissions and there has been no guidance concerning its reporting format.

HEFCE recommended that individual HEIs must set out their carbon emissions every two years internally and report annually their carbon accountability as part of the HEI’s carbon management plan over ten years currently (2010-2020) with reference to their base year of 2005 (Hefce, 2010). HEFCE and HESA will be monitoring HEIs reporting of their Scope 3 (Travel) carbon emissions from 2014 for the year 2012 - 13(Hesa, 2014) having an impact on the HEIs' internal carbon reduction policies.

HEFCE (Hefce12, p.9, 2012) statement of reporting emissions relevant to Scope 3 (Travel) are as follows:

(a) Reporting emissions from Scope 3 (Travel) from all modes of transport and account for the total cost of travel that would facilitate HEIs to identify the least cost options and save money.

(b) Reporting carbon emissions data can be used by HEIs to evaluate travel modalities and investigate how carbon reduction policies and alternative modes of transportation contribute to promoting low carbon emissions travel.

(c) Reporting processes provides HEIs the understanding concerning travel carbon emissions that could provide information for flexible home working using the internet which can contribute to lower travel costs.

(d) HEIs are well positioned to lead by example for the promotion of active travel (walking and cycling) offering health benefits and engaging students/staff on the benefits of a low carbon society.

Progressively, the HE Sector have been incorporating carbon emissions reporting classified according to the Greenhouse Protocol Standard of Scope 1, 2 and 3 (Vasquez et al 2015). Townsend and Barrett (2015) research with the University of Leeds, stated that reporting was made easier with new reporting frameworks called 'Environmentally Extended Input - Output Analysis' to derive the carbon footprint.

Table 2 (p.107) below details the reporting requirements by HEFCE Scope 3 (Travel) (Hefce12, p.12, 2012). These are classified as mandatory and optional Scope 3 (Travel) reporting emissions.

Table 2 – Scope 3 (Travel) reporting emissions from transportation modes

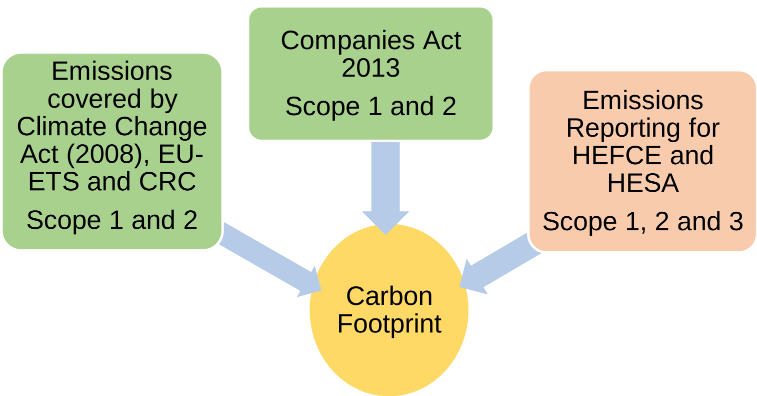
Scope 3 (Travel) Reporting Emissions from Modes of Transportation (Hefce, 2012)		
Mandatory Reporting Items	Optional Reporting Items	Description
Air Rail Company Car Hire Car Motor Cycles Vans Leased Buses	Public Bus Underground Tram Taxi Coach Ferry	These are commuting and business travel modes undertaken by students and academic staff. All modes of HEI business travel are classed as mandatory reporting items for emissions. Where available, overseas business travel (in Km journeys) emissions per country should be collated and reported as geographical regions, i.e. Africa, Asia, Americas, Europe etc.

Sufficient planning, quantifying and stating achievable carbon emissions targets by 2020 have been the key recommendations by HEFCE (Hefce7a, 2009) and HESA (Hesa, 2014). Neumayer (2007) reviewing the Stern Review on climate change (Stern, 2006) recommended that organisations execute a decisive, ethical and compelling contribution to the reduction of carbon emissions by developing their carbon emissions reporting to stakeholders. This sentiment can also be applicable to HEIs.

As from 01 January 2015 all UK quoted companies (Gov, 2013) and large HEIs have been similarly mandated by HEFCE (Hefce, 2012) for HEIs to report their carbon footprints. As a consequence, Scope 3 (Travel) carbon emissions has been summarily included within the HEIs carbon footprint reporting driven by current legislation, public interests and stakeholder demands for more environmental information. Carbon emissions reporting are ‘new’ areas for academic research but have the potential to affect future government policies, current carbon operations and identifying new business opportunities (Townsend and Barrett, 2015). Several environmental groups and HE stakeholders have been exerting pressure on HEIs to fast track their 'total' carbon emissions footprint (Scope 1, 2 and 3) for assessing climate change related business risks and opportunities (Waas et al, 2010 ; Lander et at, 2011 and Ecometrica, 2013).

The Companies Act 2006 (Regulations 2013, Section 414-416) stated that large carbon emitting organisation (i.e. HEIs) must voluntarily comply with the quantification and reporting guidelines recommended for quoted companies. HEFCE had interpreted that HEIs are within the definition of large organisation (Hefce4, 2012) consuming large in most cases in excess of the 6000 KWh as defined by the Carbon Reduction Committee (Gov, 2014). However, The Financial Reporting Council (FRC)(Frc, 2014) presented accounting and reporting guidance on the CA2006 Strategic Report. FRC guidance (Frc, p.53, 2014) stated under Schedule 7.15(2), (3) & (18) that, where practicable companies to obtain emissions information in carbon dioxide tonnes of equivalent from activities that the companies are responsible including (a) combustion of fuel (Scope 1) (b) purchase of electricity, heat, or cooling for use by the company (Scope 2) (c) Scope 3 reporting is voluntary. Figure 1 below presents various Scopes legal and other regulatory requirements.

Figure 1- Scope 1, 2 and 3 emissions reported under the various regulatory requirements



The Companies Act 2006 - Strategic Report and Directors' Report (amended and approved by House of Commons on 16 July 2013 (Ecometrica, 2013) comprises of amendments to S414 – S416 that has direct relevance to Scope 3 (Travel) carbon emissions are explained as follows:

(a) To include a carbon policy report covering disclosures of greenhouse gases in the directors' report. This report should describe the methodologies used and state the current and preceding year's carbon footprint emissions in tonnes of carbon dioxide equivalent from travel activities separately identified (Cca, 2008).

(b) The directors' report must also include 'at least one empirical ratio that cumulatively summarises the organisation's annual carbon footprint emissions as Key Performance Indicators.

The ACCA (Acca, 2014) stated that the new Companies Act (2013) emphasises the requirement by quoted companies and large organisations to enhance the directors' report as a strategic report concerning climate change and sustainable development. Stears (2013) in his legal critique to the Act stated that (i) shareholders were able to evaluate the directors' performances (ii) the trend for more quantitative reporting enabling shareholders to conduct risk assessments (iii) the objectives of the strategic reporting can lead to transparent reporting to meet the informational needs of shareholders (iv) the test of materiality could be debateable by organisations.

The enhanced reporting requirements in addition to the strict reporting of the Companies Act 2006 (Regulation 2013) had evolved from the recommendations by HEFCE by JMP Consultants in 2012 that HEIs must lead the reporting of Scope 3 (Travel) emissions by leadership (Hefce4, p3, 2012). JMP Consultants had stated that to lead by example, HEIs must be able to acquire quality Scope 3 (Travel) data and calculate emissions in a highly efficient and effective methodological procedures.

The concluding recommendations by JMP indicated that HEFCE and the HE Sector will be demonstrating good practices by mirroring Scope 3 business travel already being reported by various public and private organisations and “raising the bar” by including commuter travel emissions (Hefce4, p.4, 2012).

HESA (Hesa, 2014a) had proposed the enhanced reporting requirements for HEIs Scope 3 carbon emissions are under three main categories; (i) Supply chain report to HEFCE on HE Sector emissions under taken by Arup, CenSA and De Monfort University (Hefce14, 2014) (ii) transport (Report to HEFCE by JMP Consultants (Jmp, 2012 and Hefce7, 2009) (iii) Water and Waste. (iv) travel emissions in 2015

Cambridge University footprint and analysis of Scope 3 emissions 2014 omitted staff and student commuting as “insignificant” (Cambridge, p.3, 2014) including overseas student travel emissions. Whereas, Scope 3 emissions at Dell Corporation is the dominant driver of Dell’s supply chain total carbon footprint (Greenbiz, 2012)

Zhang et al (2014) emphasised that environmental reporting is essential to deflect criticisms and intense scrutiny from environmental pressure groups that can similarly be applicable to HEIs. However, many organisations do not have the resources both technically and financially as (Thurston and Eckelman, 2011 and Levy and Marans, 2011) had indicated for reporting their carbon emissions. Altan (2010) stated that HEIs carbon reporting had lacked clear and concise reporting formats, difficulties concerning the carbon quantification issues and difficulties in establishing assessment boundaries. Chicco and Stephenson (2012) had remarked that carbon reporting had been hampered by organisations’ lack of an environmental managements systems and accounting boundaries for effectively measuring, benchmarking and evaluating the impact of carbon emissions.

Altan (2010) research on energy efficiencies in UK Universities remarked that setting carbon emissions targets would provide the impetus for the development of environmental management practices. However, Huang et al (2009) reiterated that at a practical level, Scope 3(Travel) emissions targets does not take into account the extent to which transport demand patterns change in the future. Downie and Stubbs (2013) pointed out that setting Organisational carbon targets enables practical attainable emissions reductions as well as efficiencies and improving environmental management benefits by effectively measuring, evaluating and reporting the impact of the different carbon reduction policies and regulations in the future.

The EU Parliament on 15 April 2014 adopted the directive on disclosure of non-financial and other information by large Organisations concerning carbon emissions, climate change and sustainable development (Eu, 2014). The EU directive requires additional disclosures of the impacts of climate change risks on organisations, respect for human rights, money laundering together with corporate governance issues. These reporting procedures were the EU's own ratifying responses to the UN Global Compact Reporting Initiatives (UnGlobal, 2013). The other EU proponent for Scope 3 (Travel) reporting for organisations is the German Sustainability Code [EFFAS E02-01] (German, 2011) that had limited impact.

Global Reporting Initiative G4(GRI) has increasing become the most comprehensive reporting guidance available which has evolved into its 4th generation of reporting guidelines (Globalreporting, 2013). GRI has been developed using a consensus based, multi stakeholder processes and usable by organisations of all sizes, industry sector or geographical location. Wilburn and Wilburn (2013) reported that GRIs are strategically allied to the United Nations Global Compact (UNGC)(Unglobal, 2013), the United Nations Environment Programme 1972 (UNEP)(Unep, 2014) and the Organisation for Economic Cooperation and Development (OECD)(Oecd, 2014) by collaborating with eighty per cent of the Global 500 companies to producing non-financial reports. In summary, GRI’s guidelines contain Standard Disclosures and Performance Indicators (SDPI)(Globalreporting, 2013) that cover a full range of carbon reporting issues that are sector specific including Scope 3 (Travel) and other Scope 1, 2 and 3 emissions. The guidelines encourage organisations to undertake carbon data capture and reporting information to key stakeholders (Globalreporting, 2013).

The Global Reporting Initiative (G4 Sustainability Reporting Guidelines) (Globalreporting, 2013) is made of two parts. Part 1 – Reporting Principles and Part 2 – Standard Disclosures concerning reporting and disclosures on management approaches and key performance indicators (attributable to sustainable development, environmental management, labour practices, human rights, product liability and respect to human society).

- Part 1- The reporting principles consists of the generally accepted reporting frameworks. The main principles involve defining the report content and ensuring quality of the reported information (Globalreporting, p.3, 2011).

- Part 2 – Reporting of management approaches concerning environmental goals and performance relevant of the environmental aspects that are organisational and sector specific in addition to GRI Performance Indicators (Globalreporting, p.27, 2011).

Hahn and Kuhnen (2013) stated that GRI recommended G4 Sustainability Reporting Guidelines assisting organisations to setting goals and measuring performance on environmental impacts. They also recommended that the GRI-G4 is a framework that allows information to be independently audited, comparable and benchmarking. Skouloudis et al (2007) and Levy et al (2010) indicated that GRI Reporting Standards are the most popular reporting guideline that corporations are adopting. Levy et al (2010) indicated that the GRI's core strategy has been to institutionalise Non-Financial Reporting (Sustainable Development and Climate Change Impacts) similarly as audited financial reporting. Following the initial success, GRI is losing momentum constrained by the lack of detailed information demanded by certain stakeholders and quantifiable measures sought by others (Levy et al, 2010). Fonseca et al (2014) stated that GRI G4 had created a link between Financial Accounting Standards Board Reporting, Non-Financial Reporting and institutionalised Corporate Governance.

In 2009, DEFRA published its first guidelines on emissions reporting by providing carbon intensity factors used for calculating carbon emissions on a range of energy consumption activities. In 2013, DEFRA published its 2013 GHG carbon intensity factors for use from January 2015 (Defra3, 2013). Carbon intensity factors are predetermined CO2 emissions factors used for the calculation of carbon emissions when one unit of energy/monetary is consumed. For Scope 3 (Travel) travel, UK mode activities (air, train, car or bus) carbon emissions are based on the distance travelled or fuel consumed, multiplied by the intensity factor to give the total carbon emission (Defra, 2009).

HEIs' reporting mechanisms must adopt DEFRA's carbon intensity factors for reporting carbon emissions (Defra3, 2013). DEFRA's (Ukconversion, 2014), carbon intensity factors converts 'travel data' such as distance travelled from litres of fuel consumed into carbon emissions. Using carbon intensity factors developed by

DEFRA as a ‘standard’ would provide specific metrics covering all activities of HEIs to standardise their carbon footprint calculations within the HE Sector. This standardisation allows for comparisons of carbon mitigation performances over a period of time with similarly sized HEIs. These intensity factors used for the quantification of carbon emissions can be externally verified and reviewed by the organisation’s external auditors for stakeholder confidence (Defra, 2009).

In 2012, DEFRA’s publication – ‘Reporting Guidance for Business on Key Environmental Performance Indicators: a consultation on guidance for UK business’ (Defra, 2012a). In this publication, DEFRA emphasised seven reporting principles, which are: relevance, quantitative, measurable KPIs, accuracy, completeness, consistency, comparability and transparency but provided no further interpretation or examples. With the absence of firm guidelines had caused HEIs to postpone reporting their carbon foot prints and especially Scope 3 (Travel) carbon emissions due to its complexities. DEFRA (Defra, p.9, 2012) has stated that “KPIs should be quantifiable measurements that reflect the environmental performances” of an organisation and as such KPIs would mitigate the need for lengthy reports. These KPIs would be summative values that are easy to understand by stakeholders. However, Downie and Stubbs (2013) argued that DEFRA (Defra, pp.66-69, 2012) offered no descriptive methodologies for the quantification of KPIs, especially reporting of HEI Scope 3 (Travel) carbon emissions. Prado-Lorenzo et al (2009) stated that guidelines for additional environmental reporting information and the principles for compliances by worldwide companies were also vague. Stephens and Graham (2010) proposed that HEIs required more detailed information concerning complying with these new emissions reporting regulations, whilst stakeholders are increasingly demanding more complete voluntary environmental disclosures within

HEI annual reports and financial statements. Sullivan and Gouldson (2012) argued that no reporting guidance has been provided concerning organisational boundaries, scoping, intensity factors, identification of risks and opportunities. Olson (2010) and Haigh and Shapiro (2012) proposed that organisations are increasingly undertaking measures towards emissions reporting requirements and ensuring that their current practices reflect the new guidelines. Tipper (2013) had stated that 'the statutory significance of environmental reporting' has now been elevated to the same level as required from published financial information. On the whole, HEIs will not only require assurances that Scope 3 (Travel) and other carbon emissions are reported correctly but also a thorough understanding of how these carbon emissions are broken down across the HEIs'.

Deloittes Consulting (in Lander et al, 2011) stated that HEIs emit significant carbon emissions consuming a significant portion of their funding income on energy. They had identified that many HEIs have a poor understanding concerning their carbon emissions and had no skills or knowledge for reporting their carbon emissions. Many HEIs are unaware of their total Scope 3 (Travel) carbon emissions and where and how each type of carbon emissions is being emitted and hence are unable to undertake any reporting initiatives (Townsend and Barrett, 2015). Lander et al (2011) indicated that reporting and actively managing carbon emission would have significant management benefits and helps promoting the ethos of sustainability throughout the university.

The scope for corporate carbon and environmental reporting is expanding with climate change becoming increasingly a major concern in recent years (Huang et al, 2009) and also with HEIs. DEFRA (Defra3, 2013) had promoted the benefits of reporting environmental performance that would translate to lower resource costs, better understanding of climate risks, leadership and organisational goals. This can be applicable to strengthening HEIs' green credentials.

There are various global organisations and initiatives concerning environmental disclosures and reporting, such as the Climate Disclosure Standards Board (CDSB)(Cdsb, 2013) ; Carbon Disclosure Project (CDP)(Cdp, 2010) ; the Coalition for Environmentally Responsible Economies 2002 (CERES)(Ceres, 2014); the Global Framework for Climate Risk Disclosure 2006 (GFCRD) (Unepfi, 2006) and the World Business Council for Sustainable Development (WBCSD)(Wbcsd, 2014). These non profit organisations are developing to providing carbon emissions reporting guidelines for organisations and industry sectors including the HE Sector.

In 2007, The Climate Disclosure Standards Board (CDSB)(Cdsb, 2013) was established at the World Economic Forum. In September 2010, CDSB recommended a voluntary reporting framework presenting climate change related information that is related to the financial performance of a company. These frameworks present guidance statements adopting existing reporting standards (i.e. GHG Protocol Reporting Standard and Global Reporting Initiatives). The framework places emphasis for benchmarking and analysing risks associated with climate change including the "governance processes affecting climate change" (Cdsb, p.21, 2013). CDSB reporting framework focuses disclosures within company annual reports, carbon footprints, evaluation of the physical risks of climate change, evaluation of the regulatory risks, threats and opportunities derived from climate change and strategic analysis of climate and emissions management (Cdsb, 2013).

The CDSB principal reporting guidance (Cdsb, 2014) are:

- Encouraging standardisation to organisational accounting boundary settings in mainstream reporting for non-financial reporting facilitating investors to the funding of sustainable development.
- Adopting international financial reporting and GHG Protocol Standards.
- Encouraging financial institutions and other organisations for more climate change related information and accounting boundaries suitable to investors.

Andrew and Cortese (2013) stated that the CDSB reporting logic that underpins climate change and policy had provided little insight into the environmental disclosure regimes that the Standard proposes. Ascuii and Lovell (2012) was of the opinion that there had been an absence of articulated emergent disclosures from the CDSB, who have no pressure in doing so.

Integrated with the CDSB is the Carbon Disclosure Project (CDP)(Cdp, 2015), CDP encourages organisations to use the empirical measurements and environmental disclosures to improving the management of environmental risks. CDP leverages market forces and stakeholder empowerment encouraging organisations to measure and disclose their environmental impact assessment. CDP encourages reporting transparencies, accountability and the management of environmental risks facilitating investors to better mitigate their risks, secure opportunities and encourage action towards a more sustainable world (Cdp. 2013)

CDP key reporting recommendations are (Cdp. 2013):

- CDP provides an “independent credible rating system to benchmark corporate disclose and performance on environmental stewardship” (Cdp p.4, 2013). CDP presents ‘performance bands’ and climate performance leadership index’

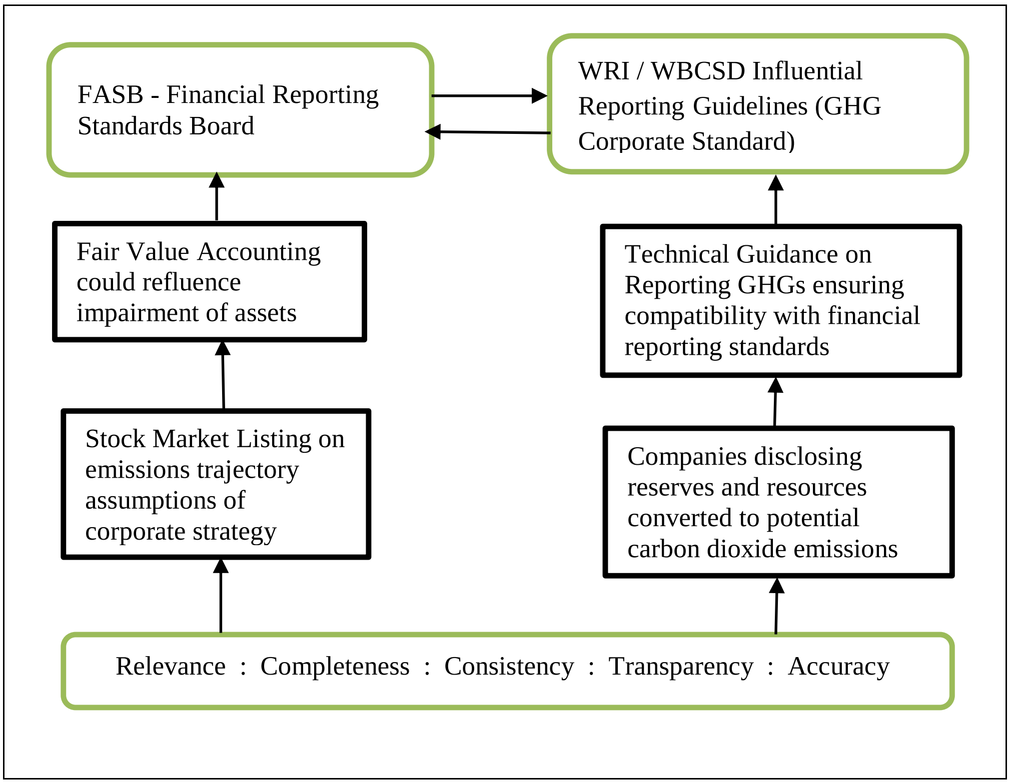
- CDP recommends organisations to disclose business critical water impact information and water stewardship strategies (Cdp, p.7, 2013)
- CDP recommends organisation to disclose deforestation for the growing agricultural commodities and preventing dangerous climate change from the GHGs (Cdp, p.9, 2013).

Kolk et al (2008) stated that CDP promoting effective guidance and communication presents challenges to the level of disclosure reporting for investors to evaluating the financial impact of carbon mitigation activities, reliability of the data and lack of standardised reporting formats to improving comparability. Andrew and Cortese (2011) stated that CDP reporting has less emphasis on actual emissions, measurement and governance issues. They also emphasised that quantitative financial information has had mixed results with regard to interpretation of climate change risks. However, Knox-Hayes and Levy (2011) were more optimistic, that the CDP has recommended strategic disclosures in ways that appeal to multitude of stakeholders and developing legitimacy for reporting climate governance standards with corporate accountability. But, they also critiqued CDP's positioning of disclosures had resulted many corporations resisting 'instructional managerialism' of governance.

The Association of Chartered Certified Accountants (ACCA) recommended the establishment of a Generally-Accepted Carbon Accounting Principles (GACAP)(Acca, 2010). The ACCA has promoted greater transparency for Organisations to promote carbon emissions and sustainability reporting worldwide through its membership and has provided guidelines for organisations in providing non-financial information to investors concerning climate change (Acca, 2010).

However, these proposals were not definitive and the ACCA document was not focused on reporting standards that could be developed by the International Accounting Standards Board. Diagram 11 below, illustrates the relationship of the Financial Reporting Framework for Reporting and the GHG Corporate Standard.

Diagram 11 - Financial Accounting Reporting and GHG Corporate Standard Framework



Developed by the researcher (Chelliah, 2015)

Financial Reporting Standards are primarily concerned with fair value assets statements and presenting carbon emissions statements concerning the company's business risks (Acca, 2010). The GHG Protocol Standard provides standards and guidelines to organisations in preparing their GHG emissions inventory is a 'true and fair account' of their emissions. Ghg (2012b) stated that the guidelines offer simplification in compiling a GHG inventory and provides information for formulating effective strategies to manage and reduce GHG emissions. GHG accounting and reporting principles similar to accounting reporting standards are the principles of relevance, completeness, consistency, transparency and accuracy. Bebbington and Gonzalez (2008) stated that there could be confusion on the rational of measurement and reporting mismatches that would result in an artificial volatility of results in companies. However, the International Financial Reporting Standard number 13 recommended that fair value measurement be used (Deloitte, 2015). Bebbington and Gonzalez (2008) stated that there must be more informational requirements ‘further’ that just accounting and reporting to reflect the measurement and risks associated with GHGs and offer a mechanism to decision makers to understand the possible effects of GHG emissions on corporate performance and prospects. Stern (2006) had earlier suggested economic analysis of GHG emissions to be global and to be dealt with long time frame horizons.

The Walker Review (Governance, 2009) and the Financial Reporting Council in the United Kingdom (Frc, 2012) have promoted a ‘stewardship code’ that required institutional investors to engage actively with their investee companies to improving corporate governance. The code did not specify carbon emission per se but Principle 3 (Frc, p.7, 2012) of the code encompasses that, institutional investors should know about the investee company’s carbon performance with full and fair disclosure of their carbon emissions and impacts to society and profitability.

Kruse and Lundbergh (2010) and Eccles et al (2010) stated that reporting environmental sustainability and carbon emissions are an evolution of responsible stewardship and corporate governance. This governance can also be strategically applicable to HEIs. Tilbury (2011) proposed that carbon emission reporting could lead to enhanced reputation and brand recognition, improved customer loyalty and supply chain management. Reporting was more than just bits of paper as Cotton and

Winter (2010) argued, that transparent reporting can drive down costs by highlighting carbon performance and efficiency savings, and helping to minimise business risks.

Apart from the disclosures and reporting initiatives taken by global organisations, UK HEIs compliance to carbon reporting are strongly driven by external legal and economic pressures (Hopkinson, 2011). Andrew and Cortese (2013) proposed the using the various disclosure frameworks, as self-regulation could be adapted by each organisation’s specific needs. However, none of the proposed carbon reporting frameworks are applicable to HEIs in terms of carbon reporting formats and standards and clarifying carbon emissions governance practices HEIs should disclose when reporting.

Presently there is no credible standard available concerning as to how HEIs’ should identify and report relevant information concerning their Scope 3 (Travel) carbon emissions. Without a credible standard, carbon emissions reporting pronouncements available would be inconsistent without sufficient details nor guidance concerning any carbon mitigation strategies (Ascui and Lovell, 2012). Wilburn and Wilburn (2013) noted that currently, the emphasis of those driving carbon emissions reporting is increasing, by virtue of legislative or compliance pressures by HEFCE and other stakeholder demands. As a result of these external pressures, James and Card (2012) stated that although HEIs have begun understanding and implementing environmental measures for reporting their environmental policies and operations.

2.7 RESEARCH GAPS AND QUESTIONS DEVELOPMENT FROM LITERATURE REVIEW

This literature review above has been able to identify the gaps that has been obtained from the body of knowledge concerning the management, quantification and reporting practices of Scope 3 (Travel) carbon emissions at HEIs in England with reference to this research. This research analysis on the literature review (Table 3, below) identified the SWOT knowledge gaps including EMS gap inefficiencies (mRating). The literature review synthesis has been analysed into six focus categories for the development and formulating the relevant five Research Questions (Table 1, p.32) including SWOT and mRating Questionnaire Development (Tables 12, A-D)(pp.178-181).

Table 3 - Development of research questions from knowledge gaps (including SWOT & mRating questionnaire development) identified from published references

Research Focus (searches in Science Direct and Emeraldinsight databases)	**Literature Review Review Analysis and Focus**	**Identified Research Gaps** (including SWOT & mRating Questionnaire Development)	**Supporting Published References supporting the research gaps.** (Referenced in Bibliography pp.420-480)
1. Scope 3 (Travel) carbon emissions Developed Research Question 2, 3, 4 and 5 (p.32)	- Identification and definition of Scope 3 (Travel) - Identification of Scope 3 (Travel) quantification models - Identification of EMS in the HE Sector	- Absence of guidance and appropriate models for carbon accounting - No EMS implementation - No carbon emissions benchmarking	Ghg (2013c), Liou (2015), Altan (2010), Bowen and Wittneben (2011), Carbon Trust (2014), Finlay and Massey (2011), Ghg (2013c), Ghgreporting (2011). Hefce4 (2012), Hefce12 (2012), Huang et al (2009), Vasquez et al (2015), Wass et al (2010), York (2012)
2. Framework for the quantification of	- Identification or recommendations from stakeholders	- HESA, requires HEIs to report	Beringer (2006), Ghg (2013c), Downie and Stubbs (2013), Stephena

Scope 3 (Travel) carbon emissions Developed Research Questions 2, 3, 4 and 5	and HEFCE for voluntary reporting - Identification of EMS applicable to the HE Sector	Scope 3 (Travel) from 2014. - Absence of formalised EMS for carbon emissions accountability - Absence of sustainability indexes for travel	and Graham (2010), Alshuwaikhat and Abubakar (2008), Andrew and Cortese (2011), Cdsb (2013), Fadzil et al (2012), Ferras-Balas et al (2008), Gomez et al (2014), Halila and Tell (2013), Jain and Pant (2010), James and Card (2012), Sammalisto and Brorson (2008), Savely et al (2007), Wright (2011)
3. Corporate responsibility & sustainability reporting Developed Research Questions 3, 4 and 5 (p.32)	- Identificagtion or significant reflection of UK legal requirements and limited voluntary reporting information	- Limited empirical and quantification methodology - Absence of Scope 3 (Travel) reporting formats - Absence of sustainability index reporting as part of enhance reporting	Bebbington and Gonzalez (2008), Townsend and Barrett (2015), Heras – Saizarbitoria et al (2013), Alazzi and Wan-Hussin (2013), Apergis et al (2013), Defra (2012), Ferreira et al (2006), Hefce5 (2012), Herremans and Allwright (2000), Lozano (2011). Lozano et al (2013)
4. Higher Education Sector carbon targets set eg. by the Companies Act 2013 Developed Research Questions 3, 4 and 5 (p.32)	Importance of Higher Education Institutes complying to the UK carbon target	- Absence of comprehensive polices on Scope 3 (Travel) reporting to stakeholders'	Evangelinos et al (2009), Hensher (2008), Rauch and Newman (2009), Bangay and Blum (2010), Waheed et al (2011), Noeke (2000) Ccc (2008), Climate Change (2010), Econometrica (2013), Wigmore and Ruiz (2010), Eu (2014), Foo (2013), Ghg (2012b), Hefce6a (2010), Hefce10 (2012), Hefce13 (2013), Ozawa-Meida et al (2013), Rauch and Newman (2009)
5. Higher Education Sector corporate governance	- Identification of theories and recommendations	- Gaps in empirical reporting	Vasquez et al (2015), Klein -Banai and Theis (2011), Alonso – Almeida (2015), Robinson et al

Developed Research Questions 4 and 5 (p.32)			(2015), Bouten and Hoozee (2013), Corporate (2013), Hefce7 (2009), Too and Bajracharya (2015), Larsen et al (2013), Levy and Marans (2011), Lukman et al (2010), Saadatian et al (2013)
6. Higher Education Sector Scope 3 (Travel) sustainability Developed Research Questions 2, 3, 4 and 5 (p.32)	- Indentification of quatification theories and applications	- Gaps identified in determining Scope 3 (Travel) carbon benchmarking and abatement strategies - Absence of Travel Sustainability Index	Marimon et al (2012), Abolarin et al (2013), Barnes and Jerman (2012), Suwartha and Sari (2013), Beringer et al (2008), Bilodean et al (2014), Brinkhurst et al (2011), Chicco and Stephenson (2012), Townsend and Barrett (2015), Robinson et al (2015), 302Fein (2012), Geng et al (2013), Globalreporting (2013), Gov (2013a), Peopleandplanet (2006), Hancock and Nuttman (2014), Hefce2 (2009), Hefce8 (2010), Kamal and Asmuss (2013). Latrobe (2014)

Source – Developed for this research (Chelliah, 2015)

This literature review provided the necessary gap analysis information as described in Table 3 above and formulating the five research questions as presented in Chapter 1.2, p.32 focusing on the managing, accountability, quantification and the reporting of Scope 3 (Travel) carbon emissions in the HE Sector. A review of the prior background research undertaken by other universities (p.28) had only provided limited understanding of Scope 3 (Travel) management and accountability, indicating that more research may be undertaken. Table 3 has four categories of tabular analysis. The first column describes the research focus of the researcher to identifying the published literature within the domain to enable the researcher to determine any research gaps. The researcher utilised an internet search of published literature within Sciencedirect.com and Emeraldinsight.com which are large reference data bases. Column 2 identifies the literature review analysis and focus. This feature enables the researcher to narrow down the specific gaps and inferences that had been synthesised from the literature. Column 3 presents the key synthesised knowledge and management systems gaps identified. The management system gaps synthesis represents the SWOT and mRating also derived from the literature. Column 4 presents the published references. Column 1 identifies the research questionnaire development that has been synthesised from the literature review.

Based on the management systems deficiencies synthesised from the published literature from Table 3 (pp.122-124). This research's SWOT and mRating questionnaires will be focusing on carbon emissions accountability, issues concerning the effectiveness of NTU's EMS, empirical measurements of the EMS efficiencies and followed by carbon reporting for legal compliances, stakeholder demands and environmental management decision making processes (Rowley, 2014 and Bilodeau et al, 2014). The research questions will also be investigating the legal reporting requirements, reasons for justifying the quantification of Scope 3 carbon emissions, carbon bench marking, and stakeholder demands to determining the effectiveness of campus environmental management systems. Other research questions relate to NTU's campus Scope 3 (Travel) environmental performance index and other management practices regarding measurements of key performance indicators.

The following are the explanations for the formulation of the research questions from the literature review gap analysis (Table 3, pp.122-124):

- *Research Question 1 - What are HEFCE and legal requirements for the accounting management and reporting of Scope 3 (Travel) carbon emissions for the HE Sector"?*

- The literature review suggested that HEIs must report their total carbon footprint and there are several frameworks available for reporting. There are no specific emerging legal, accounting or reporting of Scope 3 (Travel) in conformity to legal legislations or to HESA. Scope 3 emissions are not mandatory as per the CA2013. Scope 3 reporting to HESA commenced in 2015 and no research was available nor voluntary reporting by other Sectors.

- *Research Question 2 - What are the 'best practices' either in the Public or Private Sector concerning Scope 3 (Travel) carbon emissions quantification and reporting applicable to the HE Sector"?*

- The literature review suggests that there are no reporting requirements for Scope 3 carbon emissions from the Companies Act 2006 (Regulation 2013). Global Reporting Initiatives and Greenhouse Gas Protocol provided guidance of Scope 3 Travel emissions but with limited details or formats. However, HEFCE had pushed the boundaries of leadership requiring HEIs to report Scope 3 emissions but also there had been no appropriate formats specific to HEIs to report Scope 3 Travel carbon emissions or performances.

- *Question 3 - What are NTU's Scope 3 (Travel) carbon emissions information processes, management systems and procedures that are recommended for complying with HEFCE compliance recommendations that contribute to efficient carbon reduction management?*

- The literature review suggests that, HEIs must state their environmental policies and carbon emissions reductions procedures. However, no research to date has examined HEI disclosure practices to implementing carbon abatement policies to addressing HEFCE's carbon reduction targets of 43% percent below their 2005 base year emissions by 2020. There have been no longitudinal studies that investigates HEIs for carbon emissions disclosures within the HE Sector climate change governance contexts and issues.

- *Question 4 – What and how efficient are NTU's current Scope 3 (Travel) carbon emissions for the following?*
  (a) carbon emissions management accounting
  (b) carbon data capture
  (c) carbon emissions reporting to stakeholders

- The literature review suggests that HEIs will have to have an environmental management system that provides the necessary collation of carbon data enabling monitoring the effectiveness of an EMS. Despite the perceived expectations from Stakeholders for credible, authentic and transparent carbon emissions information. There is a complete absence of research investigating what types of information stakeholders require. HEFCE has recommended that all HEIs implement an appropriate EMS. HEIs have no carbon emissions reporting formats to comply with HESA, Companies Act 2006 (Regulation 2013) and Global Reporting Initiatives.

- *Question 5 - What are NTU's Scope 3 (Travel) carbon emissions quantification tool recommended for adoption by NTU as best practice for the following?*
  (a) carbon footprint accounting
  (b) tracking NTU's carbon emissions reduction against HEFCE carbon reduction targets

- The literature review suggests that environmental management quantification tools are essential for HEIs carbon foot printing, benchmarking, planning and management of their Scope 3 (Travel) carbon emissions reductions. However, whilst there only a limited number of reporting frameworks, these frameworks fail to establish the climate change related disclosure framework within HEI governance context and environmental sustainability disclosure indices.

2.8 CONCLUSION

This literature review had presented that within the HE Sector Scope 3 (Travel) emissions abatement are important management disciplines for campus corporate governance and reporting. The review discussed several governance models and reporting frameworks, each having a different applicability but none was specifically applicable to HEIs. (Spangenberg, 2002 ; Nikolaou and Evangelinos, 2010 ; Fonseca et al, 2014). The literature review presented the research gaps within the body of knowledge concerning HEIs Scope 3 (Travel) quantification, management and reporting. This led to this thesis's developing a theoretical framework, research questions, research aims and objectives. The literature reviews also served to establish the research gaps on HEIs environmental management system attributes and factors that would provide a management development contribution to shape the successful and effective use of a reporting model.

HEFCE and HESA reporting requirements exceed the legal requirements as per the Companies Act 2006 (Regulation 2013) for reporting Scope 1, 2 but also Scope 3 underpinning this research as to the compliance by HEIs' to disclose their GHG total carbon footprint quantum. HEFCE additional requirements is that HEIs are centres of research and there are benefits from disclosing their carbon footprint to showing leadership, securing research grants, indicative of greater GHG accountability and transparencies to meeting the requirements of the Climate Change Act, 2008

The management, accountability and reporting of Scope 3 (Travel) carbon emissions including sustainability reporting as a whole, still remains in its infancy. This is despite the recommendations by HEFCE, GHG Protocol, GRI, CDP and CDSB.

However, quantification tools are the necessity, in order to enable tracking carbon emissions performance management and emissions data drives the analysis for carbon abatement strategies (Townsend and Barrett, 2015). The literature review presents a case that comprehensive assessments and Scope 3 (Travel) carbon emissions are important sources to be accounted for as part of the HEIs' carbon footprint reporting and not as piecemeal reporting of Scope 1 and 2 and voluntary reporting of Scope 3 emissions. The HE Sector should be transparent for the purposes of reporting their total carbon footprint for comparison purposes.

This chapter had reviewed the various literature on this research's focus topic to confirm the research relevance to answering the research problem. Selected published literature was synthesised to identifying the knowledge and management systems gaps within the knowledge domain. This led to the developed of SWOT and mRating semi structured questionnaires for evaluating NTU's EMS operational state and efficiencies that generated qualitative to quantitative research perspectives and the development of R-Scores (p.267) for EMS management decision making.

The research questions developed provided a research focussed framework to designing specific methodologies to elicit the appropriate data for interpretation and inferences in answering the research questions.

There are limited peer reviewed studies on Scope 3 (Travel) carbon emissions with regard to the management, quantification and reporting by Universities in the UK and elsewhere.

CHAPTER 3. RESEARCH DESIGN AND METHODOLOGY

SUMMARY

Previously, chapter 2 presented the synthesis of the literature review for the development of the research questions and scoped literature of this research's focus. This chapter 3 presents the research's concepts, philosophies underpinning the theoretical assumptions, research paradigms, research design and action research design. Development of new environmental management systems, development of new quantification tools and UniCarbon Index methodologies for answering the research questions and problem solving.

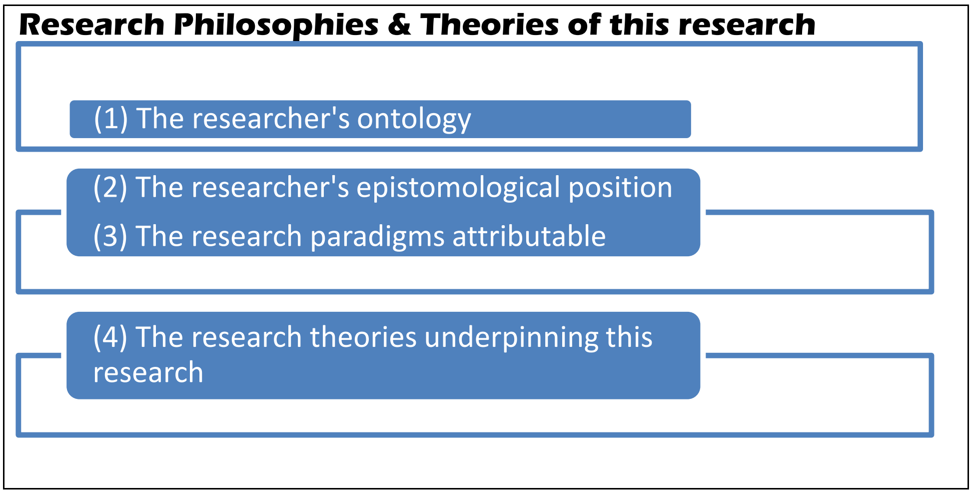
This chapter presents the methodologies applied for extricating the research data for analysis, and discussions.

3.0 INTRODUCTION

This chapter will be introducing the research philosophies, paradigms and theories that determine how this research is conducted (Pansari, 2009). The chapter presents discussions on the research design, paradigms, methodological tools and describing the justification of the use of the selected tool for data collection analysis, discussions and recommendations. The research philosophical planning concerns the ontological, epistemological issues, paradigmatic assumptions and theories that shape the research field. This research's plan will be focussing on the practical mechanisms of involving the collaborative action research practical issues with managerial relevance (e.g. managing and quantification of Scope 3 (Travel) carbon emissions.

This chapter presents in Figure 2, p.131 the research philosophies design framework underpinning this research. This framework presents the philosophical underpinnings of the research by describing (1) the ontology (2) the epistemology (3) the paradigms attributable (4) the research theories underpinning this research.

Figure 2 - The Research Design Framework



These research philosophies are the foundations which the researcher will be adopting as paradigmatic assumptions to determine the mechanics of the research undertaking. Gilbert (2007) stated that research philosophies are one of the ingredients in management research and influence valuable outcomes.

This chapter discusses the research paradigms, research theories, research design frameworks and the research planning undertaken to answer the research questions. Data collections instruments, data quality and integrity and the researcher’s justification for choosing an appropriate methodology are discussed.

The researcher presents the research design framework for the action research committee (p.156) and discusses the research design selection of action research as part of this NTU case study and other appropriate methodologies to fulfilling the aims of this research study. The researcher also discusses the research quality, minimising errors, data reliability and validity. Lastly, the researcher presents the ethical considerations applied for undertaking the online travel survey.

This research's methodological rationale involved the application of specific procedures and techniques used to identify, evaluate and analyse data to understanding the research problems, thereby enabling the researcher to critically evaluate the research's overall validity and reliability. This research's methodology focusses on the mechanisms of how the data was collected or generated and subsequently analysed to developing inferences to answering the research problems and generating new knowledge and management processes. The research methodological selections reflect the researcher's ontological and epistemological assumptions. The methodology chosen will be justified and described by detailing the procedures and methodologies that had been applied for the elicitation of environmental management systems and Scope 3 (Travel) emissions data when investigating the research questions.

This research design refers to the overall strategy specifically planned that is determined by the research problem. To enable the problem solving, the researcher will choose and integrate the different components of the research in a coherent and logical way, thereby, ensuring that the researcher had effectively answered the research problems. This research's design constitutes a guide framework for the collection, measurement and analysis of data. This research's design function is to ensure that specific relevant research evidence is secured that enables the researcher to effectively address the research problem in a logical framework.

This chapter is divided into eighteen sections as follows:

- Section 3.1 describes the ontologies relating to this research
- Section 3.2 describes the various epistemologies attributable to this research
- Section 3.3 presents and describes the research paradigms as applied to this research.
- Section 3.4 describes the theories underpinning this research
- Section 3.5 describes the research design outline
- Section 3.6 describes establishing the action research committee as a collaborative research design methodology
- Section 3.7 describes the action research as used in this research
- Section 3.8 presents and describes the SWOT design and methodology
- Section 3.9 describes mRating value scale methodology
- Section 3.10 described the Scope 3 (Travel) carbon emissions quantification methodology
- Section 3.11 describes the Scope 3 (Travel) environmental performance index methodology
- Section 3.12 describes the reporting of Scope 3 (Travel) carbon emissions
- Section 3.13 describes the internet travel survey used in this research
- Section 3.14 describes the mapping methodology used in this research
- Section 3.15 describes the research quality for minimising errors
- Section 3.16 presents and describes the data collection and analysis in this research
- Section 3.17 describes the ethical considerations of this research
- Section 3.18 describes the conclusions of this chapter

3.1 ONTOLOGY OF THIS RESEARCH

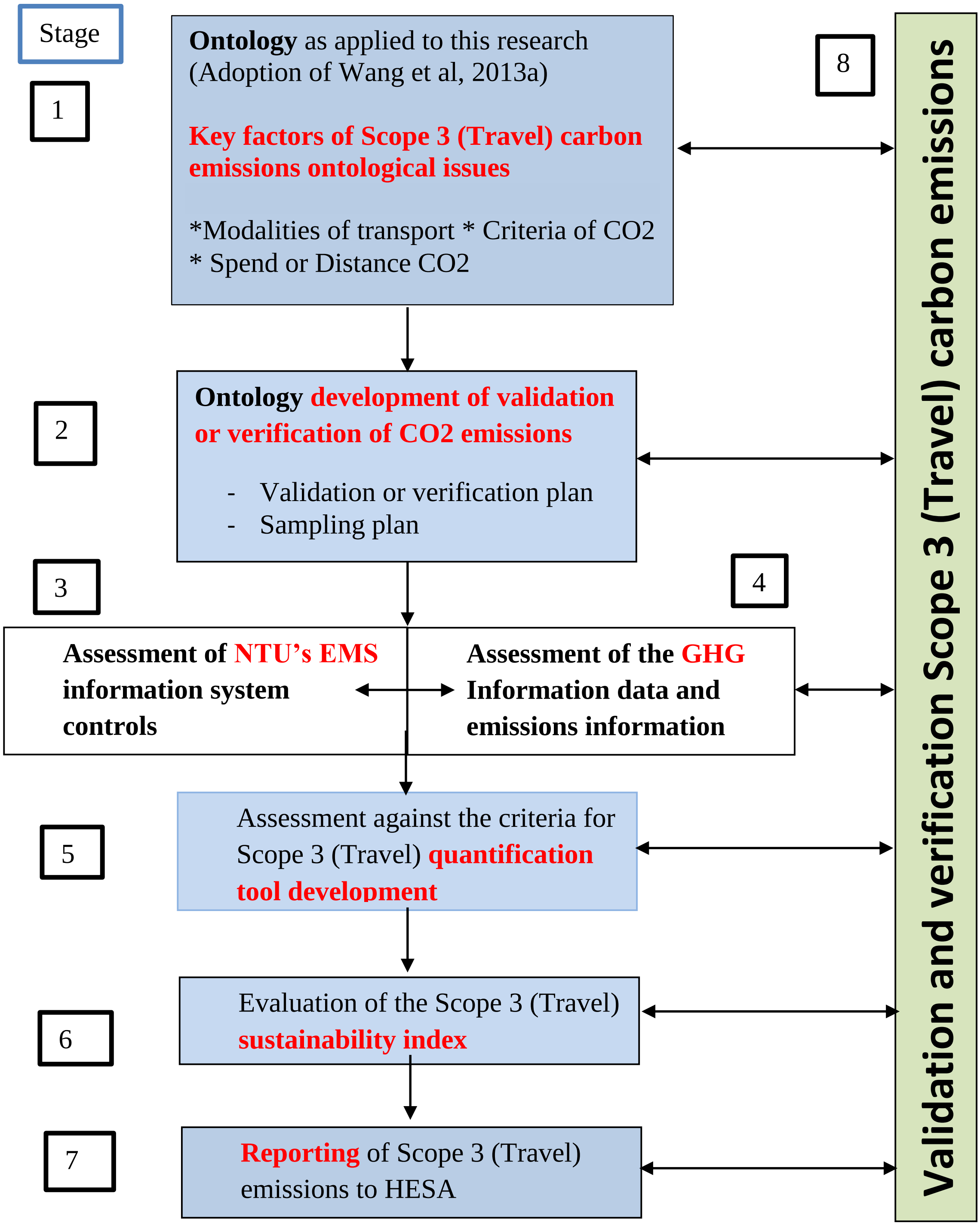
Ontology relates to research questions to whether an objective reality exists. This can be defined as the science of being (Bryman and Bell, 2007 and Blaikie, 2007)). Ontology is the fundamental assumption that is made about the knowledge and reality of 'what and how' it exists (Guba and Lincoln, 1994).

Ontologies (Gruber. 1993) are explained as key factors that represents specifications of conceptualisation and knowledge that could be understood, used and shared amongst applications and persons. (Gruber, p.1, 1993) describes ontology of a program by defining a "set of representational terms".

The ontological position of this research concerns the NTU Scope 3 (Travel) emissions and its accountability. Ontologically this research position is to evaluate whether the travel emissions are real and its accountability is objectively being measured. The objective perspective is the reality concerns for the quantification of Scope 3 (Travel) emissions can be tested. The subjective perspective involves the perceptions and interaction of NTU's EMS, travel survey, the UniCarbon Index for which this research can measure and test its accountability, whilst being a detached researcher.

Diagram 12 (p.135) presents stages (1) to (8) of the ontology of this research that follows Wang et al (2013a) views on ontology for undertaking research in a structured and chronological format. Wang et al, recommended a rule based ontology reasoning methodology described as (1) understanding 'what and how' Scope 3 (Travel) emissions knowledge structure expressed by ontology (2) the management and quantification of Scope 3 (Travel) carbon emissions is achieved by focussing decision mechanisms and discovering implicit decision knowledge from the ontology. This research's applied ontology position concerns knowledge acquisitions as to how to evaluate NTU's Scope 3 (Travel) EMS knowledge and the assumptions about the realities of Scope 3 (Travel) carbon emissions quantification, management and reporting.

Diagram 12 – Translating this research's ontology to its different processes



Application of the ontology to this research as described in Diagram 12 (p.135)

Stage 1	This research establishes the domain characteristics by determining the key Scope 3 (Travel) carbon emissions with respect to NTU's enterprise ontology i.e. carbon emissions identification, ontology analysis and knowledge development
Stage 2	This stage is the ontological verification and strategic planning of the research processes i.e. ontological constructive approach involving NTU as a case study
Stage 3	This stage represents the assessment criteria stages involving the input information analysis for the evaluation and development of NTU's EMS
Stage 4	This stage is the ontological analysis and knowledge identification of the GHGs
Stage 5	This stage represents the assessment criteria stages involving the input information analysis to extracting ontology primitives and matched to the criteria for the development of the quantification tool
Stage 6	In this evaluation stage, the specialised design methodology of adopting the STARS criteria ontology for the development of the Scope 3 travel sustainability index
Stage 7	The reporting mechanisms presents an enterprise ontology for NTU as knowledge and informational sharing and carbon emissions reporting development i.e. overseas students, staff and students travel
Stage 8	This is the ontology representation for the validation and verification for building Scope 3 (Travel) decision knowledge structures, ontology reasoning for decision making activities

3.2 EPISTEMOLOGY OF THIS RESEARCH

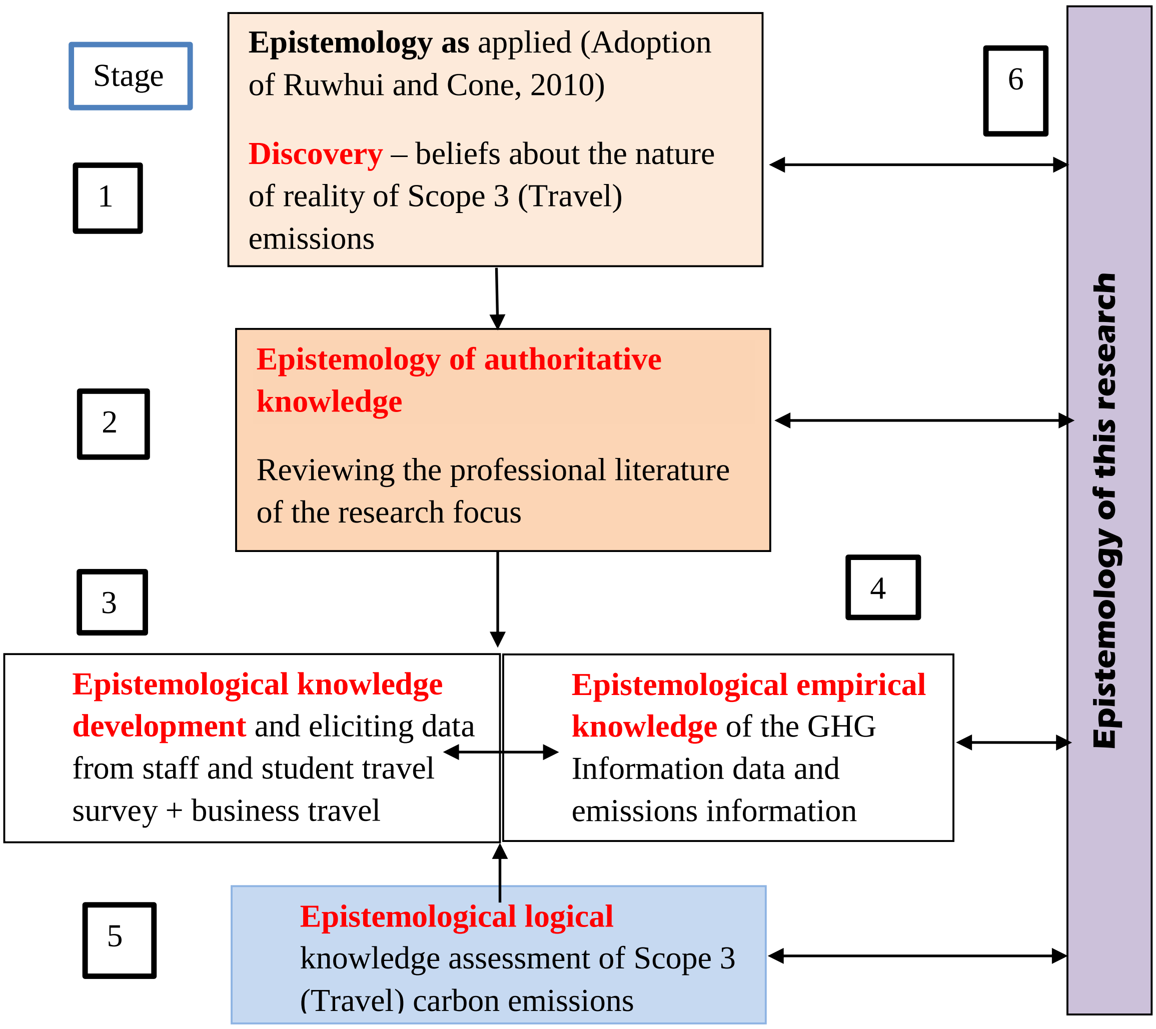
Epistemology can be described as a science devoted to the discovery of the appropriate processes of acquiring and validating knowledge (Rand, 1988). Plack (2005) described this as an understanding of what it entails in knowing in the existence of knowledge described as ‘how we know and what we know’. These are learning processes (Hensher, 2008 and Kohler et al, 2009). In other words, epistemology is the philosophical view that helps the researcher in explaining and justifying its epistemological stance (Petit and Huault, 2008 and Gray, 2009) and what data is acceptable (Gray, 2009 and Schwanen et al, 2011).

Epistemology is the philosophical grounding, its legitimacy and adequateness concerning the research (Blaikie, 2007 and Rayner, 2011). Epistemology used in this research refers to the ways in which it is possible to gain knowledge from the management, quantification and reporting of Scope 3 (Travel) carbon emissions using NTU as a case study.

This research adopts the pragmatism epistemology view of Ruwhiu and Cone (2010) adopting the characteristics of a pragmatic epistemology as a template for organisational practice. This Research’s epistemological adoption transcends to a viable positivist quantitative methodological approach for the quantification of Scope 3 (Travel) and interpretivists interpreting and understanding relationships with a qualitative perspective of NTU’s environmental management systems perspectives and efficiencies.

Diagram 13 (p.138) below represents the researcher’s epistemologist’s sources of knowledge applied to this research thesis. The primary epistemology of this research concerns the (1) discovery inquiry drawn from values, assumptions and beliefs about the nature of reality of Scope 3 (Travel) emissions requiring a philosophical framework (2) epistemology of the literature review of what constitutes knowledge from the literature review framework that is scientifically informed to this research (3) epistemology of knowledge development as an implicit view of reality (4) constructivism of the data elicitation for the travel survey and business travel i.e. logics, discourse, practices and empirical understanding and (5) rationalism of the epistemological logical assessment of the Scope 3 (Travel) carbon emissions i.e. understanding the relationship between different modes of theorising this research, and the worldviews it reflects.

Diagram 13 – Translating this research's epistemology to its different processes



3.3 THE RESEARCH PARADIGMS USED IN THIS RESEARCH

This case study has been guided by research paradigms for undertaking this research. The researcher had used paradigms that focuses and guides scientific investigation, apart from the manner in which a research is conducted, as how the researcher defines truth and reality (Loncar et al, 2014 and Minang and Van Noordwijk, 2013).

Applied in this research, specific applicable paradigms (Diagram 14) below have been used as guidance within this research for investigating the research questions proposed, the methodological design approaches and the different criteria for assessing the trustworthiness of the inquiry (Plack, 2005). This case study adopts a philosophical and theoretical framework to conducting this research as described in Diagram 14 below.

Diagram 14 – The Paradigms used in this research

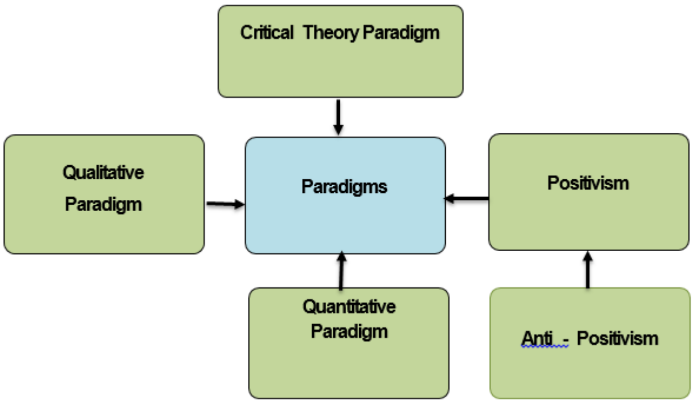


Diagram 14 (above), illustrates the various paradigms attributable to this research following Lukka (2010) and Sullivan and Gouldson (2012) statements that paradigms dealing with the investigation of the research questions consider the utility of the results emanating from such investigations. Different paradigms are used to define the problems of enquiry (Vaishnai and Kuechler, 2007 and Klenke, 2008).

The paradigms applied in this research are mechanisms that guides this research methodological collaborative case study research as a formalised set of practices. This research adopts a specific approach to gaining new knowledge and management practices as stated in the research questions (p.32). These research paradigms involve clusters of substantive concepts, variables, methodological tools and approaches that the researcher will be adopting to determining, how the research will be conducted (Guba and Lincoln, 1994 and Lukka, 2010).

3.3.1 THE RESEACH PARADIGMS USED IN THIS RESEARCH

(a) Positivism

The positivist paradigms used in this research emanate from exploring social realities and philosophical ideas proposed by French philosopher August Comte (In Martineau, 2000). In his book, 'Introduction to Positive Philosophy', Comte advocated observation and reasoning as true knowledge (Martineau, p.12, 2000). This research used a positivist research paradigm adopted by social scientists (Black, 1983 and Bahl and Milne, 2007) and involves precise empirical calculations (Wolf, 2008 and Wimmer and Dominick, 2013). This research used positivism as a pragmatic and objectivist approach to studying Scope 3 (Travel) modalities focusing on quantitative analysis (Badley, 2003). This research's positivists approach can be described as a focussed, rigid, and rigorous process which attempts to reach a clear objective to seeking the truth (Plack, 2005 and Thyer, 2008). Critics of this paradigm have stated that objectivity should be substituted by subjectivity in the methodology of scientific inquiry (Ratnatunga and Jones, 2012 and Wals and Jickling. 2012). Positivism has objectivity, measurability, predictability, controllability and constructs laws and rules of behaviour (Shelton et al, 2012 and Fein, 2012). This subsequently led to anti-positivism or naturalistic inquiry (Fein, 2012).

(b) Anti –positivism

Anti-positivism emphasises the phenomena that realities could be interpreted according to individual circumstance as being multi-faceted and complex paradigms (Cohen et al, 2011) and also having multiple interpretations (Rahim, 2013). Anti-positivism focusses a subjectivist approach to studying social phenomena and emphasises on a range of research techniques towards qualitative analysis, e.g. online surveys, open ended questionnaires. Anti-positivism emphasises understanding and interpreting meaning out of this process (Benton, 2013). Complementary to these two major paradigms led to the third paradigm of this research called critical theory.

Applied in this research from an independent stance ensures that the adoption of positivism will be in accordance with the principles of an empiricist perspective. This involves, Scope 3 (Travel) quantification being dependent on quantifiable data from NTU's SWOT and mRatings empirical data that is subjected to statistical factor analysis. This positivism research is limited to the data collection and interpretation by the researcher's objective analysis of the UK and overseas travel data, overseas students travel data and Scope 3 travel sustainability index data

3.3.2 CRITICAL THEORY PARADIGM

The principal proponent of this theory was Habermas (1996) who developed a particular approach of investigation in the social sciences that questioned and transformed the concept of rationality. Ross and Chiasson (2011) proposed that a practical understanding of the ‘research’ generates hermeneutic knowledge and an emancipating interest for the advancement of knowledge.

This research adoption of Hebermas’s theory addresses the concept of rationality. To support this claim, Habermas’s communicative theory is applied to the management, quantification and reporting of Scope 3 (Travel) carbon emissions. The application in this research involves using the internet to communicate with staff and students for conducting the travel survey to fostering iteration and reflection. SWOT and mRatings qualitative questionnaires evaluates the current NTU’s EMS perspectives.

Quantitative Theory applied in this research involves this research’s participatory action research actions undertaken collaboratively with the action research committee (p.156) promoting the grounding of knowledge concerning Scope 3 (Travel) accountability and management. The application is evidence based, problem solving orientation for the development and implementation of NTU’s hybrid EMS.

3.3.3 THE QUALITATIVE PARADIGM

The qualitative paradigm used in this research represents the action research committee’s qualitative approach when interpreting the contextual meanings, examining and reflecting from information, observations and interviews as used by (Berg, 2004 and Liamputtong, 2009) to understanding NTU’s EMS. This paradigm assumes that the truth being subjective which allows for the construction of multiple realities (Guba and Lincoln, 1994) and theory building (Maxwell, 2012). This paradigm is applied to this research’s qualitative travel survey. The qualitative analysis of this research’s travel survey data focuses a deeper understanding concerning evaluation transportation modes, distance travelled, monetary values dispensed and theory building (Maxwell, 2012). Henceforth, research in this qualitative environmental sustainability is irreducibly interpretive, subjective and not transparent (Westerman, 2014).

The qualitative perspective applied in this research involves the SWOT and mRatings questionnaires as described in Table 12 (pp.178-181) and for the development of NTU's new EMS (figures 4-9)(pp.277-284).

3.3.4 THE QUANTITATIVE PARADIGM

This research's quantitative approach is to provide an objective empirical analysis focusing on measuring and validating the data (Hjorland, 2005). This research applied Westerman (2014) quantitative empirical measurement methodologies by evaluating the Scope 3 (Travel) emissions source data for authenticity. Prion and Adamson (2013) stated that research is minimally interpretive that includes the key research processes of empirical measurement. This research adoption of this paradigm focusses of the quantification of Scope 3 (Travel) carbon emissions and carbon performance index that makes use of quantitative methods.

The quantitative perspective applied in this research involves the SWOT and mRatings questionnaires as described in Table 12 (pp.178-181) and for the development of NTU's new EMS (figures 4-9)(pp.277-284)

3.3.5 JUSTIFICATION FOR A MIXED METHODOLOGY APPROACH TO THIS RESEARCH STUDY

The concept of amalgamating research methods initially developed by Jick (1979) broadly also referred to as 'triangulation' by Flick (2004) as a research methodology from two different points. Numerous researchers have used mixed methods research primarily for recognising the value of the methodologies that can be applied to the different research viewpoints, data collection, combined strengths of quantitative and qualitative approaches and interpreting the methodologies different analytical mechanisms (Ostlund et al, 2011). Johnson et al (p.123, 2007) proposed that the “mixed methods research combines the elements of quantitative and qualitative research tools that offers a combination of different approaches each off setting biases to analysing the given phenomenon”. There are two major reasons for the increasing use of this methodology. Firstly, researchers are increasing in favour of the efficient use of both research approaches in conducting their research. Secondly, the weakness and strengths of both research methodologies presents researchers with more confidence in relying with the datasets as the best of both scenarios for data collection (Van Griensven et al, 2014).

Mixed methods research used in this case study had been most suited for the research design of interpreting the quantitative responses presented by researcher to the ARC i.e. SWOT and mRating value into quantitative empirical values. The ARC were a collective body of expertise and experience. This research adopting the transformation of qualitative to quantitative empirical research approaches are inter-dependent and complementary to ensure validation of the data sets of this research study. The first stage was the SWOT qualitative to quantitative examination of NTU’s EMS, Table 12 (A-D)(pp.178-181) developed from the literature review (Table 3, pp.122-124) and the second was the qualitative to quantitative mRating value of the efficiencies of the NTU’s EMS. This research had adopted the mixed method model as described by Greene (2007)[In Greene and Caracelli (1997) and Teddle and Tashskkori (2003)] of applications as described in Table 4 (p.145) below.

Table 4 - Adoption of Mixed Method Framework in this research

Component Designs	Descriptions	Research Design
Triangulation	Different methods are used without paradigm assumptions to assess the same phenomenon concurrently toward convergence and increased validity.	Methods employed with equal priority associated with different paradigms.
Expansion	Executing different methods for different research situations.	Results are presented side by side (i.e. SWOT and mRating value)
Iteration	Continuous interplay of methods at all research stages	Methods have equal priority together with paradigm assumptions.
Holistic	Different methods used interpedently and integrated	Methods concurrently implemented with equal paradigm importance
Transformation	Ensuring methods are value based and action orientated based on the enquiry tradition	Mixing the methods for greater pluralism. Engagement with differences and paradigm value assumptions.

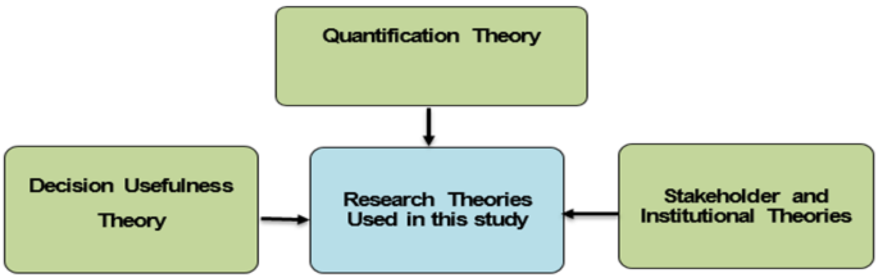
Developed by the researcher (Chelliah, 2015)

3.4 THEORIES UNDERPINNING THIS RESEARCH

This research process requires the researcher to engage with the appropriate theoretical perspectives that is appropriate to answering the research questions. The theories explain the characteristics in a clear and concise manner applicable to this research. Gilbert (2007) stated that theories presents explanations or solutions to what would otherwise be a puzzle and not obvious from a straightforward common sense approach. The general paradigm of enquiry applicable to scientific research approach consist of inductive discovery and deductive proof of enquiry. Gray (2013), stated that deduction encompasses a universal view of the scenario and works back to first principles, induction evolves from a wide spectrum of details to a more cohesive analysis of the scenario. Gray (2013) also stated that deduction focuses on hypothesis testing to either confirm or refute the presumption of two or more concepts and any inter relationships. Usually concepts are abstract ideas that can be assembled into "building blocks of hypotheses and theories" (Gray. p.16, 2013). Theories applied in this research involve the Scope 3 (Travel) quantification and sustainability index understanding that enables the complexities to be understood.

Diagram 15, below presents, the summary of the inter-related theories that the researcher had chosen for this study (i) the quantification theory (ii) the decision usefulness theory and (iii) the stakeholder and institutional theory. These theories enable the researcher to consider the different perspectives when considering answering the research questions.

Diagram 15 – Theories applied in this research study



3.4.1 INDUCTIVE AND DEDUCTIVE PROCESSES APPLIED TO THIS RESEARCH

Inductive reasoning involves a theory building process, commencing with observations of specific instances, and seeking to develop generalisations about the phenomenon under investigation. Deductive reasoning involves a theory testing process which starts with an established theory or generalisation, and seeks to establish whether the theory applies to specific instances (Hyde, 2000)

(A) The Inductive Approach as applied in this research

This research's inductive approach involves the planning procedures for data collection, analysis and to evaluating data patterns emerging and if any, evaluating their relationships between their different variables (SWOT, mRatings and travel survey data). From these initial evaluations, the research study is able to construct generalisations, inter-relationships and theories. Applying the rules of induction, the researcher is able to interpret a plausible relationship principle as described in Table 5 below.

Table 5 - Inductive reasoning as applied to this research

Stages of the inductive process	**Actions Taken**	**As Applied to This Research**
1. Research Aims	To evaluate the research's data collections strategies involved	Determining NTU's EMS policies and quantification of Scope 3 (Travel) carbon emissions
2. Theory	Selecting workable theories applicable to the research's data collection	Evaluating theoretical data collection models applicable
3. Operationalise	The researcher's collection of data sets that are appropriate	Ensuring that the data sets have data integrity
4. Testing by induction	The researcher collection of data can be corroborated independently	The Scope 3 (Travel) data sets from the travel survey are acceptable measurements including approximations used
5. Outcomes	The researcher ensures that the working theories can be subjected to inductive reasoning	New theories can be tested for viability, patterns and meanings.

Source: Adaptation from Crotty, 1998 (In Gray, 2013)

(B) The Deductive Approach as applied in this research

Following on, this research's deductive approach involves the mapping of the travel data to account for the approximate total academic travel carbon emissions. The deductive approach is explained in Table 6 below.

Table 6 - Summary of deductive processes as applied to this research study

Stages of the deductive process	**Actions Taken**	**As Applied to This Research**
1. Research Aims	To read and evaluate the research strategies involved	Evaluating NTU's EMS policies and quantification of Scope 3 (Travel) carbon footprint.
2. Theory	Selecting theories applicable to the research questions	Evaluating theoretical models applicable
3. Operationalise	The research specifying the measurement of the quantum	The researcher stating how the measurement will be done
4. Testing by falsification	Checking that the data can be corroborated with theory	The researcher stating the relationship of mapping the travel data as acceptable
5. Outcomes	Ensuring that the outcomes are within acceptable parameters	The researcher will determine if the data is acceptable compared with similar studies.

Source: Adaptation from Crotty, 1998 (In Gray, 2013)

3.4.2 QUANTIFICATION THEORY USED IN THIS RESEARCH

Quantification theory has its genre in mathematics and empirical sciences and since the nineteen seventies has rapidly become research tools for research into management and social sciences as a scientific methodology (Bryman, 2004). The theory has been used in this research as reference guides as Shen (2013) proposed when undertaking quantitative research. Zhao et al (2012) defined quantification theory as researching the correlations between independent variables and dependent variables used for Scope 3 (Travel) quantification.

The quantification of Scope 3 (Travel) carbon emissions applied in this research is The Quantification Theory Type 1(QT1) as this research's analytical tool for analysing the raw data collected from the travel survey questionnaire. Nagamachi (2011) defined QT1 as a variation of regression analysis that deals with continuous variables. This is applicable to this research's quantification of the travel survey data and extrapolating to a full academic year.

3.4.3 DECISION USEFULNESS THEORY ATTRIBUTABLE TO THIS CASE STUDY

This theory used in this research for reporting information both internally and externally according to user needs (Hitz, 2007 and Ajjan and Harshorne, 2008). Usefulness involves information relevant for the purposes of user decision making (Deegan, 2009 and Ramos et al, 2013). Carbon emissions disclosures determined as 'useful' (Bebbington et al, 2012, Setiawan and Cuppen, 2013 and Mozner, 2013) used in this research had been determined by stakeholder information demand. This research adopting this theory involves understanding and complying with stakeholders' informational demands concerning environmental sustainability, climate change and corporate governance policies (Seuring and Gold, 2013 and Lenzen et al, 2007). This research decision models emphasises the appropriate informational needs and by evaluating these needs are key drivers to guiding the content of carbon emissions informational flows (Bebbington et al, 2008)

Researchers (Solomon and Darby, 2005 ; Villiers and Staden, 2010 and Holm and Rikhardsson, 2011) had applied the decision usefulness theory for understanding environmental accounting and carbon disclosure information to a wide variety of user groups and legislative compliances. Focusing on disclosures by HEIs of their

Scope 3 (Travel) environmental performances and other environmental sustainability metrics would be assisting in decision making by management and stakeholders. Suwartha and Sari (2013) reported that the HE Sector must take a lead using decision usefulness theory as a theoretical framework concerning accountability, compliance and emission targets.

There are criticisms to the decision usefulness theory. In particular, Hitz (2007) argued the theory was deficient as a theory and can be seen as a separate methodological branch by ranking information concerning the perceived usefulness of the various users. Belkaoui (p.78. 2004) criticised this theory that as “miss-specified and under theorised”.

3.4.4 STAKEHOLDER AND INSTITUTIONAL THEORY ATTRIBUTABLE TO THIS CASE STUDY

Stakeholder theory (ST) emphasises on explaining and predicting how organisations are able to organise their functions with respect to the relationships, influences and management towards stakeholder requirements (Freeman, 2010 ; Lafreniere et al, 2013 ; Skelton, 2013 and Wellens and Jegers, 2014). Elms et al (2011) and Fassin (2009) stated that the term ‘stakeholder’ has a powerful conceptual factor and had different meanings to different groups. Reed et al (2009) stated that ST is not a ‘theory’ on an organisation’s constituencies but sets out to replace today’s neoclassical concept of the organisation. Lansiluoto et al (2013) that stakeholder influence across campuses are gaining momentum. The ST is applicable to NTU concerning providing carbon emissions information demands to stakeholders i.e., HEFCE who are primary stakeholders together with the board of governors of NTU.

The Government and local communities are both primary and secondary stakeholders who can influence NTU recommending corporate governance.

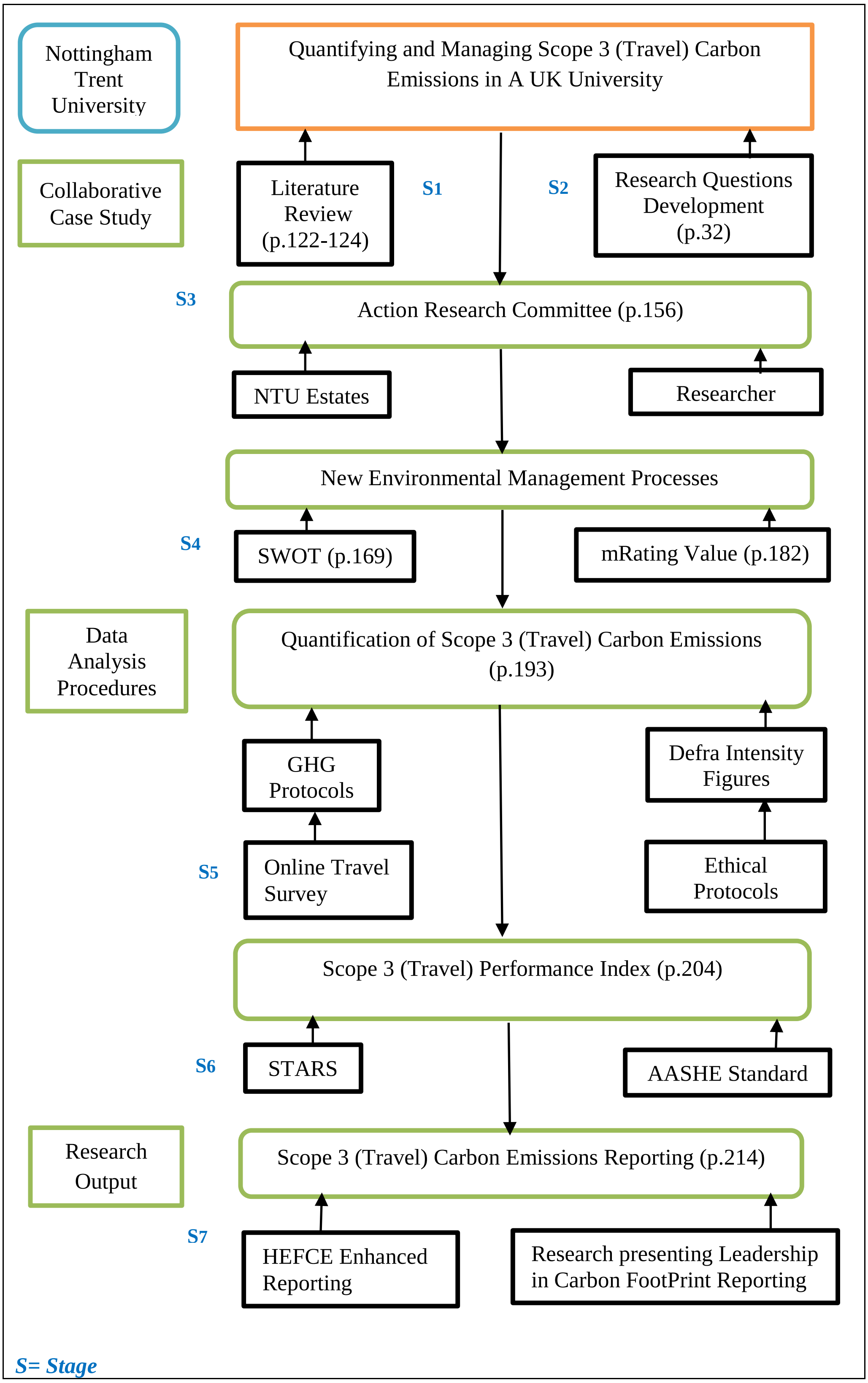
ST attempts to lay its philosophical principles by suggesting that organisations have an obligation to recognise the demands of all stakeholders (Camara et al, 2009 ; Reed et al, 2009 and Zhihong et al, 2010), environmental and stewardship impacts applicable to HEIs (Altan, 2010 and Waheed et al, 2011). Carroll and Buchholtz (2014) identified that there were linkages between proactive environmental strategies and ST concerning environmental information. The Global Reporting Initiative (Gri, 2015) are secondary stakeholders recommending reporting guidance using ST (Costa and Menichini, 2013). ST suggests that NTU's EMS and reporting mechanisms are given management considerations delivering environmental information to all stakeholders.

Institutional theory (IT) involves effective decision making by HEIs that would influence other institutional contexts within the HE Sector (Hoover and Harder, 2014). There are external and internal institutional pressures as Van Staden and Hooks (2007) stated for carbon emissions accountability and reporting applicable for companies that are applicable to HEIs. Tolbert and Zucker (2012) had indicated that relationships between institutional theory and its environment reporting putting rationality and efficiency as key organisational behaviours.

IT differs from ST in the sense that NTU is HEI that is embedded in an external environment that are influences by existing laws, regulations and management infrastructures to demonstrating norms and values of good corporate governance. Where ad ST responds to influences exerted by stakeholders coercing management to adopting particular voluntary practices and disclosures.

3.5 RESEARCH DESIGN OUTLINE

Diagram 16 - Research Design Summary Outline *(Adopted from Maxwell (2012) and Katoppo and Sudjarat (2015)*



Developed by the researcher (Chelliah, 2015)

The above Diagram 16 (p.152) describes the summary design outline as to how the Researcher will conduct the research study. Jonas (2007) described research design as ‘guiding ideas’ for users and researcher alike. This research design adopts the design features recommended by Katoppo and Sudrajat (2015) extricating the dynamic participatory research mechanism by the action research committee using action research. Based on this, the research plan has been developed as follows:

Stage 1(S1) - Undertaking the literature review to determining the current pertinent literature attributable to the research focus. From this review, research gaps had been identified and the appropriate research questions generated on key factors concerning the quantification, management and reporting of Scope 3 (Travel) carbon emissions directly relating to the NTU case study

Stage 2(S2) – Development of the research propositions adopting action research as a collaborative research design together with NTU estates. This participatory research design enabled the researcher to implement new environmental management systems, calibrate its efficiencies, administering the staff and student travel survey modalities and journeys for the quantification of Scope 3 (Travel) carbon emissions, development of a Scope 3 (Travel) sustainability index and presenting leadership for enhanced reporting of carbon footprints’ by the HE Sector.

Stage 3(S3) – Undertaking preliminaries with the action research committee concerning the qualitative and quantitative mechanism, research protocols. Developing the online staff and students’ travel data survey questionnaire and administrating the online travel survey. Obtaining NTU ethics committee approval.

Stage 4 (S4) – Analysing the SWOT and mRating qualitative and quantitative data and to testing the data sets validity using factor analysis. Critical analysis of the qualitative stage of the research to the quantitative stage. Development of a new EMS management mechanism for implementation by NTU.

Stage 5(S5) – Administrating the staff and student online travel survey. Analysing the travel data survey results to determining the quantification of NTU's Scope 3 (Travel) carbon emissions.

Stage 6(S6) – Defining the variable and constructs for the development of NTU Scope 3 (Travel) sustainability index using STARS and AASHE Standards applicable to the Higher Education Sector.

Stage 7(S7) – Interpretation of the research results and conclusions. Confirmation of the research model for effective Scope 3 (Travel) carbon emissions reporting and development of the research model for an effective reporting index.

The Research Design as shown in Diagram 16 (p.152) is this research's case study design framework involving the various tasks working harmoniously together to successfully to answering the research questions.

Diagram 16 (p.152) also had adopted the research design features recommended by Maxwell (2012). These are:

- Goals – What are the aims of the research and how would the results contribute to new knowledge?
- Conceptual framework – What are the plans for the research, theories, paradigms, and literature?
- Research questions – What does the research seek to answer?
- Methods – What methodologies are to be used to conduct the research?
- Validity – How would the data collected enable the research to support or refute the research questions?

3.6 ESTABLISHING THE ACTION RESEARCH COMMITTEE AS A COLLABORATIVE RESEARCH DESIGN METHODOLOGY

Action research is defined as a participative inquire and practice for an empirical and logical problem solving process involving cycles of action and reflection (Reason and Bradbury, 2008). They also stated that this involves a series of linear processes each composed of from planning, actions and fact finding about the results of the action. Collaborative action research has its roots in applied research where there is a relationship between the researcher and the client combine to solve practical concerns (Ragsdell, 2009). Action researchers must confront the issues pertaining to preunderstanding the problems that would be ‘hands on’ (Coghlan, 2007).

In this collaborative research facilitates the interactions between NTU estates facilitating effective communication processes, a mechanism for the exchange of data, information and various important aspects concerning the quantification, management and reporting of Scope 3 (Travel) carbon emissions. The relationship between the researcher and the committee involves the active participation of all members with the researcher solely involved with the initial design to the final presentation of the results and discussion of the committee’s action implications (Ragsdell, 2009)

The main purpose of the action research committee had been to act as a collaborative platform to inform and assist in this case study research involved in answering the researcher’s research questions. This steering committee enabled collaborative interactions by allowing accessibility for the researcher to conduct the transparent elucidation of action research preferences by the researcher and also by NTU.

The action research steering committee consist of three participants (Table 7) below from NTU's Estates management department collaborating with this case study during the investigation, planning, implementation, data collation stages and for reviewing jointly concerning NTU's EMS efficiencies and the quantification of Scope 3 (Travel) carbon emissions. Each member had been fully briefed on the research questions this case study and all information is deemed voluntary and verbal agreements were taken to safeguard their rights.

Table 7 - Composition of the Action Research Committee

Category	**Expertise**
Manager	Individual responsible for campus sustainability, carbon management and estate eco diversity management
Practitioner (Principal)	Individual practicing and implementing sustainability management and carbon abatement at NTU.
Expert	Independent consultant advising NTU on managing sustainability and carbon management for reporting purposes
Researcher	The researcher as an external consultant to NTU for developing campus EMS and for the quantification, and reporting of Scope 3 (Travel) carbon emissions and author of this thesis

The researcher served as moderator as suggested by the research committee. All members of the committee were given opportunity to speak freely on the research issues. The researcher took brief notes of the committee meetings. This action research is about creating collaborative environments where research experts and stakeholders can share their very different kinds of knowledge in the process of analysing problems, studying them, and collaboratively designing actions that can ameliorate the problems (Johnson et al. 2014).

3.7 ACTION RESEARCH AS USED IN THIS RESEACH

Action research can be defined as a collaborative and participatory inquiry to solving a management problem (French, 2009 ; Higdem, 2014 and Jiraro et al, 2014). Action research takes the form of diagnosing the management problem, planning, gathering data, implementing action, evaluating the implementation results and taking further action, improving or implementing new management systems (Dick, 2002 and Bagal, 2006). Action research involves two cycles, the first one being exploratory (inquiry), the second more focused for a specific task. Kemmis and McTaggart (2005) stated that action research is determined for its appropriateness as a research design for undertaking research consisting of inquiry, action and reflection. The advantage of the choice of using this instrument lends actions to new understanding, opens new areas of inquiry and subsequently resolving the management problems. The action research design approach will involve the researcher as the principal and NTU estates facilitating the management access, diagnosis and implementation of NTU EMS.

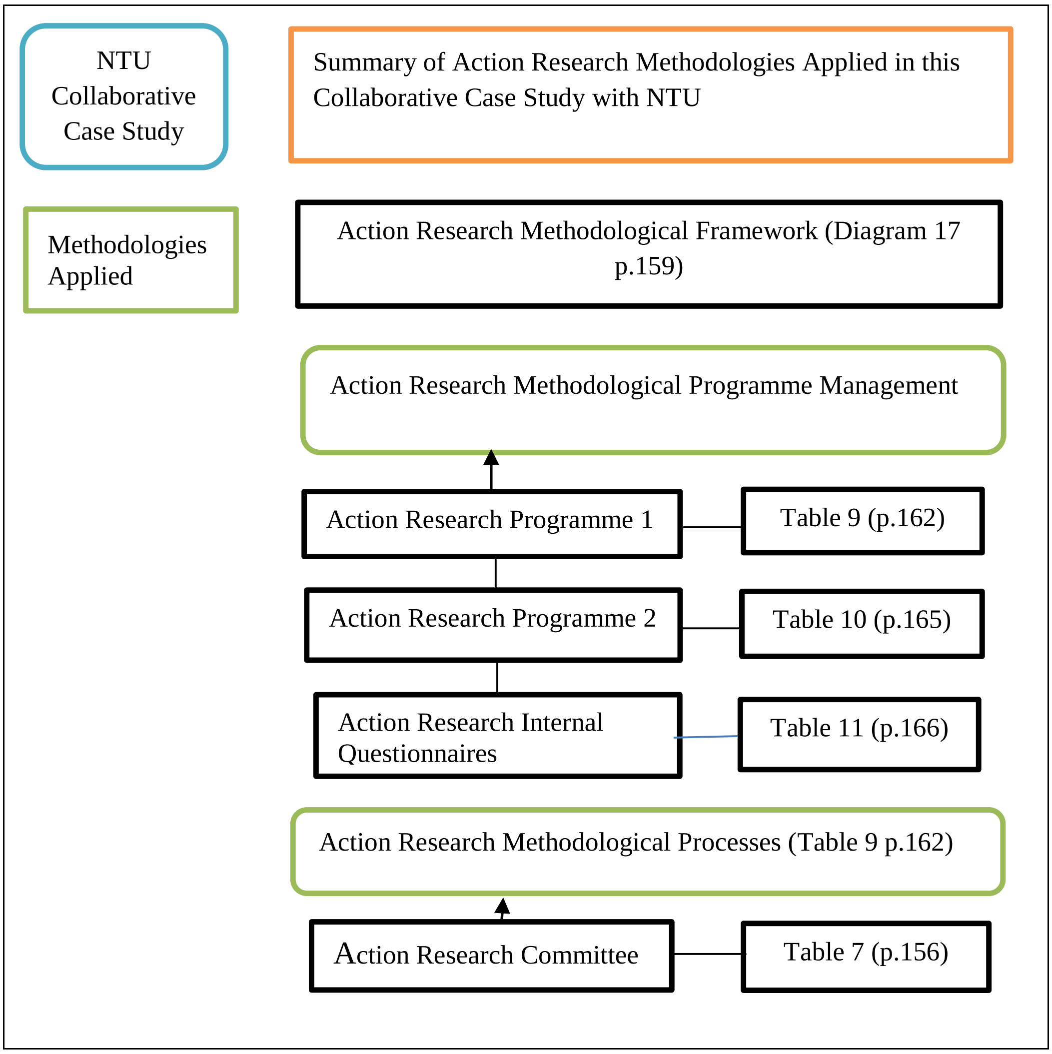
In this case study research, action research offers clearly defined roles of the researcher and others during planning and collaborative intervention by the researcher and NTU. The principal reason for undertaking an action research is to facilitate NTU in improving their EMS for the management of Scope 3 (Travel) carbon emissions. Action research is determined by the participants (action research committee, p.156) in this case study and is relevant to the participants who are the primary consumers of the research findings (NTU). The reflective stage of the instrument involves all participants evaluating the outcomes of the actions and the corresponding results of any new emergent knowledge. Westbrook (p.9, 1994) stated that action research is an intervention technique where the scope and limitations are known and its effectiveness is derived from "immediacy of feedback that the research requires. The collaborative action research process involves the following seven stage processes as applied in this case study research (Table 8, below). The process consists of a problem and a solution phase, investigation and formulation phase, implementation and solution phase and a reflective phase.

Table 8 - Action Research Processes

Action Research Process	**Methodologies applied in this collaborative case study**
1.Selecting a focus	Identifying NTU's EMS problems
2.Clarifying theories	Identifying the theoretical perspectives relating to the focus
3.Identying the research questions	Developing research questions to guide the inquiry
4.Collecting Data	Ensuring that data is valid and reliable
5.Analysing the data	Action research offers simple analysis identifying trends and patterns in action research data
6.Reporting results	Informal reporting to members and making a contribution to NTU's knowledge base regarding Scope 3 (Travel) emissions
7.Actions	Undertaking 'action planning', design and implementation

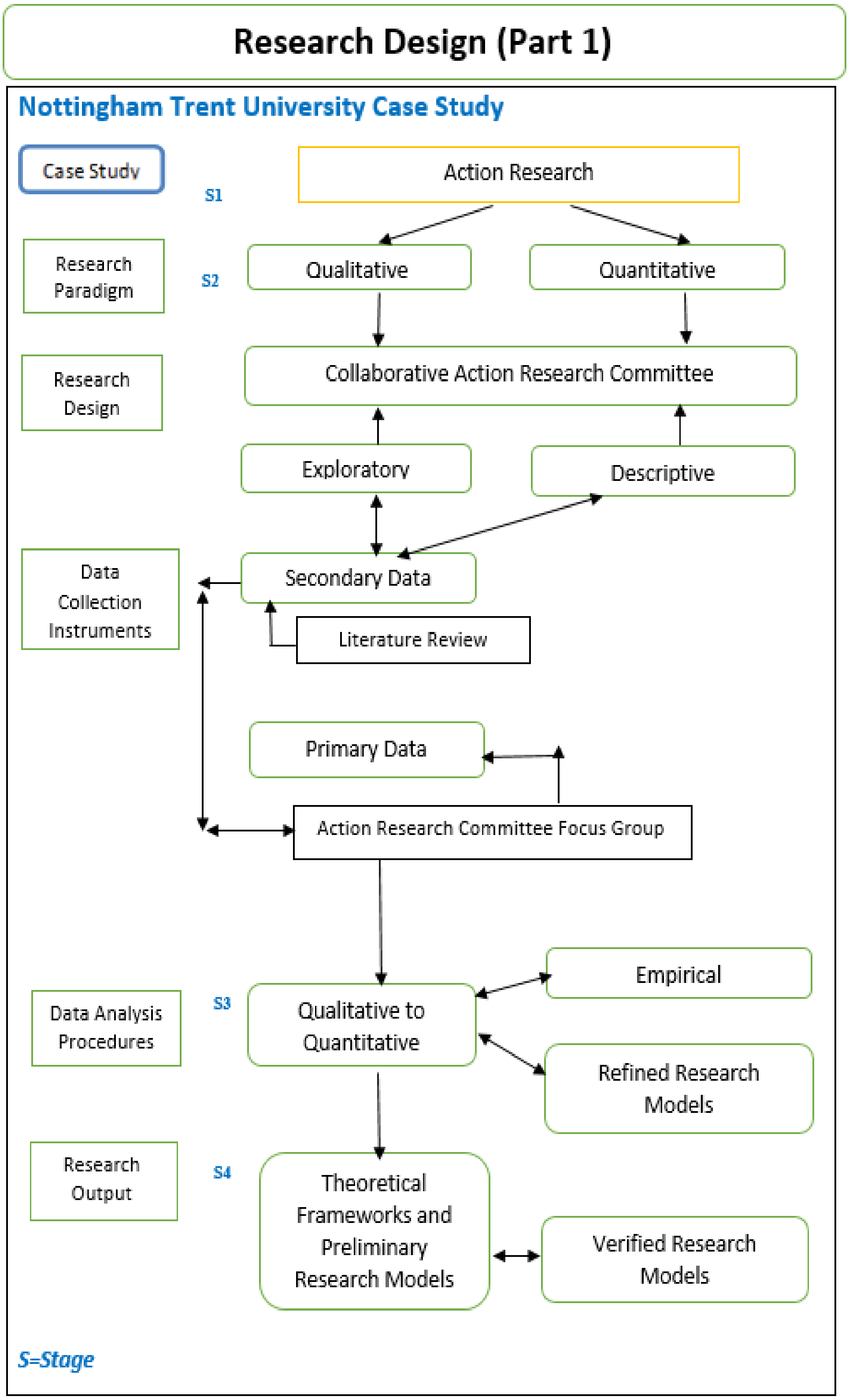
Diagram 17 (p.159) illustrates the summary of the action research methodologies applied in this collaborative case study. The action research methodological framework is explained in Diagram 18 (p.160) presents the extensive methodological processes used. The methodological processes are followed by the action research methodological programme management with the specific action research programmes referenced to Table 9 (pp.162-163) and Table 10 (p.165) and the action research internal questionnaires in Table 11 (p.166). The action research methodological processes are co-ordinated by the action research committee as per Table 7 (p.156)

Diagram 17 – Summary of Action Research Methodologies as Applied to This Collaborative Case Study



Developed by the researcher (Chelliah, 2015)

Diagram 18 - Research Design (Part 1) – Action Research Framework



(A) Research Design (Part 1) – Action research process [Diagram 18, p. 160]

Step 1 - The case study research design of NTU focuses on the action research the research and members of NTU estates forming the collaborative action research committee. The qualitative and quantitative research paradigms guided the research investigations.

Step 2 – The data collection instruments are qualitative and exploratory inductive stage that have two data collection instruments for secondary data from the literature review and primary data from the action research committee focus group and analysis of published marketing literature.

Step 3 - The data analysis procedures had been qualitative to quantitative methodologies using empirical quantum values (rubric of 1 to 10-being the best) to generating a refined research model to be constructed and tested.

Step 4 – The research design outputs involved theoretical frameworks for the developing the research methodologies and preliminary research models.

Tables 9, 10 and 11 (pp.162 -166) describes the details of the workings of the committee as applied to this research.

Table 9 (pp.162-163) lists the action research instrument management implementation phases. The phases detail the planning processes, identifying factors that enhance the collaboration with the researcher and NTU. The instrument focuses on providing information to the researcher and NTU listing key management issues and soliciting feedback on current environmental management systems, explore suitable solutions and strategies and minimise disagreements and conflicts.

Table 9 – Acton Research Methodological Programme Management (1)

Key action research Characteristics	**Action research as applied in this research**	**Application of the research instrument - details**
1. Action taken	**1.** The 'researcher' will be analysing existing environmental management data to determine its effectiveness and contributing to the development of an effective environmental data collection and management system as a valued consultant.	Aimed at management problem solving. Has characteristics of an external independent consultant
2. Problem solving	**2.** This research aims to provide a normative quantification methodology for Scope 3 (Travel) carbon emissions to facilitate NTU to effectively manage complex decision making regarding carbon emissions mitigation and (b) to contributing to the science of the knowledge of model building in the implementation of customised environmental solutions (c) to contribute to the performance management of Scope 3 (Travel) carbon emissions to stakeholders.	Aimed at development of frameworks, processes and decision supporting tools.
3. Interactive actions	**3.** Collaborative systems and design of the environmental management systems which would require continuing involvement and contingencies.	Need to support NTU to address management issues and achieving outcomes.
4. Holistic understanding	**4.** Understanding the needs of NTU's environmental management systems for the collation of environmental data.	Close proximity of researcher and some ethical issues to agree

5. Change management	**5**. Managing the Scope 3 (Travel) carbon emissions data systems and processes. The focus would be on improving the cost efficiency (low human capital) and effectiveness (software driven) for NTU and complying with stakeholders	Obligation to provide NTU with research solutions that meet the research objectives
6. Data collection	**6.** The Researcher will have direct 'hands on' experience in working the quantification of Scope 3 (Travel) carbon emissions quantification. The researcher will acquaint and use the carbon intensity values of the different travel modes attributable to Scope 3 (Travel). This will be executed in various stages from July 2012 to November 2013.	Collaboration and interaction and multiple data collections
7. Action research that represents the hermeneutic paradigm/	**7.** This thesis will not test existing theories but to follow a deductive reasoning logic, which is typical of positivism. This research offers new contribution to the existing body of knowledge with an inductive methodology case study research. This research represents a hermeneutic research paradigm and positive thinking.	Phased developments and testing. monitoring outcomes, measurements a efficiencies

Table 9, above (pp.162-163) also illustrates that the research instruments applied to this research using NTU as a case study consists of both research and actions being that both processes are integrated. The Table emphasises the instruments research phases of systematic inquiry, reflection and strategic action applicable to the research circumstances.

For this research, the action research instrument is a technical and pre developed specified intervention theoretical framework for the quantification, management and reporting of Scope 3 (Travel) carbon emissions. The application of this instrument requires a research setting where the researcher acts as an independent consultant who will assist the implementation of the new intervention as part of this research. The following are the four steps for using the action research instrument.

(1) Planning – developing an informed action to improve the current environmental management practices by NTU concerning the accountability of Scope 3 (Travel) carbon emissions. The plan should be flexible to adapt and response to reach the desired objective.

(2) Act – management action is implemented with the collaboration of NTU in real time for evaluating the benefits.

(3) Data – data collection and other evidence provides rigor by evaluating the outcomes and performances of action research.

(4) Reflect – The reflective stage provides this case study with important insights and further steps to be undertaken in the future.

An action research group was coordinated by the researcher to discuss the qualitative travel survey questionnaires with NTU Estates and NTU marketing departments (consisting of 4 persons). This action research presents that the researcher is directly involved with NTU in all aspects concerning the execution of this case study research undertaking. Under those circumstances, action research involves working collaboratively to investigating the research questions and the sharing of research information and data with NTU. The researcher will set out the terms of this action research with NTU and taking the responsibilities for reviewing the research goals, outcomes, actions etc. In effect, this action research will emulate the action research by McKeman (2013) and applying that research's action research principles to this research as follows:

(a) Selection of a small steering committee that included the researcher and NTU estates management. This steering committee has the task of defining the scope of the travel survey by staff and students over a one-week period beginning on 25 February 2013. Procedures for 'brain storming' and implementing the travel survey strategies for getting started and engaging the creative energies of the committee is implemented.

For this action research the following processes are implemented.

Table 10 – Action research programme (2)

1. Explaining the problems	1. The researcher carefully explains the research problem to be tackled. The researcher called for suggestions from the ARC
2. Record of ideas visually	2. The researcher carefully records all suggestions and detailing these on a flip chart. The researcher will discuss all the ideas taking one at a time. The researcher acknowledges that recording ideas is crucial and contributed to the committee's productivity and future reference
3. Discussion of ideas and suggestions	3. The researcher summarises ideas concerning Scope 3 (Travel) modalities, travel categories and travel classifications

(b) NTU's marketing department was entrusted to circularise the travel survey to current staff and students active email addresses. For ethical considerations no information regarding the participants were held or known to the researcher, steering committee and NTU personnel attending the meeting. NTU will be complying with all data protection rules concerning this travel survey.

(c) The travel survey questionnaire was constructed to ensure that pertinent questions of travel journeys and distances relating to high emissions factors attributable to Scope 3 (Travel) carbon emissions is given priority to minimise the complexity and time disposed for participants to undertake the travel survey.

The steering committee convened to consider the validity of the research propositions. The researcher structured the research propositions as three open ended questions. These are internal questions as follows (Table 11):

Table 11 – Action Research Internal Questions for research focus

Question 1	**1**. What are the key propositions for NTU for the quantification of Scope 3 (Travel) carbon emissions?
Question 2	**2**. Is there a reporting framework, standard or model which you know that can serve as a reference to NTU for reporting Scope 3 (Travel) carbon emissions?
Question 3	**3**. Is NTU ready to effectively report on Scope 3 (Travel) carbon, Scope 1, 2 and 3 carbon emissions of the university's carbon performance?

(d) The travel survey data journey trips are to be collected by NTU's marketing department and scripted into an excel file for further analysis by the researcher. Coding scripts were easier to implement to both open ended and closed response questionnaires. Similarities of responses across survey responses, tabulating recurring themes and critical points are especially noted during scripting.

(e) Data analysis, findings and summaries is prepared first with a preliminary report for discussion with the action research group at a meeting on 26 April 2013. The researcher will review the report and call for a frank and open discussion of the findings. Further, recommendations are formally presented to NTU on 15 April 2014.

3.7.1 THE ACTION RESEARCH INSTRUMENT – JUSTIFICATION FOR USE IN THIS RESEARCH

Johnson et al (2014) in their research concluded that action research contributes to research strategies by offering systematic methods for choosing the appropriate tools for analysing and establishing action-orientated strategies collaboratively with minimum management formalities. Somekh (2008) and Johnson et al (2014) stated that in all stages of action research there is collection and analysis of data, identifying prior and post scenarios as a consequence of the action research and knowledge generation.

The choice to using action research methodology was grounded on the following reasons: -

(i) NTU wanted to be involved in the fact finding, analysis and implementation processes

(ii) Implementation of an EMS is a process of organisation change that NTU wishes to be involved within. Action research intervention procedures provides access to rich data, management reality and evaluation of goals attainment for an efficient EMS

Action research directly involves the researcher and NTU estates management during the investigation, planning, implementation, data collation and review concerning the EMS problems at NTU. Stringer (2014) stated that the action research instrument design strengthens the internal and external validity concerning the management solution of the research problems. The action in this case study involved generating data from methodologies recommended by the committee (Table 7, p.156) and at the same time reviewing the data analysis. The action research task had been the development of an efficient EMS at NTU for effective environmental data collection.

This represents a constructive approach to solving management problems (Kharrazi et al, 2014 and Frame and O’Connor, 2011).

Chapter 1.4 (pp.36-40) describes this research as a collaborative case study with the Researcher undertaking the lead that differs from a straightforward case study approach. Collaboration enables the researcher to adopt the action research 'modus operandi' for evaluation, development and implementation without the need for formal NTU approvals and bureaucracy for this management research approach. The collaborative mechanism enables the researcher to ‘gain’ accesses for the implantation of the new EMS management strategies and processes to establishing a hybrid EMS specific for the needs of NTU. Part of the collaborative action research design feature involves the setting up an action research committee (ARC) (p.156) as a collaborative tool. This tool facilitates eliciting qualitative to quantitative information from SWOT and mRating semi structured questionnaires for evaluating NTU's EMS efficiencies, enabling the development of a tool for a travel sustainability index, new environmental management accountability processes and reporting mechanisms for NTU.

Applying this collaborative action research methodological approach enables this researcher to access data for the development of a quantification tool for Scope 3 (Travel) carbon emissions, (Sampling NTU staff and student commute travel survey, overseas business and student travel data survey), Access the computing facilities of NTU and benchmarking of carbon emissions for legal and stakeholder compliance reporting.

The above methodological approaches are different from a case study analysis as the researcher was involved in evaluation, design and implementation of this research.

3.8 SWOT (STRENGTHS, WEAKNESS, OPPORTUNITIES AND THREATS) DESIGN AND METHODOLOGY

Strengths, Weakness, Opportunities and Threats (SWOT) analysis guides researchers to identify and elicit the different attributes that impact on an organisation. Determining these SWOTs impact magnitudes presents researchers with a rough impact assessment for further analysis and decision making. SWOT was originally introduced in 1969 by Harvard management researchers which was originally developed by Albert Humphrey(1923-2005)(In Friesner, 2013). Damian et al (2014) described strengths and weaknesses as internal characteristics that can be controlled, whilst opportunities and threats are external variables taking advantage of opportunities and reducing threats.

Paliwal (2006) proposed three separate SWOT phases to be developed. One based on the current situation, one pertaining to the immediate future, and one concerned with a more distant future. Adopting Paiwal's suggestions, Jain and Pant (2010) research of an Indian university EMS using the SWOT tool had summarised their SWOT findings into a tabulated four sector grid matrix consisting of internal (on the left) and external factors (on the right).

In this case study research, the SWOT methodology is an 'enabling tool' and a 'probe' for investigating and understanding the environmental management system (Rachid and Fadel, 2013). Pesonen and Horn (2014) had stated that SWOT tools are quicker and cost efficient mechanisms offering a comprehensive environmental management 'situational audit'. However, Friesner (2013) pointed out that the SWOT tool has not been widely adopted in situational analysis and has largely been unutilised in management research.

However, despite SWOT's enduring popularity as a methodological tool, Terrados et al (2007) declared that SWOT tools remained as a theoretical framework with limited prescriptive analysis for practice and in research. Nikolaou and Evangelinos (2010) described SWOT analysis being too narrow and utilises no empirical weighting for measuring intensities and the outcomes that have no obligation to be verified independently.

The EMS research design focussed on investigating the performance effects of NTU's EMS. Scope 3 (Travel) carbon emissions performance had been the two most important aspects of the research design and the methodologies used. NTU's EMS represents its environmental management and measuring its Scope 3 (Travel) carbon emissions to meeting NTU's emissions targets and minimising its environmental impact.

Diagram 19 (p.172) Research Design (Part 2) presents the summary of the methodologies for evaluating NTU's new environmental management systems.

Step 1 - The action research design features involves both qualitative and quantitative empirical value measurements to dealing with NTU's environmental management systems concerns, implementing new revised management processes, measuring and assessing potential EMS impacts, establishing emissions targets, reviewing the implementation processes and making adjustments to ensure NTU achievement of environmental goals. The research paradigms are qualitative and quantitative perspectives.

Step 2 – The data collections were designed to extract the primary qualitative data from the action research committee

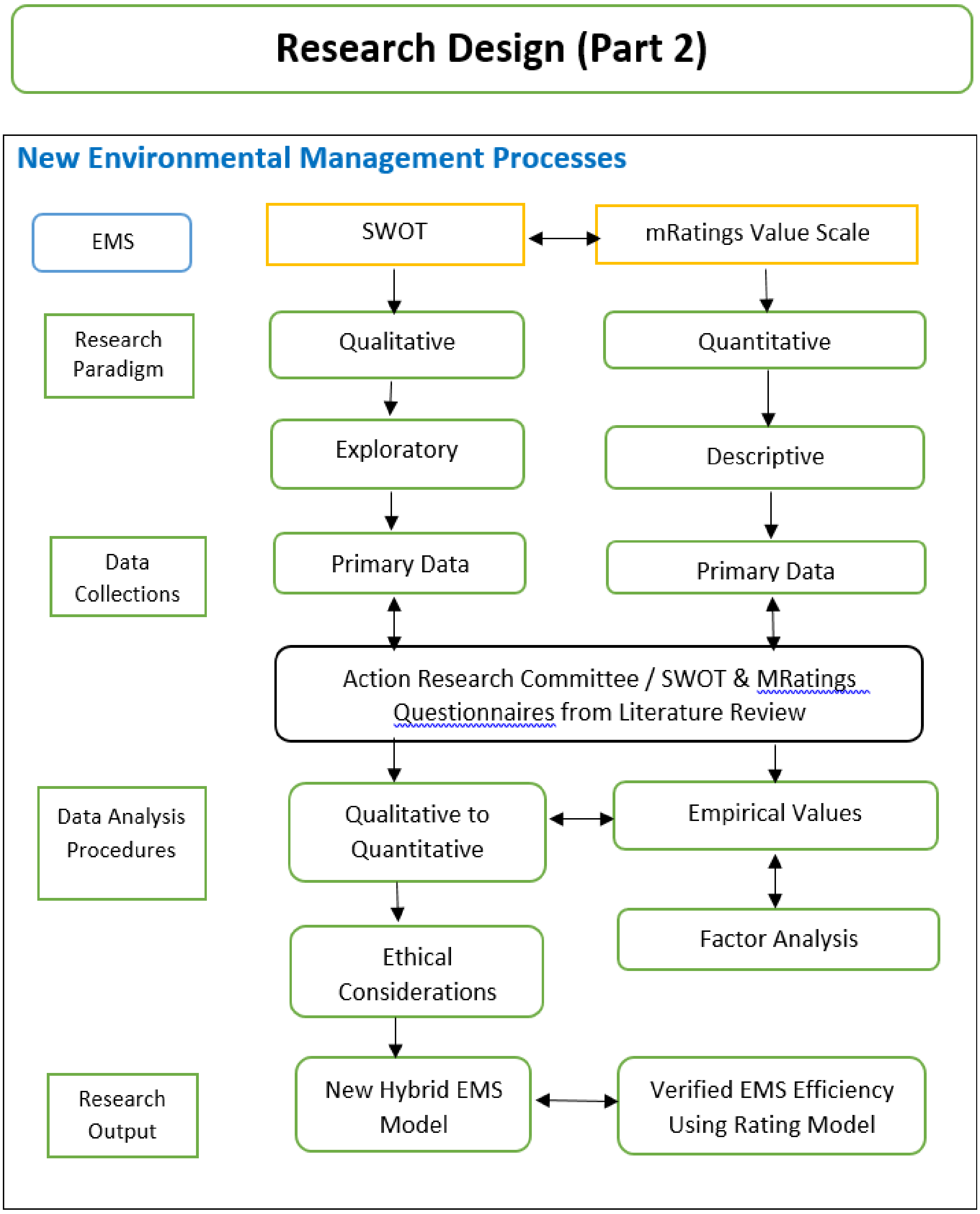
Step 3 – The data analysis procedures design was to convert the qualitative information to quantitative empirical measurements by the researcher (using the rubric 1 to 10). Statistical factor analysis was used to determining data integrity. ethical considerations were considered at all stages of the research design

Step 4 – Research output involved the development of a new hybrid EMS Model for use by NTU for managing its Scope 3 (Travel) carbon emissions accountability. The EMS efficiency will be evaluated using the ratings' model (R-Scores)(p.267).

SWOT analysis design strategies involves the internal and external assessment with the view to determining a solution or best fit between the two perspectives (Hill and Westbrook, 1997). Dyson (2004) proposed that, having identified these factors, strategies are developed which may build on the strengths, eliminate the weaknesses, exploit the opportunities or counter the threats. SWOT frameworks are useful EMS planning tools from a simplistic knowledge base but has a disadvantage of being highly subjective in nature (Nikolaou and Evangelinos, 2010). A new EMS for NTU would require a hybrid SWOT model that narrows the strategies selection and utilises optimal strategies based on qualitative and quantitative analysis (Wang et al, 2014).

The core logic of SWOT synthesis involves matching the objectives and subjective dimensions of the framework. Hence, a formal synthesis of evaluative and descriptive aspects of SWOT are to be required for an effective strategic evaluation of NTU's EMS. This would involve the coherent synthesis of the column, row and diagonal evaluations of the SWOT components for which the choice of consistent core logic are essential.

Diagram 19 - Research Design (Part 2) – Environmental Management System



SWOT analysis have some basic assumptions to ensuring that successful evaluation strategies can be achieved (Agarwal et al, 2012). The SWOT research questionnaires (Table 12, pp.178-181) focusses on the evaluation of successful strategies based on investigating the good fit between internal resources and external possibilities. The questionnaires are qualitative in nature eliciting replies from the action research committee concerning NTU's EMS's capabilities and competencies regarding

HEFCE and other regulatory requirements that require such competencies. The SWOT research paradigm is based on qualitative and quantitative perspectives. The action research committee (p.156) presents the qualitative semi structured questionnaire replies. The researcher converts these qualitative replies to quantitative empirical values using the rubric measure of 1 to 10. These replies are subjected to detailed analysis by the researcher with reference to the research questions and objectives (Table 1, p.32) ensuring that the assumptions are valid and the results are a satisfactory evaluation of the analysis.

The SWOT questions development were from the knowledge and management systems 'gaps' synthesised from published references (column 4). Each of the question is independent and not related to each other [Tables 12 (A-D)(pp.178 - 181)].

The following assumptions are made for the SWOT qualitative analysis (refer to Diagram 19, p.172) for the evaluation of NTU EMS capabilities:

- The action research committee evaluates the SWOT questionnaires assuming NTU’s resource based view of distinctive capabilities and competencies as critical for evaluating NTU’s EMS than its external environment. This is an inside-out approach of using the SWOT Tool.
- The researcher attributed the specific SWOT rubric from 1 to 10, with 10 being the best. The researcher applied the best empirical reference value for the conversion of the qualitative to quantitative interpretation of NTU’s qualitative state of its EMS capabilities.
- Statistical factor analysis is to be applied to the quantitative empirical data sets for data integrity and validity.

3.8.1 JUSTIFICATION OF USING THE SWOT TOOL FOR EVALUATING ENVIRONMENTAL MANAGEMENT SYSTEMS AT NTU

Executing Scope 3 (Travel) SWOT represents the action research collaboration by the researcher and NTU for evaluating NTU's current EMS effectiveness. Researchers (Paliwal, 2006 ; Lozano and Valles 2007, and Jain and Pant, 2010) argued SWOTs are widely used as a decision-making and planning tool in management research. They stated that SWOTs can be described as an efficient methodology for identification and analysis of the different strong and weak attributes and for evaluating the opportunities and threats applicable. Pesonen and Horn (2014) stated that SWOT is a quick and cost effective tool for modelling environmental management systems.

The SWOT tool is a qualitative examination that interrogates internal and external factors at play (Rachid and Fadel, 2013) and similarly can be used for evaluating current and formulating new EMS strategies for NTU. Using the SWOT Tool provides a systematic evaluation approach concerning the complexities relating to Scope 3 (Travel) environmental management. Establishing an efficient EMS by HEIs is viewed as a strategic compliance requirement by HEFCE (Hefce10, 2012) and HESA (Hesa, 2014) for carbon emissions data integrity.

3.8.2 SWOT TOOL AS APPLIED IN THIS RESEARCH

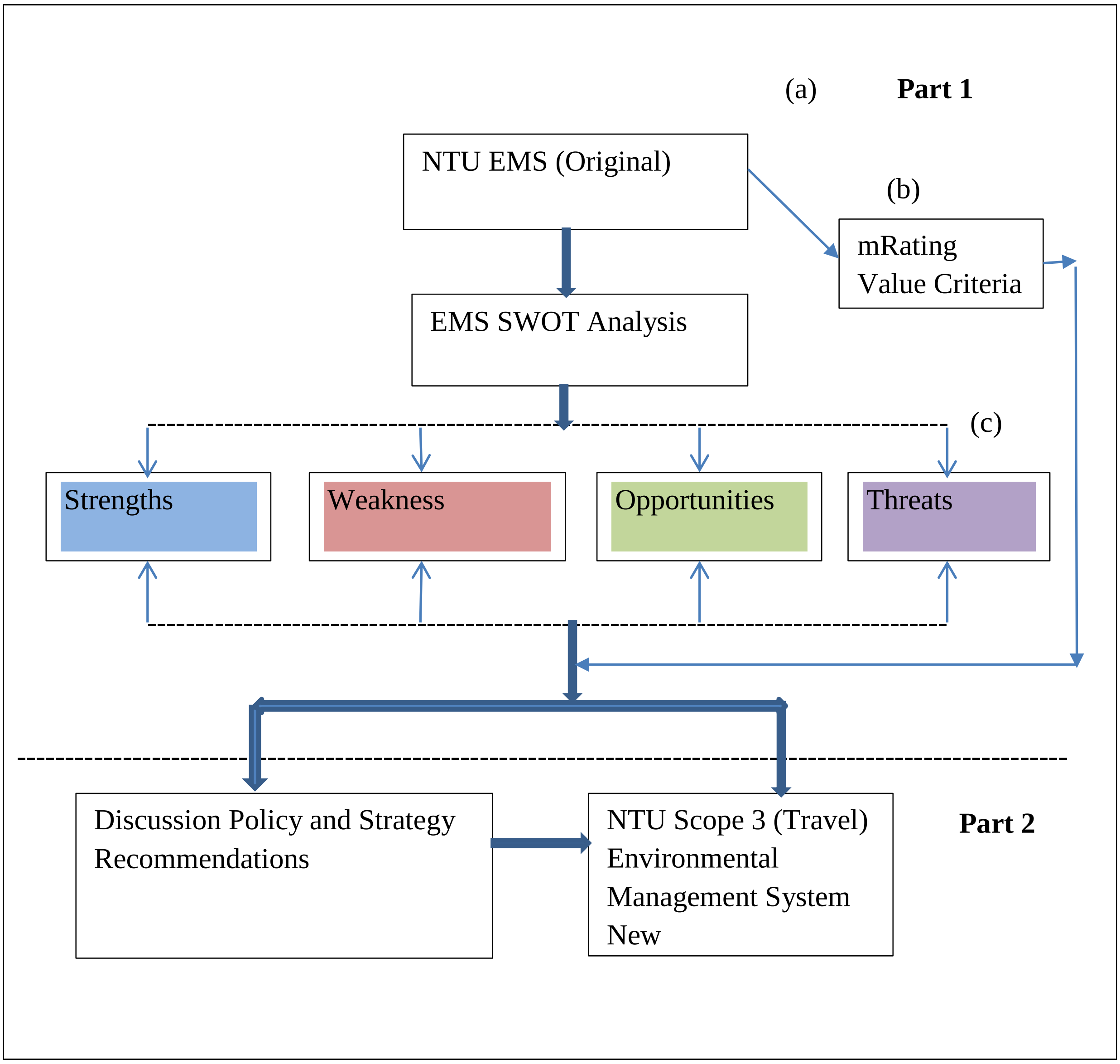
The construction of the SWOT tool for evaluating the EMS started by identifying the management problems of NTU. Each SWOT impact in Table 12 (pp.178-181) is empirically rated quantitatively from the qualitatively perspectives by the Researcher from published marketing information and analysis obtained from the ARC (p.156).

This research's SWOT methodology commences by using the four SWOT questionnaires (Table 12, A-D, pp.178-181) developed by the researcher from the literature review gap analysis synthesis (Table 3, pp.122-124) concerning NTU's current EMS practices. The quantitative empirical values are from one to ten (10 being the best) transposed from the qualitative information from published literature and replies from the action research committee members (p.156). The figure 'A' in Table 12 represents the average empirical value attributable to the particular SWOT and concerning the EMS of NTU.

The SWOT methodologies will be developed into four sets of SWOT questionnaires as illustrated in this research's methodological framework (Diagram 20, p.176). NTU's current environmental management system is initially investigated using the SWOT criteria (Diagram 20, Part 1 (c). Part 1 (b) represents the mRating value criteria empirically attributable to the efficiency of NTU's EMS. The final Part 2 represents this research's policy and management recommendations of NTU's environmental management system concerning Scope 3 (Travel) carbon emissions.

SWOT semi structured questionnaires applied in this collaborative case study presents a positive rapport between members of the ARC in a simple, efficient and practical way of getting data that the researcher is not able to observe. The questionnaires have high validity from the expert panel of the ARC. Complex SWOT issues can be discussed with clarity which can enable the researcher to make an informed judgement of the qualitative to quantitative empirical evaluation.

Diagram 20 - NTU environmental management system research methodology structure



(Adopted from Nikolou,I.E. and Evangelinos, K.L., 2010)

(b) SWOT questionnaires for evaluating NTU's management of Scope 3 (Travel) emissions

The SWOT appraisal questionnaires from Tables 12 (A) – (D)(pp.178 - 181) include what future benefits occur when implementing new environmental management systems and processes, what competitive advantages that NTU would gain taking advantage of these opportunities, what changes may take effect to the green ethos of

NTU, stakeholders and students. These questionnaires were synthesised from the literature review Table 3 (pp.122-124).

Each SWOT attribute constitutes 10 questionnaires that are put before the action research committee for qualitative interpretive answers which then converted to their quantitative empirical measurement values for further analysis. The SWOT scoring rubric is based on values 1 to 10, with 10 being the best. Following an informal discussion, each member of the action research committee commenced with a mode of generating quantitative measurements, by addressing strengths first and then following with weakness, opportunities and threats.

The follow up questionnaires were designed based on the development of a new EMS for NTU that would be specific based on the data analysis of the SWOT and mRating Value questionnaires. There are additional questionnaires on each of the specific new strategies and empirically scoring for the factors supporting the proposed strategies with reference to ISO 14001 specific attributes for a robust EMS (Figures 4 -9, pp.277-284).

Dyson (2004) stated that SWOT analysis, may have an old fashion feel about its framework, but it has stood the test of time and is flexible to readily be incorporated to newer management approaches such as competency-based analysis. This research relies on the ARC's own and shared qualitative mental models and belief structures about how the EMS should be performing in an ideal situation. Diagram 20 (p.176) recommends adoption of the belief structures of the ARC as knowledge framework that the researcher actively modifies from qualitative to quantitative empirical perspectives that is coherent and knowledge consistent representation of experience.

Table 12 - Environmental Management Systems SWOT and mRating Value Questionnaires

(A) Strengths [Actual Empirical Data Sets Presented in Appendix 3, p.371]

Action Reseaarch Committee Member Reference			A	B	C	D	Av	A	B	C	D	Av
Questions Key Nomenclature Reference are:	**What are the strengths of NTU when**											
SWOT STRENGTH = QS	**(QS1)** Adopting best environmental management practices?	**(QSm1)** Examination of the internal strengths of NTU in implementing (or maintaining from a pre-existing) environmental management system										
mRATING STRENGHT = QSm	**(QS2)** Scope 3 (Travel) emissions data management efficiencies?	**(QSm2)** By evaluating NTU's management practices such as the accounting for environmental impacts.										
	(QS3) How does NTU operate its data recording procedures?	**(QSm3)** EMS meeting targets of NTU's carbon policy and meeting HEFCE's compliances.										
	(QS4) How is NTU perceived externally?	**(QSm4)** Ensuring the EMS meet the shared value base in order to operate effectively to reduce Scope 3 (T) carbon										
	(QS5) How effectively has NTU managed its environmental strategic objectives?	**(Qsm5)** EMS meeting the long term objectives										
	(QS6) How effective has NTU managed its Scope 3 (Travel) strategic aim?	**(QSm6)** NTU EMS using the best resources available of scope 3 (T) reduction efficiencies.										
	(QS7) NTU's organisational mission for Scope 3(Travel) reduction strategies	**(QSm7)** EMS Operational objectives in place for reducing Scope 3 (T) carbon emissions										
	(QS8) How is Scope 3 (Travel) carbon emissions reductions managed	**(Qsm8)** EMS core systems for NTU manage Scope 3 (T) carbon emissions.										
	(QS9) How does the overall vision of Scope 3 (Travel) carbon mitigation?	**(QSm9)** NTU's EMS overall purpose for managing carbon emissions.										
	(QS10) How does NTU's objectives relate to the overall purpose and mission for the next 3-5	**(QSm10)** EMS meeting the demands from stakeholders from carbon accountability										
	Average Value											

(B) Weakness [Actual Empirical Data Sets Presented in Appendix 4, p.376)

Question	SWOT Questionnaire	EMS Evaluation Methodology	SWOT Values					mRatings Value				
Action Reseaarch Committee Member Reference			A	B	C	D	Av	A	B	C	D	Av
Questions Key Nomenclature Reference are:	What are the weakness of NTU when											
SWOT WEAKNESS = QW	**(QW1)** adopting environmental practices	**(QWm1)** Examination of NTU's weaknesses and the HE Sector in general when adopting environmental management practices.										
mRATING WEAKNESS = QWm	**(QW2)** HEFCE compliances	**(QWm2)** Examining if an effective EMS is dependent on IT Infrastructure										
	(QW3) Difficulty in understanding and recording carbon emissions	**(QWm3)** Ensuring that the staffing levels is able to manage the EMS.										
	(QW4) Evaluating if NTU has limited access to capital funding.	**(QWm4)** Evaluating NTU's strategic mission can be active for Scope 3 (Travel) reductions.										
	(QW5) stringent bureaucratic requirements	**(QWm5)** Evaluating NTU's day to day EMS operations are efficient.										
	(QW6) Lack of appropriate management.	**(QWm6)** Ensuring that the EMS operational objectives are achievable.										
	(QW7) How does the collective mission of NTU's vision of meeting its Carbon Reduction Targets?	**(QWm7)** NTU EMS are complex and difficult to prepare detailed instructions that will feed into work plans.										
	(QW8) How does the long term changes that NTU is able to implement?	**(QWm8)** Long term EMS challenges that can effect efficiencies.										
	(QW9) How does NTU maintain appropriate carbon emissions record keeping?	**(QWm9)** Keeping appropriate records for carbon audit is cumbersome and difficult to implement.										
	(QW10) How does NTU ensure performance measures are adequate?	**(QWm10**) EMS performance measures are difficult to measure										
	Average Value											

(C) Opportunities [Actual Empirical Data Sets Presented in Appendix 5, p.384]

Question	SWOT Questionnaire	EMS Evaluation Methodology	SWOT Values					mRatings Value				
Action Reseaarch Committee Member Reference			A	B	C	D	Av	A	B	C	D	Av
Questions Key Nomenclature Reference are:	What are the opportunities of NTU when											
SWOT OPPORTUNITIES = QO	**(QO1)** adopting new environmental management practices?	**(QOm1)** Examines the opportunities NTU may face externally when adopting such environmental practices.										
mRATING OPPORTUNITIES = QOm	**(QO2)** Scope 3 (T) pollution control measures	**(QOm2)** Evaluating information, systems, processes and challenges such as 'green campus' and new financial challenges.										
	(QO3) carbon emission pollution auditing expertise to other HEI	**(QOm3)** Investigating the potential benefits of an efficient EMS for carbon accountability										
	(QO4) Scope 3 (Travel) consultation opportunities to other HEIs.	**(QOm4)** Investigating the potential of EMS improvement for Scope 3 (T) carbon reductions.										
	(QO5) Influencing HEFCE carbon policies on Travel management.	**(QOm5)** Increased implementation of carbon reduction with less complexities and supportive policies										
	(QO6) Developing best practices of Scope 3 (Travel) carbon accountability for HEIs	**(QOm6)** Implementing EMS systems that are applicable to Scope 3 (Travel) carbon management.										
	(QO7) Availability of more funding support for developing specific EMS for HEIs	**(QOm7)** EMS delivering pollution control management that can be transposed to waste, energy, economy and sustainability										
	(QO8) Establishing carbon accountability for calculating carbon credits	**(QOm8)** EMS systems that offer Scope 3 (Travel) carbon monitoring and carbon audits for management purposes.										
	(QO9) Developing EMS standards for HEIs	**(QOm9)** EMS that can provide evidence for eco labelling of campus										
	(QO10) Generating innovative EMS	**(QOm10)** EMS for integrating sustainability and environmental management systems.										
	Average Vale											

(D) Threats [Actual Empirical Data Sets Presented in Appendix 6, p.393]

Question	SWOT Questionnaire	EMS Evaluation Methodology	SWOT Values					mRatings Value				
Action Reseaarch Committee Member Reference			A	B	C	D	Av	A	B	C	D	Av
Questions Key Nomenclature Reference	What are the threats of NTU when											
SWOT THREATS = QT	**(QT1)** adopting environmental management practices?	**(QTm1)** Investigating the threats to NTU adopting such environmental practices.										
mRATING THREATS = QTm	**(QT2)** lack of HEFCE support and skills shortages	**(QTm2)** Evaluating future environmental regulations and additional capital expenditure capping.										
	(QT3) impact of funding opportunities for capital projects to reduce carbon emissions	**(QTm3)** Evaluating the communication demands of all stakeholders										
	(QT4) How the barriers for carbon reduction polices (transport technology)	**(QTm4)** Evaluating the lack of long term planning tools for NTU's EMS for implementation of policies.										
	(QT5) what the competition from other universities in the UK for a greener university	**(QTm5)** Investigating the availability of computing systems to be able to cope with carbon accounting.										
	(QT6) Carbon reduction operational standards are difficult to implement and costly.	**(QTm6)** In view of the overwhelming production of carbon data, how secure is this data to external threats.										
	(QT7) Future insecure factors of hydrocarbons for travel.	**(QTm7)** Analysis of EMS failure in implementation of systems and accountability of Scope 3 (Travel) carbon reductions.										
	(QT8) Adverse political mandatory legislations for accountability	**(QTm8)** Analysing lack of skilled management and manpower for delivering an efficient EMS.										
	(QT9) Severe change in Climate Change	**(QTm9)** Analysing the lack of sustainability attitudes of Staff and Students by NTU										
	(QT10) future legislation to implement EMS	**(QTm10)** Evaluating the lack of Top Management for support of NTU's EMS										
	Average Value											

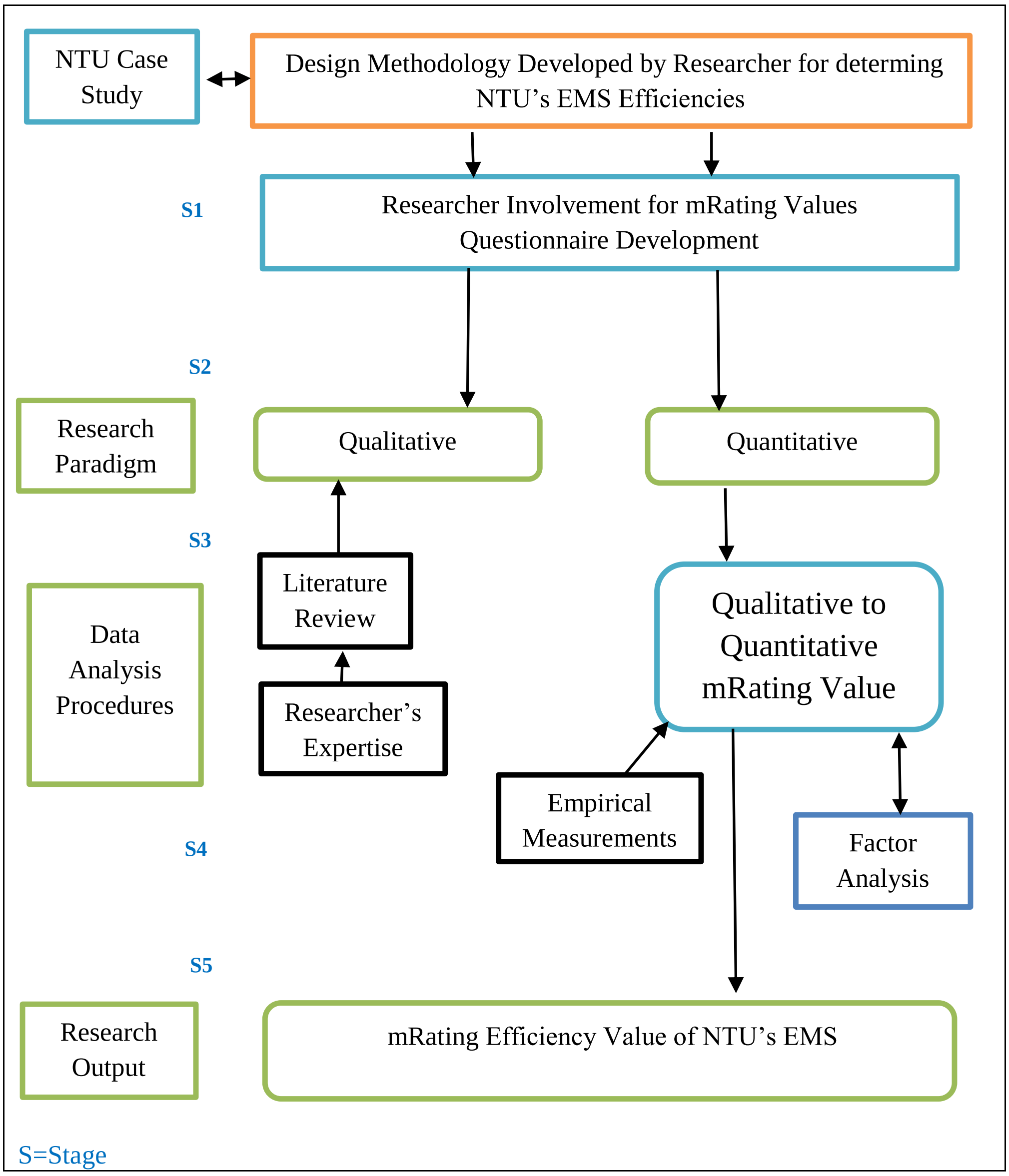
Table 12 (A-D)(pp.178-181) presents the four SWOT questionnaires for the investigation and evaluation of NTU's EMS efficiency status. The questionnaires are broken into Strengths, Weaknesses, Opportunities and Threats. SWOT answers and mRating value are qualitatively determined by the ARC and transposed quantitatively by the researcher. These questionnaires are not related to each other.

The above research methodologies had been adopted from Kajanus et al (2012) research methodologies used in forestry management, by using the SWOT analysis and mRating value measurements as a qualitative examination and transposed into quantitative values to evaluate the internal and external factors at 'play' within NTU's environmental management system. These methodologies probe NTU's specific Scope 3 (Travel) environmental management system efficiency status by attributing empirical measurements that offer meaningful interpretations of efficiencies and for effective management decision making. Data obtained from these methodologies are used to redesign a new EMS for management decision making.

3.9 mRATING VALUE SCALE METHODOLOGY

Environmental management systems have become an important management focal issue for decision making by HEIs concerning carbon abatement policies (Disterheft et al, 2012). To effectively measure the efficiencies of an EMS and HEIs are well placed to develop empirical measurements to determine its efficiencies empirically. This empirical efficiency is measured using rating values ranging from 1 to 10 being the highest attributable value. The rating value tool instrument in this research has been designated as 'mRating values' which is specific to this research as an empirical efficiency value. Singh et al (2011) stated in their research concerning empirically rating the degree of sustainability by companies using rating values for policy making and for communicating complicated environmental information as a simplified value that can be easily be understood by stakeholders. Diagram 21 presents the mRating value design methodological plan as applied in this research.

Diagram 21 – mRating Value Design Methodological Plan



Developed by the researcher (Chelliah, 2015)

Stage 1(S1) - The research methodological design involves the action research committee, which is led by the researcher to focusing on the development of the mRating value questionnaire evaluating NTU's EMS efficiency rating as a key management feature.

Stage 2(S2) – The research questionnaires had been developed from the literature review and action research committee's experiences. The questionnaires are open semi structured qualitative to quantitative in perspective.

Stage 3(S3) – The researcher with the consensus of the action research committee transposes the qualitative interpretations to quantitative empirical values for research analysis and decision making.

Stage 4(S4) – The quantitative empirical values are further statistically analysed using factor analysis for ensuring data integrity and validity

Stage 5(S5) – The research output represents the mRating value of NTU's EMS efficiency value

Various types of assumptions are to be investigated in using the mRating Value qualitative research for evaluating EMS efficiencies by focussing on the different aspects of systems efficiencies, stakeholders, and reporting compliances. This research focuses on assumptions for evaluating the efficiencies of NTU's EMS. The qualitative questionnaires (Table 12, pp.178-181) concern assumptions based on the research paradigms of qualitative and quantitative perspectives. The action research committee (p.156) presents the qualitative questionnaire replies. These replies are subjected to detailed analysis by the researcher with reference to the research questions and objectives (Table 1, p.32) ensuring the results are subjected to satisfactory evaluation and analysis for decision making by the researcher.

The following core assumptions are made for mRating value (refer to Diagram 21, p.183) that are considered particularly salient to the evaluation of NTU EMS efficiencies:

- The action research committee consisted of experts within NTU with considerable knowledge concerning the efficiencies of NTU's EMS efficiencies from a qualitative perspective. The ARC's knowledge, experiences and references to the literatures review were key subjective attributes provided for this research's credibility.

- The researcher attributed the specific mRating value rubric from 1 to 10, with 10 being the best. The researcher applied the best empirical reference value for the conversion of the qualitative to quantitative interpretation of the qualitative EMS efficiency rating.

- Statistical factor analysis is to be applied to the empirical data sets for data integrity and validity.

The mRating questions development from the knowledge and management systems 'gaps' synthesised from published references (column 4). Each of the question is independent and not related to each other [Tables 12 (A-D)(pp.165 -168)].

The rating scale tool uses the SWOT format as presented in the questionnaires Table 12 (A)-(D)(pp.178-181) and their corresponding quantitative values from qualitative interpretations concerning the HEIs' EMS. The rating tool is similar in structure to the Thrustone or verbal rating scales used in social sciences (Socialresearch, 2006) and Plotnick et al (2008). Other value ratings using Likert Scales (scaling responses) are not suitable due to the complexities of measuring EMS, Scope 3 carbon emissions and measuring carbon abatement performances (Baumgartner, 2009 and Rindfleisch et al, 2008). The mRating value tool measures performances from sets of highly correlated SWOT factors (Pesonen and Horn, 2014) and subjected to statistical analysis to determine its validity (Chung et al, 2008). The mRating value methodological tool presents a platform to prioritise Scope 3 (Travel) carbon emissions performance over statements concerning environmental emissions policies and carbon reduction strategies by providing an empirical measurement that can be easily understood. Lukman et al (2010) researched ranking of environmental performance between universities using a ranking systems using ‘Analytical Hierarchy Process’, which may be more accurate but practically very complex to execute. Bencze et al (2012) research in the construction industry had similarly introduced a concept of performance based rating systems that focuses on improvement in the carbon performance of buildings with the Leadership in Energy and Environmental Design - LEED Rating Value (Leed, 2014). Kajanus et al (2012) stated that the rating value tool provided the means for analytically determining the importance of internal and external SWOT qualitative factors of environmental management and performance values targeting the informational needs of stakeholders who are requiring specific measurement scaling values.

3.9.1 JUSTIFICATION OF USING THE RATING SCALE TOOL FOR EVALUATING ENVIRONMENTAL MANAGEMENT SYSTEMS

In establishing a rating value methodological tool for assessing the effectiveness of Scope 3 (Travel) carbon emissions environmental management systems requires an empirical rating value system that is widely accepted as a ranking framework used in other industries (Marginson and Van der Wende, 2007). The Higher Education Associations Sustainability Consortium (HEASC)(Heasc, 2013) was formed in 2005 in the USA as an informal network of HEIs launching a commitment to sustainability, lower carbon emissions and had developed a campus rating system.

Within HEASC, The Association for the Advancement of Sustainability in Higher Education (AASHE)(Aashe, 2013a) was formed in 2006 with the same ethos and practicality for establishing a campus sustainability rating measurement in the USA and Canada. The researcher acknowledges the ethos of the AASHE (Aashe, 2012) for developing a specific rating value system for HEIs using standardised frameworks to measure the efficiency of a HEI's sustainability value measurement called sustainability tracking, assessment and rating systems (STARS)(Aashe, 2014). This research methodology emulates the principles of STARS that had been specifically developed for HEIs greater accuracy when evaluating campus EMS (Wigmore and Ruiz, 2010). Shi and Lai (2013) reported that empirical rating values must be transparent and have a self-reporting framework open to all HEIs to understand their environmental management system performances. This tool has the infrastructure mechanisms for a ranking framework that is able to evaluate the subjective nature and multi criteria attributes concerning carbon emissions and policy management. This tool enables NTU to communicate its environmental management system performances to HEFCE and other stakeholders concerning carbon emissions performance management in a meaningful way. Lozano et al (2013a) in their research on sustainability rating in universities stated that the development of a rating value methodological tool offers universities to undertake meaningful comparisons with other universities using a common framework and criteria that contributes to useful information exchange and mutual learning and comparisons between HEIs.

Kamal and Asmuss (2013) benchmarked HEI sustainability using the rating value tool whilst, Beringer et al (2008) researched the state of sustainability at Canadian Universities argued that HEIs who are involved in carbon reductions would require more carbon emission transparencies when developing rating values which are key drivers for assessing the University's carbon status and carbon reduction performance measurement values.

3.9.2 RATING VALUE SCALE AS USED IN THIS RESEARCH

The rating value methodological tool is an assessment evaluation tool for ascertaining and demonstrating leadership by empirically evaluating EMS efficiencies (Shi and Lai, 2013). Research by Riddell et al (2009) at a HEI indicated that this methodological tool has the mechanism in ascertaining empirically campus EMS performance. This has relevance for NTU to complying with HEFCE (Hefce12, 2012), HESA (Hesa 2014) and other stakeholders for establishing a suitable EMS for Scope 3 (Travel) carbon emissions management.

The mRating value methodological tool empirically formulates a qualitative quantum, quantitatively as a measurement value in determining NTU's environmental management efficiencies and carbon performances accountability of Scope 3 (Travel) carbon emissions. The mRating methodological tool is applied in tandem with the EMS SWOT evaluations and quantitatively providing a numerical quantum value determining its performance value.

The mRating will have a maximum score of 10 points called 'point allocation' (PA) as used in Bottomley and Doyle (2013) research as a flexible quantitative measuring value tool. The mRating empirical value had been determined by the Action Research Committee (p.156) and presented in Table 12 (A)-(D)(pp.178-181). This mRating Value ranking tool measures NTU's current EMS efficiencies. The mRating value data analysis will be used to exert significant influences for improvement planning concerning environmental management and performance. Implementing any new EMS will be similarly being evaluated.

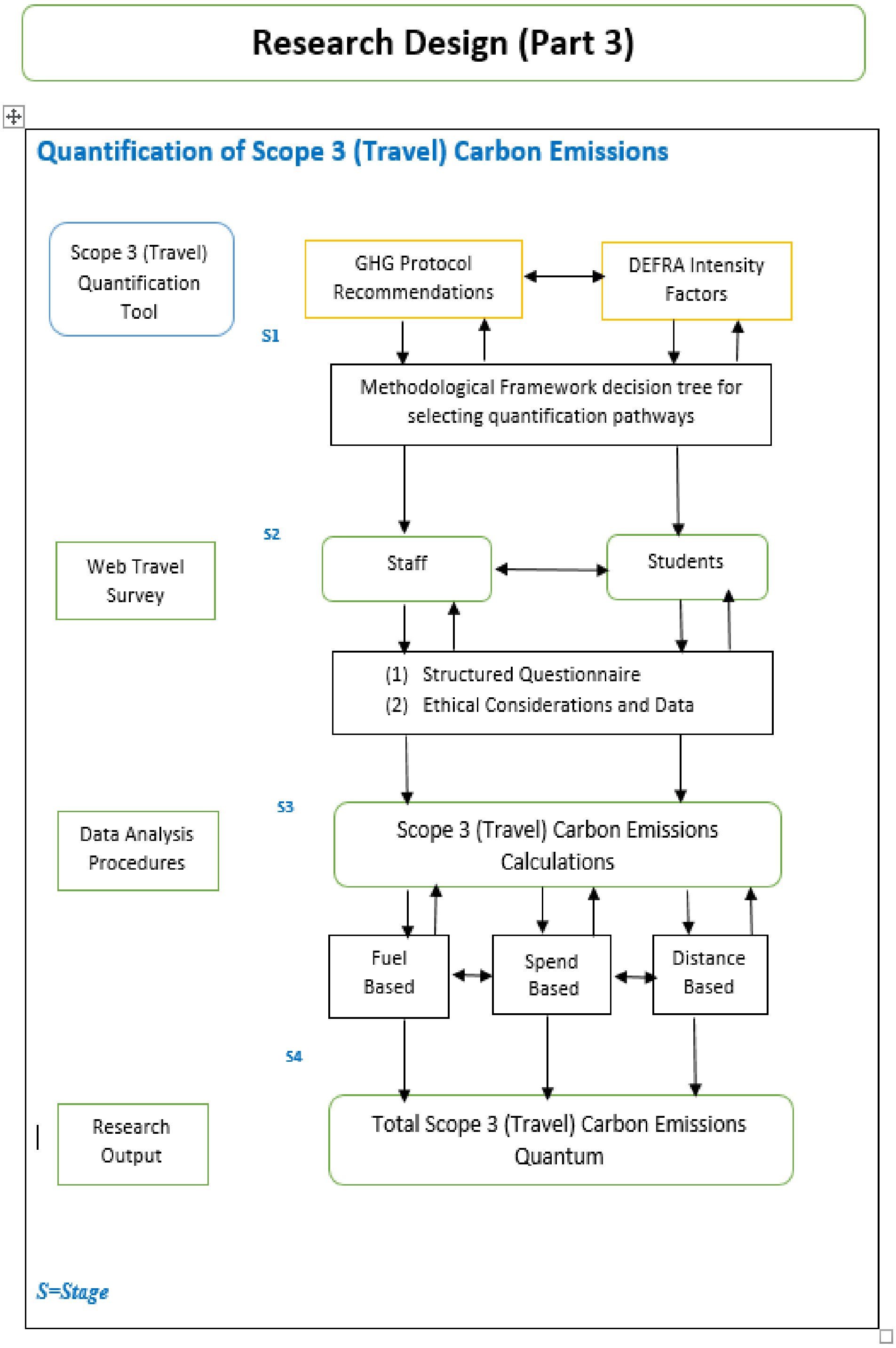
3.10 SCOPE 3 (TRAVEL) CARBON EMISSIONS QUANTIFICATION METHODOLOGY

Scope 3 (Travel) carbon emissions are direct consequences of undertaking commuting and travel actions from transportation sources not owned or controlled by the organisation (Lai, 2015). Scope 3 emission quantification have become necessary for universities to comply with HESA (Hesa, 2013), HEFCE (Hefce4, 2012), the Companies Act 2006 (Regulation 2013)(Gov, 2013a) and the Climate Change Act 2008 (Cca, 2008). HESA (Hesa, 2013) recommended that all HEIs are required to report their total carbon footprint. Pre 2014 carbon footprint reporting represented Scope 1 and 2 carbon emissions of their own facilities, equipment and vehicles and omitted Scope 3 emissions from transport, recycling, supply chains and student housing. Travel carbon emissions is categorised by the type the travel mode, distance travelled and relevant emission factors.

The core principles of calculating Scope 3 (Travel) emission are based on the recommendations by HEFCE (Hefce4, 2012) based on measures that avoid double counting of emissions between the different Scope categories. The accuracy of emissions calculation will depend on the quality of the data available and carbon conversion rates used (Hefce4, 2012). HEIs quantification benefits is to positively engage employees to reduce emissions from business travel and staff/student commuting (Trust, 2014). Quantification are measured in CO2e (Defra, 2012).

From the research design perspective, it is the focus of this research to develop a consistent Scope 3 (Travel) quantification approach as shown in Diagram 22(p.190).

Diagram 22 - Summary of the methodologies for the quantification of Scope 3 (Travel) Carbon Emissions



The research design part 3 above, Diagram 22 presents the summary methodological processes the quantification of Scope 3 (Travel) carbon emissions for eliciting the data for the computations. The research design will be focussing on determining the proportion of Scope 3 (Travel) carbon emissions that are generated from road, air, rail travel modalities, multiplying this with their carbon intensity factors giving rise to the carbon quantification footprint. The following describes Diagram 22 (p.190)

Stage 1(S1) - GHG Protocol Recommendations and DEFRA intensity factors form the basis of the Scope 3 (Travel) quantification tool. The design effort will be in tandem with Figure 3 (p.194) that is providing the methodological framework decision tree for selecting the quantification pathways.

Stage 2(S2) - Web travel survey of staff and students using semi structured questionnaires to determining their travel data and specifying their journey trips.

Stage 3(S3) - Data analysis procedures design mechanisms had included the three travel carbon emissions basis (volume consumed and distance travelled in UK) for the quantification of Scope 3 (Travel) carbon emissions calculations.

Stage 4(S4) - The research output involved the calculation of NTU's Scope 3 (Travel) carbon foot print

3.10.1 JUSTIFICATION OF SCOPE 3 (TRAVEL) CARBON EMISSIONS QUANTIFICATION TOOL USED IN THIS RESEARCH

The quantification tool is similar to an accounting tool that measures carbon emissions from a given set of distance travel data or other energy data units (Sari and Bayram, 2013). HEFCE (Hefce, pp.2-3, 2012) published guidance reports containing information on procedures as to how to calculate Scope 3 (Travel) generated from travel data involving commuting and business travel. There are two organisations with which HEFCE had aligned its guidance with important credibility organisations. These are:-

(i) The Greenhouse Gas Protocol (Ghg, 2013)(Chapter 2.4.1). Offers organisations an internationally accepted management tool for carbon quantification sanctioned by the World Resource Institute (Wri, 2013a)

(ii) DEFRA (Defra, 2012) guidance on carbon intensity factors are a series of calculations for determining GHG inventories from transportation including air and sea travel.

On practical and compliance levels, HEIs are recommended to use (i) and (ii) above as their quantification tool guidance that will be aligned with the UK and HESA legal requirements. These guidelines provide standardised quantification methodological tools for HEIs and all UK based organisations.

This research's quantification methodological tool identifies the various travel modes to determining its corresponding carbon emissions. Commuting by UK staff/students and overseas students/business travel are the principal Scope 3 (Travel) carbon emissions identified in this case study research. The quantification tool uses the best guidance practices concerning carbon accounting protocols described by HEFCE (Hefce, 2012) and WRI (Wri, 2013a) and in particular the recommendation based on the Greenhouse Gas Protocol (Ghg, 2012 and Hefce, 2010). Garcia and Freire (2014) research in the particleboard industry stated that the recommendations of the GHG Protocol for a quantification methodological tool uses core carbon accounting principles, standardised structure and best practice recommendation. HEFCE (Hefce4, 2012) recommendations for a standardised Scope 3 (Travel) carbon emissions tool will provide statistics for comparing HEI performances, sharing carbon reduction strategies, evaluating diminishing resources and impacts of climate change. Buys et al (2014) argued that quantification tool must be transparent, credible, and defensible against misinterpretation by policy makers and stakeholders.

3.10.2 SCOPE 3 (TRAVEL) CARBON EMISSIONS QUANTIFICATION METHODOLOGICAL TOOL USED IN THIS RESEARCH

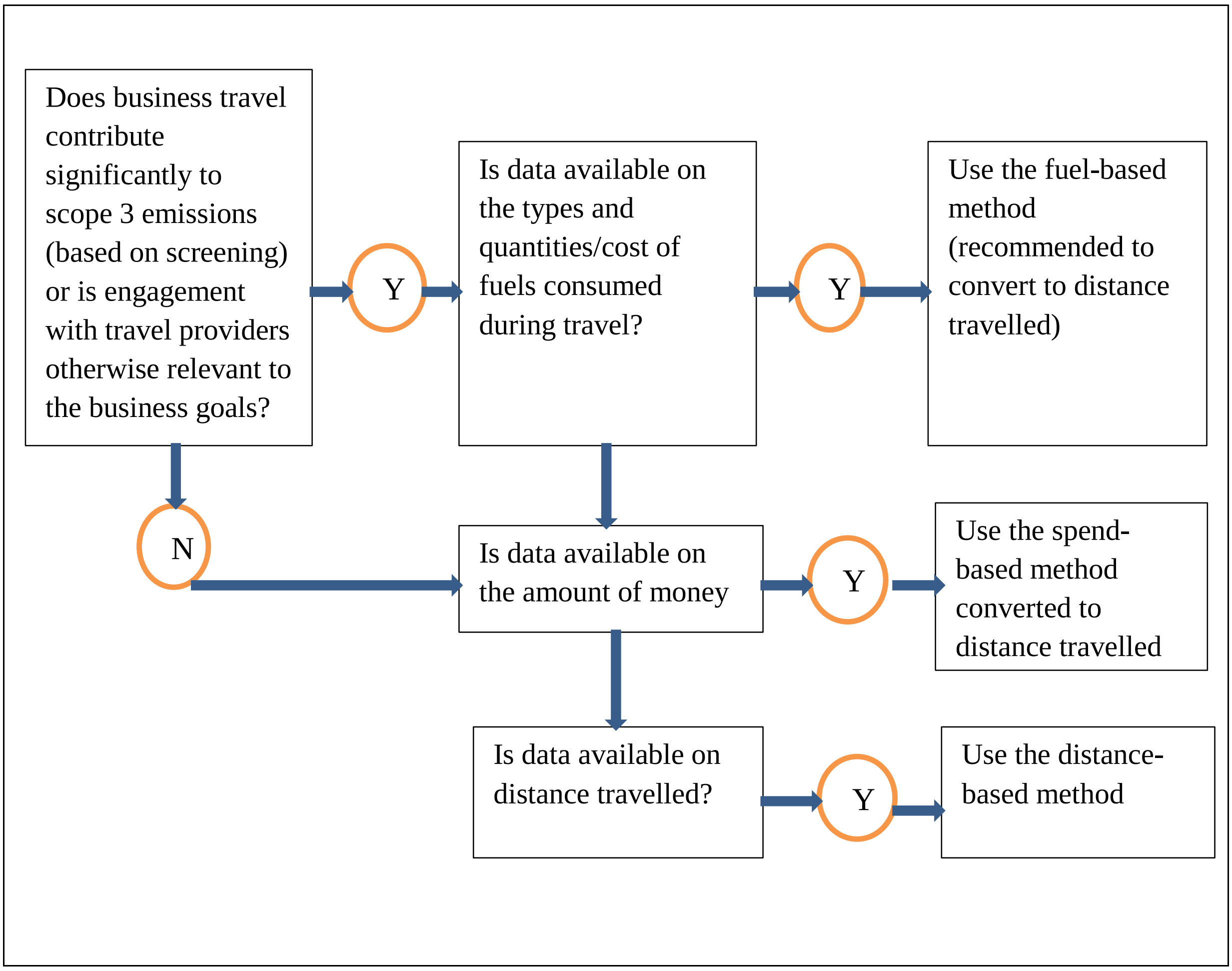
The quantification tool in this research uses the distance travelled based accounting system approved as a 'quantification tool' recommended by the UNFCCC (United Nations Framework Convention on Climate Change (Unfcc1, 2014). (Wiedmann and Minx, 2007 and Ozawa-Meida et al, 2013). Mozner (2013) stated that the distance travelled tool presents a methodology to measure Scope 3 (Travel) carbon emissions correctly assisting HEIs to focus on the right carbon policies and carbon reduction solutions (Figure 3, p.194). Mozner also stated that the distance travelled base model of this quantification tool sets the de facto standard for Scope 3 (Travel) carbon accounting. Skelton (2013) stated that this distance travelled journey based tool is easy to use and cost effective.

Travel data obtained from the NTU travel survey distance travelled journey trips (on 25 February 2013), overseas business travel and overseas student travel are grouped into different travel mode categories i.e. bus, train, air travel etc. From the travel data, calculation methodologies are applied to determine the specific Scope 3 (Travel) carbon emissions value. The methodological process applied is based on the distance travelled based model for carbon quantification using the framework calculation model as presented in Figure 3 (p.194). This framework presents the distance travelled based carbon emissions accounting methodologies used in this research and similarly been used by other researchers concerning Scope 3 carbon emissions (Weidmann, 2009 and Ozawa-Meida et al, 2013). The methodologies will collate all distance travel modes categories for final calculation of NTU's Scope 3 (Travel) which are identified in Table 14 (p.196) as (i) used of fuel consumed base

(UK only) (ii) monetary spend base (converted to distance travelled and (iii) distance travelled using a particular travel mode, i.e. train, bus, vehicle type, air travel etc.

The quantification of Scope 3 (Travel) carbon emissions of this case study will apply the 2012 government GHG conversion factors for July 2013 developed by DEFRA (Gov, 2013) as presented in Table 13, p.195 for company reporting.

Figure 3 - Methodological framework decision tree for selecting the quantification of Scope 3 (Travel) carbon emissions - *(Developed for this research methodology)*



Adapted from Greenhousegas Protocol (Ghg, 2013)

Each organisation has the choice of adopting one or all three GHG quantification estimations and there are no specific recommendations of which method to use.

Figure 3 (p.194) above shows the methodological framework processes for selecting the appropriate quantification method concerning NTU's emissions from Scope 3 (Travel) modes.

The formula for calculating the emissions is detailed in Table 13 below.

Table 13 – Carbon Emissions Calculations

Carbon Emissions Calculations				
Distance Based on Table 14, p.196	Multiply	Conversion Factor	Equals	Carbon Emissions
	x		=	

To calculate Scope 3 (Travel) carbon emissions HEFCE (Hefce12, p.6, 2012) recommends that Scope 3 (Travel) quantification must consider three inputs.

- The travel mode;
- Distance travelled and
- An appropriate conversion factor

Conversion factors are published by the Department for Environment Food and Rural Affairs (Defra)(Defra, 2012) and the Department of Energy and Climate Change (Decc) (Gov, 2013). Table 14 (p.196) presents the methodology for the three different quantification methods of Scope 3 (Travel) that would be used for the quantification of NTU's carbon emissions. DEFRA recommends organisations to use tonnes of CO_2e. when reporting carbon emissions (Defra. 2012).

Table 14 - Types of Scope 3 (Travel) based methodology (Ggh, 2013)

Scope 3 (Travel) Type	**Methodology Used**	**Limitations of Each Method**
Fuel based method (UK Only)	determining the particular fuel (diesel or benzene consumed, engine size and applying the appropriate emission factor.	(i) may not accurately reflect consumption with engine size (ii) no account of engine efficiencies taken into account
Spend based method (converted to distance travelled)	determining the travel mode and monetary spend for UK only. Converted to distance travelled for UK and Overseas distances	(i) arbitrary due to world price of fuel fluctuations (ii) inflation and currency factors can distort prices
Distance based method (overseas students, business and commuting)	determining the distance and mode (aircraft, rail, land and sea transport etc) and applying the appropriate emission factors	(i) arbitrary due to dependence on traffic, weather and speed (ii) distance travelled are estimates

Table 14 above, presents the methodologies used for determining NTU Scope 3 (Travel) carbon emissions based on land/sea /sea travel data (distance travel mileage) framework. The distance travelled data (or UK volume of litres consumed by hire vehicles) or distance travelled by staff and students in the UK only. These are primary sources data for use by all carbon emissions reporting HEIs for calculating their Scope 3 (Travel) carbon emissions including NTU.

3.10.3 ASSUMPTIONS USED FOR THE CALCULATION OF GHG EMISSIONS FROM THE TRAVEL SURVEY AND INTERNATIONAL STUDENT TRAVEL

Emissions are calculated using the distance travelled model (Figure 3, p.194) of the different emanations sources by the corresponding emission factors providing the Green House Gas. All emissions are presented in CO2 equivalents (Chapter 1.10, p.52). The travel survey journey trips had provided the staff and student travel information to estimate the following based on annual NTU policies and agreement with the action research committee. The following assumptions had been adopted from De Montfort University carbon management planning (De Montfort, 2011) for use at NTU.

- Campus (City, Brackenhurst and Clifton)
- Staff and students (full time only)
- Mode of transport (single occupancy car driver, car share, bus, train, bike, walk or taxi)
- Starting postcodes to calculate distance (<5, >5 <9, >10<19,>20<29, >30<39, >40<49,>50 [Data calculation used with highest mileage distance only]
- Frequency of use of different mode of transportation (to estimate the amount of journeys undertaken per week and distance travelled)
- Engine size of car used (small & medium- petrol and diesels) 80% (small petrol), 15% (medium petrol), 5% Diesel (Determined by NTU transport management and DEFRA (Defra, 2012a)(p.295) and adopted in this researcher
- NTU human resources provided data for Staff and Student Headcount
- Staff commute to iniversity 40 weeks per annum (determined by NTU) (p.222)
- Students commute for 37 weeks per academic year (determined by NTU) (p.222)
- Part time students were excluded for 2013
- Demographics of NTU overseas students during 2013 were provided by NTU administration to the ARC (subject to data protection act information).

International Students

Data for the number of overseas students per country of origin were amalgamated to geographical locations in line with HESA (Hesa, 2014) recommendations for classifications. The number of international students is restricted to the current registered student at NTU (Table 29, p.299).

- 15% of NTU students are overseas studnets using air transportation (Table 30, p.303)(OP21(B)(p.210) [STARS credit factor methodology adopted]
- 15% of international student families use air transportation (STARS, Table 30, p.303)[STARS credit factor value methodology adopted]
- Assumption that international students use their capital cites (furthest from the geographical zone) to London Heathrow (developed by the researcher).
- Distances calculated per geographical location to the UK as per DEFRA guidelines (Defra, 2012b) of point to point distance travelled to the UK. Africa (5,000km), Asia (9,700km), Australasia (17,000km), Caribbean (7,500), Europe – short haul (1,500km), Middle East (5.500km), North America (7,000km) and South America (9,400km). The Researcher advices these are maximum distances.
- Assumption of 2 student trips per academic year [rail from Heathrow to Nottingham to be added as recommended by NTU administration (p.302, 2nd para)]
- Assumption of 3 individuals per graduating family per year from each region [rail from Heathrow to Nottingham to be added as recommended by NTU administration (p.302, 3rd para)]

3.11 SCOPE 3 (TRAVEL) ENVIRONMENTAL PERFORMANCE INDEX METHODOLOGY

The Companies Act 2006 [Regulation 2013, Section 414-416, (Gov, 2013a)] had extended directors' duties to report on material environmental impacts on the organisation in the long term, its employees, its suppliers and also the impact of organisation on the community and the environment. This has also become a reporting requirement of the EU Accounts Modernisation Directive (Eu, 2014). The Act extended the directors' report (Enhanced) to organisations unable to state the environmental matters affecting their businesses [s414 (1-4), (Gov, 2013a)] can instead, which is applicable to the HE Sector. HEIs should report key performance indicators concerning their carbon emissions.

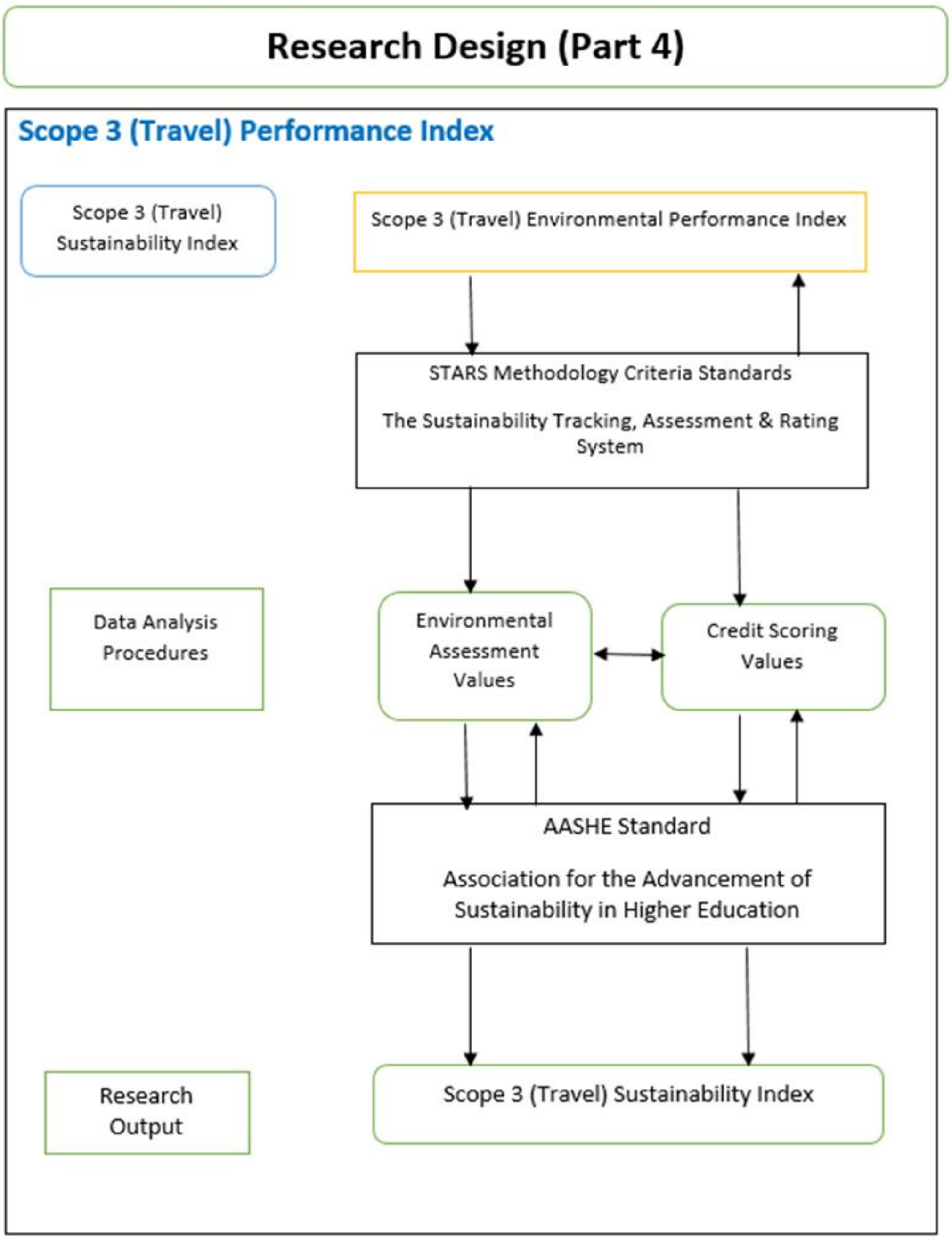
Combined with Sections 473(3), 1290 and 1292(4) of the Companies Act, 2006 (Regulation 2013) has provided a legal requirement for organisations and HEIs disclosing carbon performance indexes in the directors' report that must be audited and certified (Gov, 2013). This requirement is also part of corporate governance.

The Scope 3 (Travel) performance index provides a microcosm view of sustainable transportation at NTU by empirically reporting a measurement that is a synthesis of the key transport sustainability factors. The central element of the performance index is the examination and re-evaluation of sustainability transportation highlighting ways to improving its carbon emissions impact. Gandhi et al (2006) stated that formalised monitoring and assessment is a quantification of performance for management to monitor continuous priority improvements. They also stated that progress of the sustainability improvement processes can be measured and demonstrated in terms of key operational performance indicators.

The selection criteria for the data in the Scope 3 travel performance index for this research had been adopted from Yale University (Yale1, 2014) as follows:

- Relevance – The performance index tracks the important issues in a manner that is used in the HE Sector.
- Performance Orientation – The performance index provides empirical data on the ambient transport sustainability outcomes
- Data quality and completeness – The data represent the best measure available

Diagram 23 – Summary of the methodologies for Scope 3 (Travel) Performance Index



The concept of Scope 3 (Travel) carbon emissions sustainability operations, the development of its sustainability index is an essential management tool for NTU to determining an organisation's carbon abatement efficiencies and contributing to meeting its environmental emissions targets with reference to the CCA (2008).

This research's design concept described in Diagram 23 (p.200) will be adopting the sustainability methodological tool widely recommended as an indicator in the Higher Education Sector, principally in North America, drawing inferences about the campus travel sustainability attributes and analysing them. The summary of the methodologies used for Scope 3 (Travel) Performance Index is explained as follows:

Step 1 - The research design focus is to replicate the sustainability index criteria developed by STARS as the established Standard as used in the Higher Education Sector worldwide.

Step 2 - The data analysis procedures and credit scoring research design focus, represents the AASHE Standard as used in the Higher Education Sector mostly in the USA.

Step 3 – The research output design concept presents the development of a Scope 3 (Travel) sustainability index that is part of the overall campus index.

3.11.1 JUSTIFICATION FOR USING THE STARS METHODOLOGY FOR SCOPE 3 (TRAVEL) PERFORMANCE INDEX CALCULATION TOOL IN THIS ESEARCH

Organisations are increasing focusing their understanding on how to measure, manage and communicate their environmental performances via key performance indicators. This research's methodological tool selection provides the most detailed classification for a performance index currently adopted by Higher Education Institutes in the US and Canada (Aashe, 2013). This principal KPI enabler offers a transparent reporting framework for HEIs to measure HEI sustainability performances (Aashe, 2013).

(i) STARS (Sustainable Tracking and Assessment & Rating System)

STARS offered the following advantages: -

(a) Has a flexible framework for understanding and evaluating Scope 3 (Travel), Scope 1, 2, 3 and other sustainability performance measurements specially designed for the HE Sector

(b) Offers common measurement processes enabling comparisons developed from the consensus from HEI campuses

(c) Performance index spurs incentives for continuous improvement on carbon reduction

(d) Communication of carbon performance information to stakeholders and information sharing of HE carbon abatement practices and performance.

The other methodology was the Environmental Performance Index (EPI – Yale Centre for Environmental Law and Policy) (Yale, 2014) providing science-based quantitative metrics not taken up by HEIs.

This empirical methodological tool provided (a) carbon abatement and management leadership tool with essential sustainability knowledge resources (b) offered opportunities for NTU for continuous carbon abatement development (c) a framework for describing the summary empirical quantum created with a carbon performance index that will be contributing to lower carbon emissions and sustainability initiatives (Aashe, p.1, 2013).

The STARS methodological tool focuses in recognising the unique Scope 3 (Travel) challenges, constraints, and opportunities for lower campus carbon emissions. The tool can be described as a “tool for looking at all facets” of a HEI involving campus carbon reduction operations and planning (Aashe, p.3, 2013).

The justification of using the STARS performance index are as follows: -

(a) STARS will provide this case study research with a key travel management index that enables measuring the travel sustainability attributes

(b) Facilitates Scope 3 (Travel) carbon abatement management policies

(c) The index provides a measurement of carbon abatement progress and contributes to better carbon management and resource allocation.

(c) The index has the ability to benchmarking and comparison with other HEIs

The STARS methodological tool (Aashe (a), p.10, 2014a) and the environmental performance scoring system (Aashe (a), p.11, 2014) enables the calculation of an environmental performance index with a set of metrics to quantify the efficiencies and effectiveness of NTU's Scope 3 (Travel) environmental sustainability. Alwaer and Clements-Croome (2010) stated that choosing the most appropriate criteria is important for enabling a workable carbon policies and environmental targets. Ramos et al (2013) argued that methodological tools for calculating the key performance indicators (KPIs) as vital navigational instruments to determining successful implementation of its carbon reduction policies. Maubane et al (2014) stated that the index reporting tool describes the practice of measuring, disclosing and being proactively accountable to internal and external stakeholders. Johansson and Cattaneo (2006) stated that environmental indexes favour the more heavily weighted index objectives than the smaller indexes that could sometimes be misleading.

Shi and Lai (2013) advocated that STARS sustainability index is based on an acceptable HE Sector Model used extensively by North American universities that has a methodological perspective that collectively aggregates other indicators and condenses to an overall performance index. Lukman et al (2010) stated that the STARS index evaluates complex sustainability criteria relevant to HEIs, which are then transformed into simpler scores beneficial to stakeholders and decision-makers.

3.11.2 SCOPE 3 (TRAVEL) PERFORMANCE INDEX METHODOLOGICAL TOOL USED IN THIS RESEARCH

Adopting the STARS tool provides a static snapshot of NTU's Scope 3 (Travel) carbon emissions synthesised into an empirical index and described in this research as the UniCarbon Index. This methodological tool utilises a mechanism for empirically weighting the attributes of Scope 3 (Travel) carbon abatement strategies and environmental policy designs. Adopting the STARS weighting scheme, its emissions parameters and the direct impact relationships of each of the carbon metrics enable the development of the Scope 3 (Travel) carbon performance index.

This research's environmental performance index methodologies conforms to the mechanism and principles of the Global Reporting Initiative G4 (Gri, 2015) and STARS (Aashe, 2013) that forms the basis for the development of the UniCarbon Index. The index is constructed by ranking the environmental performance of each attribute concerning Scope 3 (Travel) carbon emissions abatement strategies.

This research had adopted the methodologies based on the STAR credits index (Aashe, p.9, 2013) systems developed in large part by reviewing NTU's Scope 3 (Travel) mitigation assessments, sustainability policies, mRating values and SWOT analysis. The development of NTU's carbon performance index methodologies had been derived from methodologies similar to the STAR factor points index (Aashe, p.18, 2014) which uses predetermined factor values developed by STARS. The factor points have a maximum of 208 points in total, of which Scope 3 (Travel) has a maximum of 7 factor points allocation. An additional 4 credits had been developed for this research to include for business travel and overseas student travel as these have direct relevance to this NTU case study research.

Table 15 - Transportation Credits (Aashe, p.201, 2013). Points Available = 11

Reference	**Description**	**Maximum Points for Conversion to UniCarbon Index**
OP 18	Campus Fleet	1
OP 19	Student Commute Modal Split	2
OP 20	Staff Commute Modal Split	2
OP 21	Support for Sustainable Transportation	2
*OP 21A	Business Travel	2*
*OP 21B	Overseas Student Travel	2*

* *Developed by the researcher for this research as additional travel emissions sources*

Appendix 2 (pp.369 - 370) presents the assumptions of the STARS methodologies and credit system framework used in this research.

Diagram 24 – Summary of Scope 3 Travel Sustainability Performance Index Calculation Methodology as applied in this research

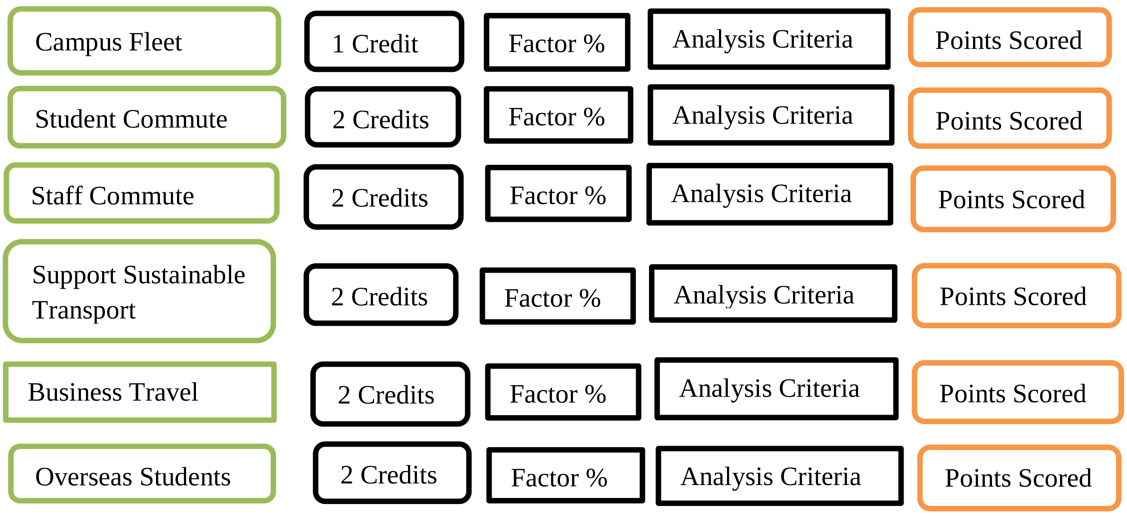


Diagram 24, presents the topographical summary of the Scope 3 travel sustainable performance index as adopted in this research. Each of the sustainable transportation modality is awarded a credit score derived from the STAR's methodological process. The factor percentage is also derived from the STARS's methodologies. The analysis criteria are particular to each HEI. In this NTU case study research, detailed explanations of the methodologies used are described within each criterion rational and credit scoring. For each transport modality there are calculation methodologies which are explained on each table. The final scores awarded on each transport sustainability modality is summarised to obtain the points scored for determining the Scope 3 travel sustainability performance index.

OP18 : Campus Fleet (Managed by Nottingham City Transport)

Table 16 - Campus Fleet

Campus Fleet – Entre Values indicated below to calculate points credited						
Factor	Multiply	Number of Vehicles that meet the criteria	Divide	Total Number of Buses in Fleet	Equals	Total Points Obtained
1				No Electric Buses	=	

Criteria Rational

NTU will be allocated a maximum of 1 point attributable as a credit when *all* busses have alternative low carbon fuels, hybrid or battery powered. NTU collaborates with the city transport to offer inter campus travel.

Scoring

If 50% of sustainable transport fleet were powered by alternative fuels. The factor is reduced by this percentage.

OP19 : Student Commute Modal Split (Maximum points 0.02)*[Appendix 10 (A), p.413]*

Table 17 – Student Commute

Student Commute Modal Split – Enter Values indicated below to calculate points credited				
Factor (as a %)	Multiply	Summary percentage of all students less carbon emissions commuting options (0-100)	Equals	Total Points Obtained
0.02	x	62 (see p.207)	=	

<u>Credit Rational</u>

This credit attributable to NTU recognises the various students' alternative modes of transport when commuting to and from the NTU's campuses. The travel commute modality is often used in measuring and evaluating the carbon emissions performance of Nottingham's transportation system. There are benefits when other lower emissions transport modes are used contributing to lower pollutions from GHG emissions. NTU has schemes offering free bike hire and encouraging walking.

<u>Criteria</u>

NTU's students commuting travel using lower carbon emissions such as walking, bicycling, carpooling, riding small motor scooters, using public transportation or NTU shuttle buses, or an either of these options. Campus based students are also included within this calculation from commuting between NTU's two satellite campus sites and the main NTU city centre campus.

<u>Scoring</u>

NTU can earn a maximum of 0.02 points under the STARS when all students will be using alternative sustainable transportation for getting to and from the various NTU campus sites. For the purposes of our research the following percentages are being applied (only 1% drive due to limited car parking spaces). The following represents the total percentage using alternatives = 62% [Appendix 2 (C)(p. 370)]

10 percent live on campus
10 percent use non-motorised transportation
40 percent use public transportation or campus shuttle buses
2 percent staff and student carpool

62

OP 20 : Staff Commute Modal Split (Maximum points 0.02)*[Appendix 10 (B), p.415]*

Table 18 – Staff Commute

Staff Commute Modal Split – Entre Values indicated below to calculate points credited				
Factor (as a %)	Multiply	Summary percentage of staff using less carbon emissions commuting options (0-100)	Equals	Total Points Obtained
0.02	x	43 (see below)	=	

Credit Rational

This credit attributable to NTU recognises the various staffs' alternative modes of transport when commuting to and from the NTU's campuses. Walking and biking have positive health benefits.

Criteria

NTU's staff commuting travel using lower carbon emissions such as walking, bicycling, carpooling, riding small motor scooters, using public transportation or NTU shuttle buses, or either of these options. The following represents the total percentage using alternatives = 43% [Appendix 2(C), p.370)]

2 percent use non-motorised transportation
40 percent use public transportation or campus shuttle buses
1 percent staff and student carpool

43

OP21 : Support for Sustainable Transportation (Maximum points dependant on Sustainable transport initiatives). *(Refer to Appendix 10 (C), p.417)*

Credit Rational

Credit is attributable to NTU's staff and students commuting travel using lower carbon emissions such as walking, bicycling, carpooling, riding small motor scooters, using public transportation or NTU shuttle buses, or either of these options.

Promoting and incentivising lower carbon emissions transportation are key to decreasing air pollution.

Part 1 – NTU's active support Total = 0.375 (0.125 points for each initiative)
(0.125 points for each initiative as prescribed by STARS, Appendix 10C, p.417)

(i) Non-motorised transportation facilities – biking storage
(ii) Secure non-motorised routes
(iii) Sharing programme for bikes

Part 2 – NTU's strategies for encouraging more sustainable transport Total = 1.250
(0.25 points for each initiative as prescribed by STARS, Appendix 10C, p.417)

(i) Reduced bus pass
(ii) Encourages car pooling
(iii) Vehicle charging stations
(iv) Offers telecommuting (remote working)
(v) Other strategies that encourage less travel

OP21(A) : UK staff business travel encouraging sustainable transportation
(maximum 2 points) (Refer to Appendix 10 (C), p.417)

Table 19 - UK staff business travel encouraging sustainable transportation

Business Travel Modal Split – Entre Values indicated below to calculate points credited				
Factor (as a %)	Multiply	Summary percentage of staff using less carbon emissions commuting options in the UK only (0-100)	Equals	Total Points Obtained
0.02	x	70 (see p.210)	=	

[Developed for this research by the researcher with reference to Appendix 10(C)(p.417)](Chelliah, 2015)

OP21A was developed specially for this research with respect to Scope 3 (Travel) business travel which was omitted within the STARS framework. The credit rational for the support for sustainable transportation from sustainable transport initiatives Part 1 was the same weightings used in the STARS framework.

Recommendation as in OP21 (p.209) i.e. awarding 0.125 points for each sustainable initiative by NTU as shown in (p.209). Part 2 (p.209) also from STARS recommendation, awarding 1.250 points for each encouraging initiative to sustainable transportation. References are found in Appendix 10 (C), p.417 referencing the section of the STARS manual.

This represents business travel undertaken by academic staff and students that is reimbursed or paid for by NTU. Some modes of NTU business travel are classed as mandatory reporting items for emissions, whereas other modes are optional. The following represents the total percentage using alternatives = 70% (below) and Appendix 2 (C), p.370

10 percent use public transportation
15 percent use grey fleet (reimbursed for using their own transport)
40 percent take trains transportation
5 percent use air transportation

70%

OP21(B) : Overseas student travel (maximum of 2 points) *(Refer to Appendix 10 (C), p.417) and Table 30 (p.303)[15% i.e 3680 overseas students out of 24,534]*

Table 20 – Overseas Student Travel

Overseas Student Travel – Entre Values indicated below to calculate points credited				
Factor (as a %)	Multiply	Summary percentage of overseas students using less carbon emissions commuting options (0-100)	Equals	Total Points Obtained
0.02	x	15 (see p.211)	=	

Developed for this research by the researcher (Chelliah, 2015)

This represents overseas travel undertaken by students and their families. Also some modes of NTU student travel are classed as mandatory reporting items for emissions, whereas other modes are optional. The following represents the total percentage using alternatives = 15% (Appendix 2(C), p.370)

12 percent of international students use air transportation
3 percent of student families use air transportation

15

The source and details concerning credits and percentages described in Appendix 2 (C) (p.370) describes the details as to how the percentages (as part of the scoring and credits paragraph) are computed from best estimates from the information received from the ARC, literature review (green gown awards), NTU's marketing and sustainability information. The researcher had consulted the National Travel Survey England (Appendix 2C, p.370) for guidance to make an informed percentage calculation for travel that was applied to this research. Appendix 10 (A)(B)(C) (pp.415-419) for referencing the STARS recommendations for the calculations of percentages and credit system used as a methodology for this research. The STARS framework is a recommended framework used by many North American Universities and adopted in this Thesis

The values obtained for OP18 to OP21B for the basis of NTU's Scope 3 (Travel) carbon performance index or UniCarbon Index for external reporting purposes as presented in Table 30 (p.303)

3.12 REPORTING OF SCOPE 3 (TRAVEL) CARBON EMISSIONS

The HE Sector and HEIs are uniquely placed to contribute to lower carbon emissions by developing and changing current practices towards a lower carbon society. Reporting assists HEIs to set emissions goals, measure performance and manage change to make campus operations a low carbon environment. The reporting methodological tool presents relevance to HEIs to communicate carbon emissions to stakeholders and complying with the requirements of HESA (Hesa, 2014), HEFCE (Hefce, 2012), Climate Change Act 2008 (Cca, 2008) and the reporting requirements of the Companies Act 2006 (Regulation 2013), (Gov, 2013a) concerning enchased directors' reporting of the organisation's climate change impact and stating key performance indices.

The Carbon Trust (Trust, 2014) has recommended that reporting entities must have effective emissions management and transparencies for reporting thus adopting robust and effective methods. Methodologies must comply with The Global Reporting Initiative G4 (Gri. 2015) who produces the most widely accredited and used global standards reporting tools worldwide that is inclusive of economic, environmental and social dimensions (Alazzani and Wan-Hussin, 2013). The following are the most widely used methodological tools for reporting.

(a) Greenhouse Gas Protocol Reporting Tool (Ghgreporting, 2011)

The tool represents the mechanism whereby HEIs collate their travel data from the distance travelled methods and summarily reporting to stakeholders the amount of Scope 3 (Travel) carbon emissions (Ghgreporting, pp.58-66. 2011)

(b) Global Reporting Initiative G4 Tool (Globalreporting, 2013)

The GRI for sustainability reporting is sector specific each with its specific content in reporting that has been classified as G4 guidelines. These guidelines emphases material information critical to their business and stakeholders i.e. sustainability impacts that matter, reporting climate change impacts, being more concise and focused, offering more credibility, and easier for stakeholders to navigate the complex information in a simplistic way for understanding.

At the moment there are no guidelines for the HE Sector concerning campus reporting of their Scope 3 (Travel) carbon emissions.

3.12.1 JUSTIFICATION OF SCOPE 3 (TRAVEL) REPORTING TOOL AS USED IN THIS RESEARCH

In order for NTU to state its environment commitment towards the reduction of Scope 3 (Travel) carbon emissions. NTU will have to benchmark its current base level of Scope 3 (Travel) environmental performance at 2013 and reference this back to the base year of 2005. The methodological reporting tool builds on the momentum for carbon emissions reporting requirements to HEFCE (Hefce, 2012) and other stakeholders (Lozano, 2009). Given these facts, the methodological reporting tool communicates the university's environmental performance (Ozawa-Meida et al., 2013). Lozano and Huisingh (2011) stated that reporting campus environmental efforts indicates the HEI's commitment to environmental sustainability.

This case study uses a definitive Scope 3 (Travel) reporting tool utilising the Global Reporting Initiative 4 (GRI) (Gri, 2011) and Carbon Disclosure Programme (Cdp, 2010) recommendations. This tool represents the GRI reporting metrics thus enabling NTU's Scope 3 (Travel) carbon emissions reporting made more accessible, comparable, and providing stakeholders with "appropriate environmental information" (Gov, p.3, 2014). Adopting GRI principles includes matrixes validated internally or voluntarily externally which lends credibility to the reporting tool methodologies (Alazzani and Wan-Hussin, 2013).

This research's reporting tool represents the GRI-G4 (Sustainability Reporting Guidelines) version published in May 2013 (Gri, p.12, 2014) requiring core general Standards disclosures for Scope 3 (Travel) carbon emission reporting that matter, containing valuable reporting information most critical to NTU and establishing this reporting tool as standard practice. The reporting tool places emphasis on transparency, auditability, completeness, relevance, accuracy, materiality and comparability that have to be part of the disclosure statement.

3.12.2 SCOPE 3 (TRAVEL) CARBON EMISSIONS REPORTING METHODOLOGIES USED IN THIS RESEARCH

This research methodology uses the legal framework for reporting under the Companies Act 2006 (strategic report and directors' reports, regulation 2013, S414-415) (Gov, 2013b). The methodological processes reference the Global Reporting Initiative 4 recommendations that include the general and standard disclosures (Gri, 2011). NTU's reporting format has been partially adopted from the sustainability report of La Trobe University which has the accolade as the first HEI to publish a sustainability reports in Australia (Latrobe, 2014).

The methodologies recommended included processes and procedures recommended by The GRI's Standard Disclosures (Gri, 2011) to be included in NTU's Scope 3 (Travel) carbon emissions reporting. These methodological procedures adopted are as follows:

- Scope 3 (Travel) profile – disclosing the mechanism and procedures that able to set the overall context for understanding NTU's carbon performance such as its strategy, profile, and governance.

- Scope 3 (Travel) carbon policy – disclosing the overall understanding of NTU's carbon policies that sets the overall context in understanding NTU's carbon performance of Scope 3 (Travel) carbon emissions.

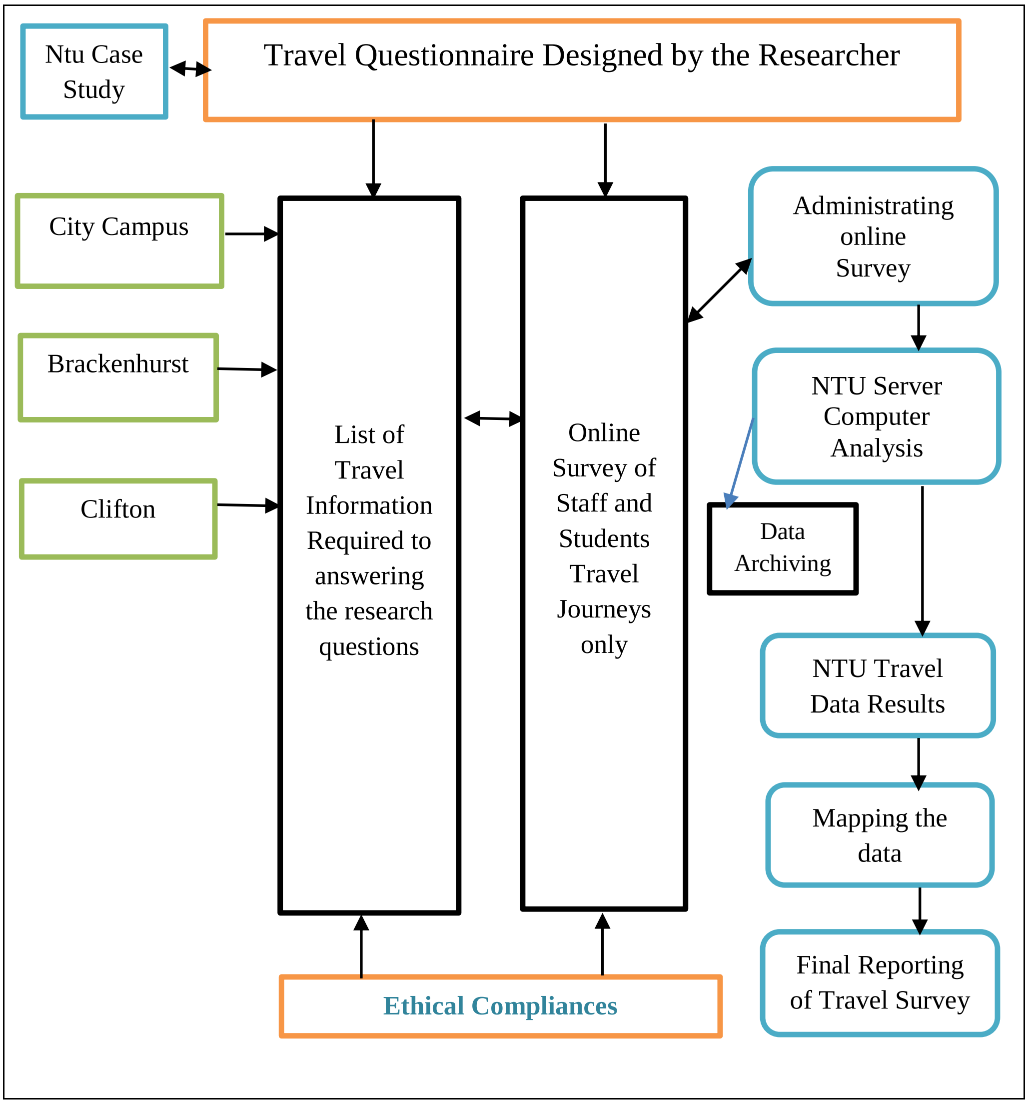
- Scope 3 (Travel) performance indicators – methodologies that elicit NTU's Scope 3 (Travel) carbon performance (UniCarbon Index).

3.13 INTERNET TRAVEL SURVEY USED IN THIS RESEARCH

There is a growing momentum behind sustainable transportation initiatives promoted by HEFCE (Hefce5, 2012) requiring HEIs in the UK to commence reporting Scope 3 (Travel) carbon emissions beginning 01 January 2015 (Hefce12, 2012). This requirement has been further strengthened by the Climate Change Act 2008[c.27, Part 1-6](Cca, 2008) and Companies Act 2006 (Regulation 2013) for HEIs to report their Scope 1 and 2 carbon emissions. The internet travel survey tool focusses on capturing the travel behaviour of NTU's potential 4,893 staff and 24.534 students' replies with this online travel survey tool (Appendix 1, p.364) for determining Scope 3 (Travel) carbon emissions. This research methodological tool concerning the travel survey was undertaken on 25 February 2013 by forwarding the questionnaire to all email accounts of staff and students held at NTU.

The internet provides researchers with a new platform to undertake research on a variety of research issues and as such has become a major impact in developing research tools at every stage of the research process (Berry, 2004). This research's methodological tool consists of the online travel survey tool for gathering travel data for the quantification and reporting of Scope 3 (Travel) carbon emissions. The online travel survey research design methodology is described in Diagram 25 (p.216) below, is based on a measurement concept for online data collection.

Diagram 25 - Online Travel Survey Research Design and Ethical Issues



Designed by the researcher (Chelliah, 2015)

Step 1 - The researcher and the action research committee prepared the design and construction of the travel survey questionnaire (Appendix 1, p.364). The development of the questionnaire was determined by this case study research questions, accuracy of the wording used, minimising bias and keeping the sequencing, layout and flow consistent to past years' questionnaire formats.

Step 2 – List of travel survey information required to answering the research questions of the case study research. The online data travel survey data had been appropriately archived and safe within NTU's secure archive data bank.

Step 3 – The research together with NTU created awareness via ‘NTU NOW’ web pages highlighting and welcoming students to complete their contribution to the online travel survey for NTU’s commitment to lower carbon consumption.

Step 4 -The research ensured that all ethical compliances were complied with (Appendices 8A, p.404 : 8B, p.405 and 8C, p.406)

Step 5 -The researcher ensured that NTU’s computer capacity was appropriated for the duration of the online travel survey avoiding any ‘IT systems crashes’.

Step 6 - The appropriate mapping methodologies were applicable

Step 7 - Final NTU travel data survey reporting was adopted.

3.13.1 JUSTIFICATION OF THE INTERNET TRAVEL SURVEY TOOL AS APPLIED TO THIS RESEARCH

The travel survey methodological tool development follows the research by Paez and Whalen (2010) who made a study at McMaster University, Canada investigating the various socio-demographic and attitudinal variables affect student’s desire to increase or decrease their daily commute. This NTU case study methodological tool uses the internet as a means to collect travel data from staff and students commuting journeys to specific assumptions, such as travel frequencies, distance travelled and emission factors. Similar research methodological tools have been undertaken by Rice University, Tulane University, and the University of Maryland (Aashe, 2011).

This methodological tool follows the research undertaken by Ramos et al (2013) and Hewson et al (2004) who stated the apparent advantages of online research tools have over traditional methods is in terms of time, cost and reach has undeniably presented this research tool’s attractiveness. Rasmussen and Thimm (2009) stated that an online research tool requires a higher degree of control within the research interactions as the tool is qualitative in nature and having more variables. In contrast, Groves (2006) and Brick et al (2006) viewed that on either end of a travel survey research's continuum, the research has to trade off the technical demands associated and the limitation of its use. Alwin (2010) indicated that online survey offers much more reliability for data collections and further analysis.

This research's online research methodological tool offers flexibility and can be conducted via email and can be administered in a time efficient manner taking into account the size of NTU as a case study with a potential target group of 28,000 persons. Online surveys have the technological advantage, convenience and ease of data entry (Evans and Mathur, 2005 and Frankel, 2010).

3.13.2 ONLINE TRAVEL SURVEY METHODOLOGY USED IN THIS RESEARCH

This research's online travel survey seeks travel information based on the 'bottom-up', or 'distance travelled' (i.e. journeys) model developed by (Howitt et al, 2010) as used in passenger cruise travel. A bottom-up approach estimates the quantum of Scope 3 (Travel) carbon emissions based on individual travel activities that are based on NTU personnel travel modes used for commuting and business travel purposes (for example, the distances travelled by buses, trans, airplanes). The travel survey commenced on 25 February 2013 and closed after two weeks. Twenty travel questionnaires was developed by the researcher in collaboration with the action research committee (p.156) using a combination of tick boxes and free text questions for completion to ensure a degree of accuracy of the travel data collected (Appendix 1, p.364).

The researcher had overall responsibility to the drafting of the travel survey questionnaires. A trial run with dummy data was carried out to detect weaknesses in its design which (Cargan, 2007 and Shukla, 2008) stated in their research as beneficial to eliminate errors. The questionnaire had been prepared by the researcher and jointly reviewed by the action steering committee (p.156) concerning the actual wordings, relevance to the research questions and ensured that the questionnaires has complied with NTU's social research ethical requirements. Appropriate approvals from NTU's executive and unions were obtained by NTU estates. The survey was administered by NTU's marketing department after securing these approvals and ethical clearances had been obtained by the researcher (Appendix 8B, p.405). All replies were confidential and the marketing department has full responsibility to save the research data according to NTU's data achieving and protection policies. For this action research, the researcher made an ethical directive that participants of the online travel survey will not be receiving the results of the survey.

No sample survey was undertaken, as the researcher was of the opinion that there was no cost benefit and the focus group was already identified as NTU staff and students. On the whole, the researcher ensured that the survey questionnaires were similar to last year, with only minor changes allowed to refining the questionnaire wording and to minimise any variables that are not directly comparable across years.

This case study methodology involved two simultaneous surveys: one from students, the other from staff. To promote this travel survey, advertisements prompting students to partake in the travel survey were displayed online and on campuses to make aware to staff and students concerning the value students would be contributing to NTU's carbon emissions accountability when completing the survey.

3.13.3 ADMINISTRATING THE ONLINE TRAVEL SURVEY

NTU staff and students were the target focus group participants and emails were sent to all active recipients together with information detailing the research objectives of the travel survey. The survey included explanations concerning the ethical measures taken to safeguard the participant's anonymity. To ensure travel data integrity, the researcher ensured that every questionnaire was not optional, so as to ensure full completion with the format layout being simple to answer. On a technical level, NTU's own email server running on Microsoft Outlook Exchange was the principal software used to conduct this travel survey research. The server virtualisation services have been handled by NTU's IT services allowing extra computing power to be made available and system configuration to handle the anticipated responses without page loading delays and server inaccessibility or even 'crashing'.

The online travel survey methodology elicited NTU staff and student travel data commuting to the campuses, indicating their mode, vehicle occupancy, journeys, distance travelled from post codes (term address) and information about NTU's transport management that could be useful. Some additional questionnaires were included to assess the demand for car parking space at the Clifton campus and the utilisation of intra-campus transportation services provided by Nottingham buses.

To ensure there was no interference by the researcher or by other members of the steering committee. The travel survey was administered independently of the researcher by NTU's marketing IT resources department. To ensure secure transfer of survey data, hyperlinks were setup to a secure server specifically dedicated for this research. This hyperlink had been scripted as secure by disabling any features on the online travel survey system that would compromise the identities of the respondents.

The 2013 online travel survey was open to accept responses up to two weeks after the survey was initiated from 25 February. During that period, five reminders were sent to ensure that this research secures the maximum amount of responses from the NTU target case study. The online survey was closed on 8 March 2013 and all hyperlinks were disabled.

3.14 MAPPING METHODOLOGY USED IN THIS RESEARCH

Modern day mapping tool strategies used in management began with social forecasting and public policy considerations, planning and decision making in complex and uncertain situations where the outcome cannot be determined precisely (Bradfield et al, 2005).

Davidson et al (2014) proposed that mapping tools are a new phenomenon to initially better understand the travel behavioural responses from travel surveys and extrapolating to a future scenario. Nitsche et al (2013) proposed that using an appropriate mapping tool and collection of travel data are key tasks for transport modelling. Reschke and Huttich (2014) indicated in their research that a cost effective and accurate mapping tool is essential for managing uncertainties.

The key component of Scope 3 (Travel) environmental management is to map the summary of distances travelled data from the different transport modes and extrapolated for an academic year. Mapping used in research allows researchers to compute the possible outcomes of a particular scenario based on trends and assess their implications and opportunities for new management measures as was used by Shucksmith and Kelly (2014) in their marine environmental research on pollution.

3.14.1 JUSTIFICATION OF USING THE QUANTIFICATION MAPPING TOOL IN THIS RESEARCH

This mapping tool focuses on the various Scope 3 (Travel) carbon emissions and enables NTU to extrapolate the travel survey data for an academic year. In other researches, travel mapping forms a legal requirement by the NHS using this methodological tool for prioritising service improvements, staff quality of life and enable planning and the use of resources efficiently as part of the NHS's carbon management plan in meeting its own carbon sector reduction target (Mgh, 2013). Hancock and Nuttman (2014) used the travel mapping methodological tool in an Australian university to embed sustainable transport policies and programmes and act as a catalyst for more extensive and integrated Scope 3 (Travel) carbon emissions performance across a multi campus university.

The methodological mapping tool extrapolating data has increasingly been accepted among practitioners and academics as a tool for supporting strategy formulation in organisations (Franco et al, 2013). This methodology is also applicable to this research. The mapping driven methodological tool processes involves building a set of challenging but plausible 'future scenarios'.

3.14.2 MAPPING UPLIFT FACTOR USED IN THIS RESEARCH

The Researcher had been advised by NTU administration the 'uplift factor' for extrapolating the travel survey data information used within the mapping models of the quantification of Scope 3 (Travel) carbon emissions for an academic year ending 31 August 2013. The justification had been based from NTU's term tenure records.

(a) Students academic year - 37 weeks

(b) Staff academic year - 40 weeks

3.15 RESEARCH QUALITY AND MINIMISING ERRORS

Research quality encompasses all aspects of the case study in particular research questions, methodologies used, data measurement and analysis. There had been large hierarchies of evidence generated from the research methodologies. The researcher had applied quality measures for data accuracy recording and double checking excel computational calculations used to minimising errors of the research.

3.15.1 RELIABILITY AND VALIDITY

Reliability are measures that can be replicated yielding similar results thus providing consistent results. Validity evaluates whether the research actually measures appropriately what was to be measured and how truthful the research results can be relied upon. Validity relates to whether the findings are relevant to assist the researcher in solving the research problems (Maxwell, 2012). Validity and reliability had been important factors which the researcher had been concerned about while designing the research, analysing the data and evaluating the quality of the research (Patton, 2014).

The quality of this research is to persuade stakeholders that the research findings are trustworthy. To ensure this, the researcher took measures to improve the reliability and validity of the research findings. These are:

(i) To reduce bias and ensure data integrity, the researcher had planned and constructed in advance the SWOT and mRating value to be ‘wide semi structured’ questionnaires (Table 12, pp.178-181) which enabled eliciting greater definitive answers and securing greater accuracy in determining the empirical value from qualitative to quantitative measurements. The data sets obtained were designed to be subjected to statistical factor analysis to determining the Cronbach Alpha, KMO and Eigenvalues that presented this Thesis with a measure of data integrity. Any bias and errors had been cancelled out.

(ii) Internal testing of the travel survey questionnaire made the survey coherent and easy to understand thus improving the reliability of the SWOT and mRating semi structured questionnaires.

(iii) Each of the travel survey questionnaire covered the research issues had concerned the quantification of Scope 3 (Travel) carbon emissions. This provided the research with content validity for greater reliability of the internet travel survey data.

3.16 DATA COLLECTION AND ANALYSIS

Environmental data research is a complex inter disciplinary research that is multifaceted. Data analysis gives meaning to the raw data collected. The data analysis used in this research are quantitative data obtained from the travel survey questionnaires. The other quantitative data concerns the calculation of the Scope 3 (Travel) carbon performance index. The qualitative data is derived from the SWOT Analysis and mRating values qualitatively derived from the action research committee (p.156) and converted to quantitative data by the researcher. The application of these methods, both quantitative and qualitative approaches are different methodologies of studying the same phenomenon and able to answer the same research questions (Busch et al. 2012).

Data Processing and Coding

All data processing was undertaken by NTU's marketing department who had the back office resources of using powerful computer processing capabilities. All responses were machine coded and computed using scripting computer language specially written by NTU's computer centre by offering their expertise for undertaking this case study research.

Analysis of Overseas Business and Student Travel

(1) NTU's UK business travel analysis was obtained from NTU's financial ledger and converted to journey distances. Carbon emissions were calculated from distances travelled and travel mode using DEFRA factors (Defra, 2012b). Overseas business travel data was obtained from travel agents providing distances and travel mode within geographical zones and corresponding carbon emissions. Quantification methodologies used must be stated and consistently applied every year for comparison purposes.

(2) Carbon emissions incurred by overseas students were calculated from NTU's student data bank. Overseas students return to their home countries every summer according to NTU student housing management to the researcher. In their graduation year and extra two persons (parents) were added based on graduation ticket sales information by the Graduation Offices to the researcher. NTU's travel agent independently provide distance travel data, mode of transport, fuel type and intensity factors (UK Only)[if not available an estimation of the intensity factors with disclosure and caution can be provided]

(3) DEFRA Intensity Factors have taken into account the three Scope 3 Travel emissions calculations methods (p.225) using research models to providing the intensity factor vales based on distance, engine size and fuel type. This calculation method has its own unique carbon factors produced by DEFRA (Defra, 2012b). DEFRA had developed the carbon intensity factors based on scientific research analysing a mix of vehicles, vehicle age, fuel types, emissions from MOT certification, mileage per gallon and many other parameters to determining the carbon conversion factors. The conversion factors for use by the distance base has been standardised for UK reporting entities. DEFRA has also published train, buses, boats and air transportation conversion factors originating from the UK (Defra. 2012b).

3.17 ETHICAL CONSIDERATIONS OF THIS RESEARCH

There is no generic formula for assessing the likely risks from the NTU case study research enquiry. However, the researcher had been sensitive to all possible ethical consequences concerning this research and had been vigilant against predictable negative effects. All information, whether systematically collected or not, could be subject to misuse, if not managed ethically (Shewan et al, 2014). This research faces ethical challenges in all stages of the research study from designing to reporting. In this research ethical consideration include anonymity, confidentiality, informed consent of the participants and the researcher's potential impact on the participants and vice versa. It is important that the researcher and participants are well informed and a well-defined and adopting of practical guidelines and protocols in all stages of this research is implemented. The researcher had obtained ethical clearance by this research's supervisors and from NTU ethical clearance administrator (Amanda – Jane Lomax at NTU- Appendix 8B, p.405 following clearing submission in 04 February 2013).

Diagram 26 (p.227) illustrates the topography of the ethical issues that were considered. At the planning stage of this research, core fundamental ethical implications had been considered. No information was considered devoid of possible harm to NTU's staff and students and pre-empting any sensitive misrepresentations, not to counteract them, if and when they occur. This research adopted Mauther et al (2005) research ethical guidelines and advocated that ethical decisions arise throughout the entire research process from conceptualisation and design, data gathering to analysis and reporting. Mauther et al's ethical guidelines have been adapted as shown in Diagram 26 (p.227).

Diagram 26 – Topography of the practical ethical issues considered

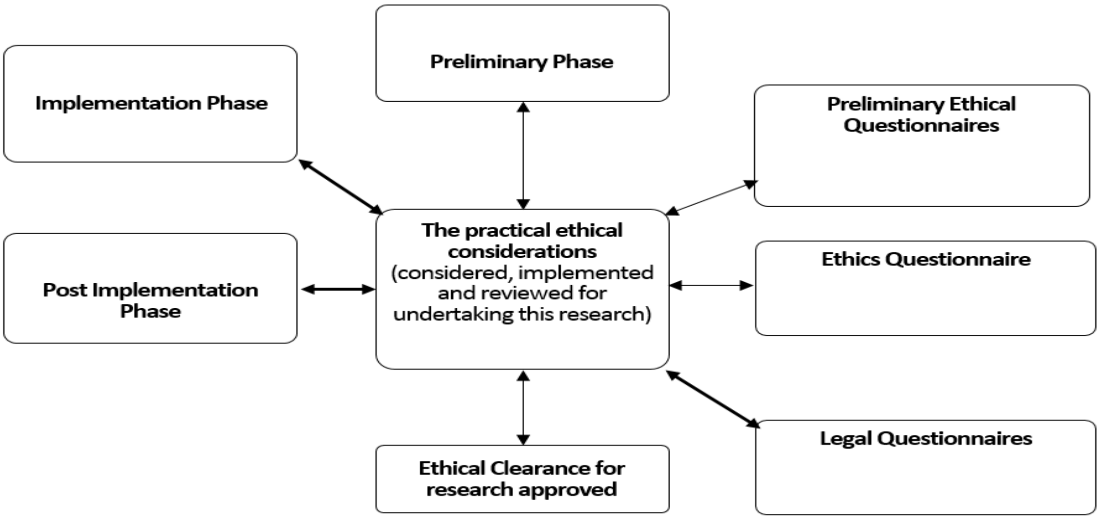


Diagram Adapted from Mauther et al (2005)

At the planning stage of this research, core fundamental ethical implications had been considered. No information was considered devoid of possible harm to NTU's staff and students and pre-empt any sensitive misrepresentation not to counteract them, if and when they occur. This research adopted Mauther et al (2005) research ethical guidelines and advocating that ethical decisions arising throughout the entire research process from conceptualisation and design, data gathering to analysis and reporting.

The statement of informed consent (Appendix 8A, p.404) was presented to participants' before completing the online travel survey, adopting the ethical principles recommended by O'Mahony (2014). The informed consent form had expressively outlined the importance of the research, emphasising confidentiality and anonymity of the participants' responses. Participants were advised that participation was voluntary and without prejudice. Strict confidentiality and anonymity would be applied throughout this research.

The online research ensured the receipt of the statement of informed consent from all participants, prior to the completion of the travel survey by securing a tick box confirmation had been adopted. The consent form had outlined in writing the aims of the research, describing the confidentiality and anonymity of participants' responses and archiving of the results, using specific algorithms that was secure at NTU.

Table 21 below describes the three key ethical issues followed by the ethical issues questionnaires and the researcher's actions and answers to dealing with these issues.

Table 21 - Questions considered by the Researcher before the online travel Survey

Type of Questions	Questions considered by Researcher	Researcher's Action / Answers
Preliminary Ethical Questionnaires	1. Is the internet study best way to answer research questions numbers 1 to 5 (p.32)	- this method is cost effective and has access to a larger population sample.
	2. How should the travel survey questionnaire webpage to be designed for answering within 15 minutes?	- questionnaires numbers are kept to a minimum without being laborious. - questionnaires written succinctly
	3. How to ensure that the questionnaires are clear and concise to answering the research questions?	- a specific scripting programme is used for direct data capture into NTU mainframe computers
	4. What are the reliability and validity of the data capture when using the internet?	- data captured directly on to NTU's mainframe computer
	5, How can the participant contact the research with questions?	- via email available on the consent form

	6. What possible harm could the participant be drawn into as a result of the online survey and how would the researcher deal with this?	- no harm is envisaged as no personal or incriminating data is requested
Ethics Questionnaires	1. How can the relationship between the researcher and participant on the online survey be minimised? 2. What are the risks and benefits of the participant? 3. How did the researcher acknowledge that participants have read the informed consent and understood the risks and benefits? 4. How is the participant acknowledge that the travel survey is voluntary and clearly defined on the consent document? 5. What moral obligations are implied to the participant by the researcher? 6. How would the researcher assure the participants anonymity? 7. How does the researcher assure that the data is stored securely	- no relationship, complete anonymity - No perceived risks or endangerment - online signature with tick box confirmation - online consent with tick box confirmation - honestly and integrity of the research questions and data - no personal information is required - data is protected by firewall and secured within NTU's protected servers
Legal Questionnaires	1. How does the researcher confirm that the participant's consent is voluntary and duly assumed to be informed? 2. How does the researcher protect the participants' privacy? 3. Has the researcher conformed to the Data Protection Act 1998?	- it is assumed that when the participants' ticks' the consent box, the participant acknowledges consent and reneges liability - no personal information requested - no data obtained are within this act.

Table 22 describes this research's online travel survey ethical consideration that has been implemented that were divided into three stages as follows:

Table 22 – Implementation of ethical considerations

(1) The preliminary phase	During the informal discussions within the action research committee about the ethical issues. The researcher ensured that the online travel survey will be administered following NTU's guidelines (Appendix 8C, p.406) The researcher assured the action research committed that NTU had cleared the ethical the online travel survey in writing (Appendix 8B, p.405) With this assurance, the researcher focussed on the what ethical concerns may be attributable from this online research and the storage of the research data. The researcher acknowledges that the use of the internet can be a security risk from human errors and the data in electronic transit can be intercepted by computer hackers.
Preliminary Ethical Issues - Implemented by Researcher	The researcher was the principal and in charge of executing the entire online travel survey. The following are the key ethical issues managed by the researcher. (1) The primary ethical considerations the researcher had considered, was to ensure respect and care for the participants right to anonymity. No IP addresses is to be collected. (2) The key requirement will involve that the staff and students participating on the online travel survey are regarded as an integral part of this research.

	(3) The researcher will consider the autonomy of the participants and ensuring to act with beneficence (doing the right thing, no harm intended.
(2) The implementation phase	The fundamental ethical issues concerned the ethical conduct involving persons of diversity, moral rights securing maximum research benefits and minimising harm to participants whilst undertaking this research.
The implementation ethical issues - Implemented by Researcher	The following are the key ethical issues managed in this research (1) The researcher acknowledged and implemented procedures that will ensure the participants privacy issues. The online travel survey questions were designed not to request any personal details. The level of control and the degree of distance to the participants is set at anonymity. (2) The privacy issues were administered by the acceptance of informed consent, truth-telling, confidentiality, and anonymity prior to the commencement to completing the travel survey (Appendix 8A, p.404). (3) The informed consent will clearly state that participants are fully conversant of the risks and benefits for participation and that the participant is allowed to withdrawn from participation at any time. The researcher will be available via email to answer any questions.

	(4) The researcher had included in the consent form for participants to waive liability and to release the researcher from any liability, so it is crucial to be clear about the nature of any legal relationships being formed. (5) The online survey had been computer scripted (*for automatic collation of data or data deletion when web browser is closed partway during completion*) to be completed using NTU's secure server (with firewalls) by direct access completion of data entry. This procedure involves an encryption mechanism. This procedure has a high degree of safeguards from any interception of data by hackers. The researcher will secure firm assurances from NTU IT for complete security. The log time limit has been set at 30 minutes or else data encryption will '*delog'* the participant.
(3) The post implementation phase	Participants had been informed as to how the data will be transported and stored in secure modalities by NTU.
The post implementation ethical issues - Implemented by the Researcher	The researcher acknowledges that the use of the internet had been conducted with privacy online concerning post implementation procedures (a) encryption coding was used to store all information within NTU's archiving as per NTU's IT data security requirements. The researcher had no direct access to this information. (b) no information or data was posted on any public domain media

	(c) all data elicited have been within the framework of anonymity i.e. deemed no value information to third parties

The researcher acknowledges that online surveys do not provide a means for undertaking an oral examination of the research and to take oral consent. The researcher had accepted the tick box as a digital signature as a consent declaration (Appendix 8A, p.404). The researcher made ensured that the data elicited from the participants would be materially harmful in anyway.

3.18 CONCLUSIONS

As had been presented above, the philosophical underpinnings and paradigms had guided the research design to investigating the research questions. The appropriate use of paradigms favoured two stages for the research design to this case study. First stage builds on the philosophical justification and second on the paradigms to guide the research to developing the appropriate methodological tools for eliciting the research data.

The collaborative action research together with action research committee presented a uniqueness to this research and with the researcher in the lead functioning collaboratively with NTU to developing new knowledge generation for the accountability, quantification and reporting of Scope 3 (Travel) carbon emissions. Collaborative action research methodologies enabled the researcher to solve the management problems at NTU and simultaneously develop new environmental management processes as new management knowledge. The action research supports management theory building by NTU providing access to the rich empirical data.

This action research methodology enabled the researcher to investigate, evaluate and understand the reality of NTU's management issues.

The SWOT attributes had determined NTU's EMS perspectives and mRating value rubric determining the EMS efficiencies. The research methodologies used had been qualitative to quantitative empirical measurements as the source of the primary EMS evaluation data. Pragmatic and normative aspects of the EMS qualitative interpretations had been advised by the action research committee. The qualitative datasets had been transposed from a positivist assumption to a quantitative empirical measurements and supporting the use of mixed methods methodologies.

The STARS methodological tool provided a framework for understanding the travel sustainability attributes at NTU, creating incentives for continuous improvement by developing the Scope 3 travel sustainability index as a management tool.

The methodologies adopted for this case study research detailed the mechanisms for conducting this research that had centred on the evaluation of the environmental management system, online travel survey, quantification, mapping and developing a performance index for Scope 3 (Travel) carbon emissions. Finally, describing the procedures of this research's data integrity and ethical considerations implemented.

The next Chapter 4 presents the data analysis and findings.

4. DATA ANALYSIS AND FINDINGS

SUMMARY

This chapter presents this case study's collaborative action research data analysis of the efficiencies of NTU's existing and new EMS for Scope 3 (Travel) carbon management and accountability. The SWOT and mRatings qualitative interpretations has been transposed to quantitative empirical data by the researcher. The quantitative data obtained was subjected to statistical factor analysis for determining the Kaiser- Meyer-Olkin, Cronbach Alpha and Eigenvalues for determining confidence and data integrity.

Travel survey data had been collected from NTU's staff and students' commuting travel modalities. Overseas business travel data was provided my NTU's appointed travel agent. Other primary UK and overseas business and students' travel data is obtained from NTU for further analysis. NTU's Scope 3 (Travel) sustainability index has provided a summative value for reporting together with NTU's total Scope 3 (Travel) emissions.

This chapter presents the data analysis, findings, discussions and recommendations of this research to answering the research questions.

4.0 INTRODUCTION

The previous chapter described the details of the research design, data collection instruments and methodologies used in this case study research. The qualitative data analysis concerned that empirical value assessment of NTU's EMS efficiencies using SWOT and mRating values from data elicited from the action research committee (p.156). The primary data collected from the travel survey of NTU's staff and student's travel modes, distance travelled data. Business travel data had been provided by appointed travel agents. The other quantitative data involved the development of the UniCarbon index constructed by ranking the environmental performance of each sustainable attribute concerning Scope 3 (Travel) carbon emissions abatement strategies.

This Chapter is divided into ten sections as follows:

- Section 4.1 describes the action research committee meetings
- Section 4.2 presents the analysis of the action research committee's qualitative empirical measurements
- Section 4.3 describes the SWOT analysis
- Section 4.4 presents the SWOT and mRating value data analysis summary
- Section 4.5 describes the 'Turnaround' data analysis of the new environmental management system
- Section 4.6 presents the data analysis of NTU's staff and student travel survey
- Section 4.7 presents the data analysis of NTU's business travel
- Section 4.8 presents the data analysis of NTU's overseas students travel carbon impact
- Section 4.9 presents NTU's Scope 3 (Travel) carbon emissions UniCarbon Index (KPI) and reporting
- Section 4.10 presents the conclusions to the Chapter

4.1 ACTION RESEARCH COMMITTEE MEETINGS

The committee meetings were informal and the researcher was appointed to keep brief notes of the proceedings. The following are the main agenda proceedings.

Table 23 – Action Research Committee Meeting Schedules

Dates of Meetings	**Summary of Notes**
August 2012	Formally appointing the researcher to undertake the action research for the evaluating and developing NTU's EMS Contributing expert knowledge for the quantification, management and reporting of Scope 3 (Travel)
November 2012	Drafted the travel survey questionnaire Travel survey questionnaire was tested and approved for circularisation in the spring term
January 2013	Researcher presented to the committee that NTU's marketing and computer department were ready to take final instruction for the travel survey Final inclusion of NTU's car parks management of questions to determine car parking demands for the future
February 2013	Travel survey was launched on 25^{th}
March 2013	Preliminary EMS status was provided to the committee
July 2013	The researcher presented to the committee a new EMS plan
November 2013	The research presented the final report to the committee concerning the EMS

4.2. ANALYSIS OF ACTION RESEARCH COMMITTEE'S QUALITATIVE EMPIRICAL MEASUREMENTS

The SWOT and mRating values had been quantitatively measured empirically by the researcher after receiving the qualitative perspectives from the actions research committee (ARC). The framework for evaluating the qualitative to quantitative empirical values are obtained from the questionnaires in Tables 12 (A)-(D)(pp.178-181). These Tables presented the qualitative to quantitative empirical framework and corresponding empirical measurements evaluations from the SWOT and mRatings questionnaires attributes that had been empirically transposed by the researcher [see Appendixes 3A(p.371), 4A (p.376), 5A (p.384) and 6A (p.393)]

The results fall into two categories (1) the qualitative interpretations of the action research committee (ARC)(p.156) based on personal and external evaluation criteria (2) The conversion of qualitative to quantitative empirical measurements (using the rubric measurement, 1 to 10) was undertaken by the researcher. This research had structured the questionnaire development from the synthesis of the literature review (pp.122-124) for the SWOT and mRating value questionnaires and also having a reference to answering the research questions (p.32).

The ARC presented the group's dynamic discussions and interactions amongst the committee, had yielded high quality qualitative interpretive evaluations. These interpretations had focused on the SWOT and mRating values attributes for evaluating NTU's EMS questionnaires for further empirical analysis. The researcher presents below (Table 24, p.239) the findings of the ARC quality control mechanisms for the empirical measurement transposition analysis as detailed in Appendices Three, Four, Five, and Six, (pp.371-398)

Table 24 - Results of the action research committee's qualitative empirical values

Type	Description of Data Obtained	Result
Opinion Consistency	Qualitative data from opinions and reliability of the answers to SWOT and mRating value. Quantitative data values entered in Appendices 3 to 6 (pp.371-398) showed minimum factor variances of qualitative opinions.	High percentage of opinion consistency Higher quality opinions
Opinion Stability	Qualitative data of overall opinions stability showed marginal significant variances. There was no absolute shift in overall opinions.	Higher quality opinions
Opinion Confidence	Each member of the action research committee had indicated (i) had sufficient information to form an opinion (ii) had been able to form an accurate impression of NTU's EMS (iii) was certain about their overall qualitative opinions	High confidence

4.2.1 FINDINGS AND DISCUSSIONS OF THE ACTION RESEARCH COMMITTEE'S EMPRIRICAL VALUE MEASUREMENTS

The Researcher reviewed the ARC qualitative opinions perspectives detail analysis for conversion to quantitative empirical values had presented this research with higher degree of effectiveness from the group discussions in terms of efficiency measurements attributable by the researcher in assessing NTU's environmental management system efficiency. All members of the committee received and processed similar information based on the SWOT and mRating questionnaires at the same time providing measurement consistency, stability and data confidence. The SWOT results analysed are presented in Table 25 (pp.242-244) presented the overall SWOT qualitative interpretations of this research, focusing with high levels of indicative reliability with minimum factors for variances from any misguided interpretations. Each member of the committee presented qualitative interpretations with a high degree of knowledge, accuracy and confidence.

No committee member was able to exert any undue influence and the Researcher had ensured that the SWOT questionnaires evaluations had met with the important criteria of relevance when seeking NTU's EMS internal and external attributes and other information that will be significant to answering the research questions.

4.3 SWOT AND mRATING ANALYSIS

This NTU case study had used the qualitative to quantitative empirical values perspectives specifically designed as an EMS SWOT tool for evaluating NTU's EMS's current strengths and weaknesses as well as future opportunities and threats. This had involved evaluating the EMS attributes with regard to carbon accountability and management efficiency levels. The SWOT and mRating tool has presented an integrated mechanism based in the four 'SWOT' perspectives that has been assessed for both mitigation and adaptation for implementing an efficient EMS.

The SWOT and mRating data are presented in columnar format for easy formatting using MS Excel. The data obtained are grouped into an aggregate data format. The data format consists of records of the qualitative to quantitative empirical data. The grouping requires the researcher to transform the data into one record per the SWOT and mRating attribute. Data filtering is applied for analysis based on the range of data obtained from the 10 questionnaire sets (SWOT and mRating) replies.

Statistical factor analysis (FA) had been applied to investigate and discover the possible existence of underlying factors which give an overview of the information contained in a very large number of measured variables within SWOT and mRating. The structure linking eigenvalue to variables is initially unknown and factor analysis had provided the major factors assumed in this case as F1, F2 and F3. The FA method application is an iterative method which enables the communalities with each of the SWOT and mRating attributes to be gradually converged. The calculations will cease when the maximum change in the communalities is below a given threshold or when a maximum number of iterations is reached. The initial communalities assume that the input variables follow a normal distribution. Once the XLStat software had computed the results, these resulting analysis are transformed in order to make the resultant data much more easy for interpretation. The resultant data is subsequently used for the calculations of the correlation/covariance matrix, Cronbach Alpha, Kaiser Meyer Olkin and Eigenvalues.

The data analysis are presented in Appendix 3A, 3B and 3C (pp.338-340) ; Appendix 4A, 4B and 4C (pp.376 - 380) : Appendix 5A, 5B and 5C (pp.384-389) ; Appendix 6A, 6B and 6C (pp.393 - 398). The data format is transferred into XL Stat and using the factor analysis module (similar to SPSS) to be subjected to computational analysis to determining data integrity and reliability using statistics.

Data derived from the EMS SWOT analysis had been based on the various environmental reports issued by NTU, including sustainability and carbon polices for which the ARC members had professional working experiences of its detailed functionality and the individual member’s field of expertise. Qualitative to quantitative data had been analysed from the SWOT questionnaires as presented in

Tables 12 (A)-(D)(pp.178-181). The quantitative data ranged from 1 to 10, being the most efficient value. The SWOT questionnaires evaluation had commenced with the evaluation of strengths concerning NTU's EMS. Weakness had included factors that are obstacles when an EMS had been adopted. Opportunities include external benefits for NTU from the adoption of environmental management practices in terms of environmental data credibility. These had been included as to what future benefits or competitive advantages might be gained that would be beneficial to NTU. Finally, threats had included future problems and obstacles from not implementing any environmental management practices. The detailed SWOT preliminary overview summary analysis interpretation of this research is presented in Table 25 below.

Table 25 – Summary of SWOT Analysis Results [(Appendix 3A, p.371), (Appendix 4A, p.376), (Appendix 5A, p.384) and (Appendix 6A, p.393)]

Strengths		**Weakness**
In an effort to promote environmental management and accountability practices. NTU had adopted specific environmental management tools that had significant environmental improvements. NTU focused more attention towards the holistic environmental management systems which are designed to managing its environmental responsibilities. NTU had top management support, with minimum qualified and experienced staff to manage Scope 3 (Travel) data collection		As NTU adds more capacity to its education model, NTU risks damaging its brand as a green campus. NTU has a legal obligation to cap its carbon emissions by 43% (by 2020) to the base year 2005. NTU may at some point need to consider its strategies of further faculty expansions. Environmental management practices require large amounts of continuous funding. Typically, NTU spends less than 1% of its total revenue in adopting environmental measures, personnel environmental training and appropriate IT spend.

NTU supports 'green strategies' adopting Eco Campus EMS Software implementation for future ISO14001 certification. NTU carefully records travel data on staff and student travel modalities by promoting discounted bus travel passes and cross discounts to other services as incentives. Also promotes a minimal change for campus/city bike Use. NTU is a huge global brand recognisable for two main reasons. It has won numerous green campus awards and early supporter of campus bio diversity.		Implementation of EMS by NTU is overburden by bureaucratic requirements for the frequent completion of numerous documentations, internal environmental reporting, travel surveys and independent audits concerning carbon emissions. Budgetary constraints have not funded NTU's estate management to recruiting skilled management and staff for supporting environmental practices. NTU's focus on multiple Scope 3 (Travel) carbon mitigation issues could be detrimental to the University by shifting the focus away from important environmental issues and mitigating unnecessary costs NTU requires specialised and experienced management for aggressively managing Scope 3 (Travel) abatement strategies.
Opportunities		**Threats**
NTU has installed EcoCamopus. A customised version of the EcoCampus EMS that will enhance Scope 3 (Travel) environmental management. A collaborative EMS with EcoCampus would only enhance NTU's brand name.		The quick changing pace of UK Climate Change, Companies Acts, HEFCE and stakeholder demands for more carbon mitigation could make NTU vulnerable to incur high costs. This could be coupled with budgetary restraints.

EcoCampus ISO14001 Software has been adopted by over 100 UK Universities as an EMS Platform for carbon emissions accountability and management The new EMS adopted would enable NTU to benchmark carbon emissions and enable NTU to become a key strategic HEI offering carbon management services to third parties.		Students are concerned about global warming demanding eco-friendly campuses. Other university competitors both local and foreign are competing for the lucrative overseas student market, where Scope 3 (Travel) can be a major component of their carbon footprint. The HE Sector wide cap of carbon emissions at 43% below their 2005 base by 2020 is too optimistic with current technology and consumption. NTU could be forced to pay fines.

(a) Preliminary SWOT Analysis and Discussions

In terms of the usability of the EMS SWOT the action research committee's (p.156) evaluations had presented a 'rough and usable' scenario analysis as presented in Table 25 (pp.242-244) above. The EMS SWOT assessment framework had been a helpful aid in structuring the evaluation of the overview concerning NTU's EMS efficiency status. The EMS SWOT offered NTU a user friendly tool to self-analyse and become aware of the four SWOT impacts. This analysis had offered the Researcher the foundations to develop a new EMS that will incorporate opportunities and avoiding threats into longer term carbon reduction planning. The main application areas derived from the SWOT framework analysis had involved developing strategies for EMS efficiencies.

The EMS SWOT had been helpful in understanding and evaluating the implementation concerning carbon emissions accountability including legal and stakeholder compliances. This had underlined the importance of NTU's carbon emission policies and targets. The EMS SWOT study had provided a tool to combine Scope 3 (Travel) carbon emissions accountability issues into strategic management decision making. Adopting these techniques had contributed for the development of a simplified tool to EMS evaluation requiring lower technical skills and minimal costs.

The standard SWOT framework had incorporated the four quadrant components (Table 25 pp.242 -244) that had involved NTU's strength and weaknesses as well as competitive factors that NTU faced i.e. opportunities and threats concerning its EMS carbon management and accountability. Table 25 also had presented the SWOT situational analysis on the basis of controllable and uncontrollable EMS attributes within the four SWOT perspectives. The quantitative interpretations of the SWOT EMS had been based on the expertise, knowledge, impacts and visions that had concerned the efficient mechanics of NTU's EMS.

Table 25 had further presented the four different SWOT categories as formal synthesis of the core logic of the qualitative description analysis and interpretations. The four SWOT categories had highlighted the various strong and weak attributes of NTU's EMS currently implemented. The majority of the strengths had centred on the existing EMS that had provided the accountability framework and structural benefits. From an analytical perspective, the key attributes within the SWOT analysis are whether EMS factors can be controllable or uncontrollable (Novicevic et al, 2004). The analysed SWOT framework had presented the four critical categories that includes NTU's EMS's strength and weaknesses and correspondingly NTU's competitive factors that it faces in the HE Sector (opportunities and threats).

Matching of NTU's SWOT components across all these four diverse categories had entailed some logical inconsistencies. This inconsistency had resulted when each SWOT component had been assessed in both objectively and subjectively (Pesonen and Horn, 2014).

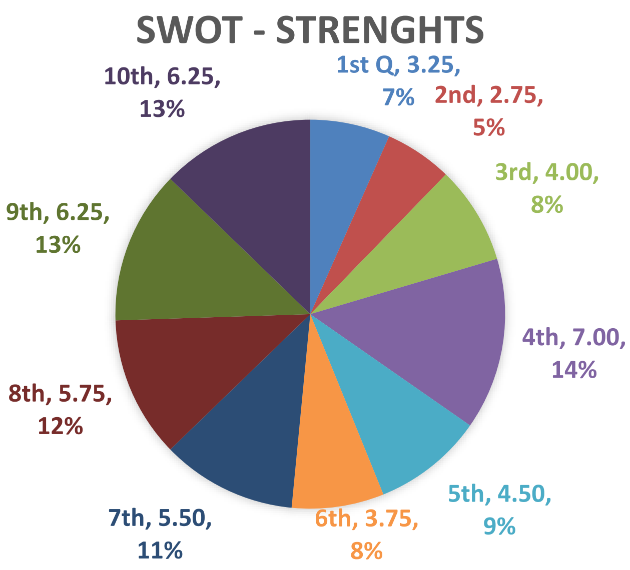
4.3.1 STRENGTHS AND OPPORTUNITY ANALYSIS

As shown in Table 25 (pp.242-244) above the strengths of NTU's EMS had been synthesised and had included the following factors: environmental management tools, holistic management systems, carbon accounting and information technology. In fact, NTU's EMS had clearly identified as being dependent on IT resources as the key driver for accountability that had been indicative as a major strength. Administrative and top management support had also been indicated as a major strength. Management's role had been to create and empower NTU to fostering knowledge based environments that had offered each personnel the opportunity to learn, develop and meaningfully contribute to achieving NTU's carbon targets. NTU's environmental management team had diverse skills that had enabled creative and strategic Scope 3 (Travel) carbon emissions abatement. Pesonen and Horn (2014) stated that 'teams' that are diverse and socio-cognitively complex had been better equipped to meet the challenges of carbon reductions.

NTU's had strengths in bio-diversity management and recipient of 'green' accolades (Ntu, 2014) had provided a competitive advantage over other HEIs permitting greater innovative gains for NTU EMS. NTU's environmental management and information technology had supported this ‘green strategy’ for managing carbon emissions accountability. Key strengths had concerned NTU’s adoption of ISO14001 EMS standards that had presented a regulatory framework and carbon management framework that had presented a degree of stakeholder compliances.

(A) SWOT - Strengths

Diagram 27 - Summary of SWOT (Strengths) Questionnaires (Data presented in Appendix 3A, p.371 and p.372)



Average SWOT Value = 4.90 (p.371)

Action Research Member	Kaiser-Meyer-Olkin Value	Mean Value	Standard Deviation
A	0.713	5.0	1.563
B	0.803	4.5	1.350
C	0.856	4.8	1.989
D	0.719	5.2	1.476

above figures in p.372

Cronbach’s Alpha = 0.925 (p.372)

Kaiser-Meyer-Olkin Value = 0.764 (p.372)

Eigenvalue F1=3.046 (Cumulative 79.929%) (p.372)

The SWOT (strengths) data summary presented in Diagram 27 above describes the magnitude of the quantitative strengths, measured between 1 to10. These values were interpretations on the questionnaires presented in Appendix 3 (pp.371-373). Each question empirical quantitative measurement had a maximum of 10 points (10 being the best). Data analysis had presented the quantitative empirical values of the qualitative consensus (inter-rater reliability) elicited from the action research committee (p.156) qualitative interpretations of the SWOT (Strength) questionnaires. The results are presented as a pie chart profile. The empirical data elicitation had been analysed for data reliability using factor analysis using XLSTAT software analysis (detailed in Appendices 3 to 6, pp.371-398). The statistical analysis to ensure data reliability of the SWOT analysis had been represented by the Cronbach Alpha and Kaiser-Meyer-Olkin (KMO) Values. The Cronbach Alpha represented the internal consistency measure of how closely related the quantitative values had been within the action research committee's (p.156) empirical measurement values. The SWOT Strength's, Cronbach alpha value 0.925 had implied that the scale of reliability of the SWOT Strength quantitative values had a good consistent measure of consistency between the other empirical values.

Next, the data analysis of the SWOT's (Strength) Kaiser-Meyer-Olkin (KMO) Value presented a value of 0.764 representing the partial correlations among the variables as indicative that there are 'strengths' of the qualitative correlation of the SWOT Strength values. The KMO value of 0.764 represents the strength coefficients as positive and in an upper middle sector range. This data analysis value presented (pie chart Diagram 27, p.247) had incurred very small ranges of about 5 to 14 percentage points of partial correlations. The range of partial correlations is acceptable to this research as having a minimal effect on the overall impact to the data analysis. NTU's SWOT Strength average value of 4.9 is indicative that NTU's initial EMS for the management of Scope 3 (Travel) as not very efficient but rather a mid-value efficiency level. In similar studies by other researchers, Guerrero-Baena et al (2014) research indicated that multi criteria analysis can evaluate the efficiencies of the company's EMS and identify the best EMS alternatives that would maximise the firm's environmental accountability.

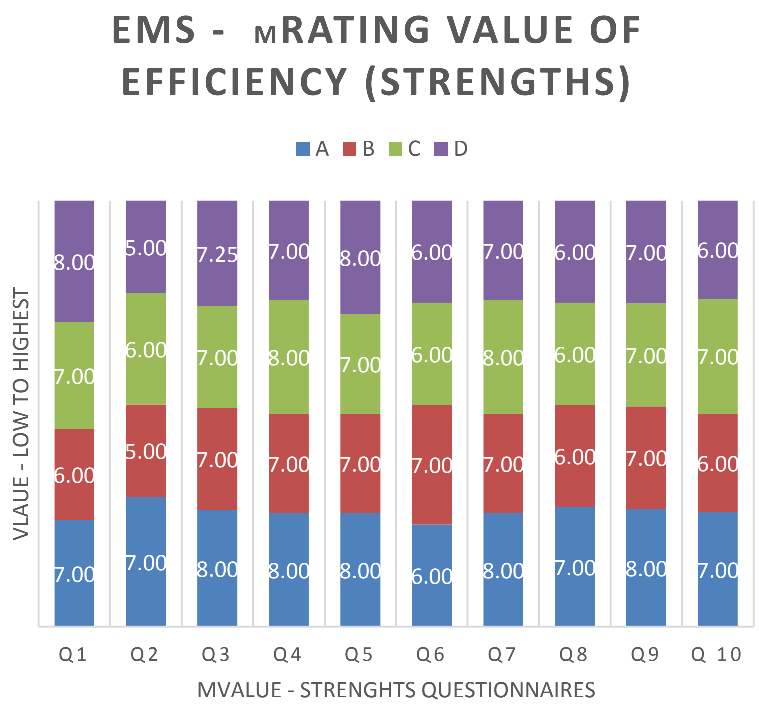
The eigenvalues of SWOT Strength were represented by F1 value of 3.046 (Cumulative 79.929%)(p.372) and (Diagram 27, p.247) with F1 being the dominant factor. The eigenvalues of the correlation matrix are positive numbers The cumulative eigenvalue is statistically significant with a 20% bias value based on the average score of the ten questionnaires evaluating NTU's SWOT Strength. The eigenvalue underlines the importance the ARC had granted to the important aspects of an efficient EMS at NTU. This issue refers mainly to the management processes and strongly relegated to the possibility of developing new IT systems and ensuring more technical resources are available. The practical aspects of this eigenvalue lies in the relatively small divergence of covariance's matrices from the quantitative values of NTU's EMS SWOT.

The factor analysis described above represented the data reduction of the SWOT empirical values that used the univariate option. The mean value of 4.9 (p.247 and p.371) represents the mean of the variables used for the SWOT Strength analysis indicating a balanced perception about the empirical weight of the aspect from rom each member of the ARC. The standard deviations are the variables used in the factor analysis with values greater than 1 (p.247).

NTU's has been slow to adopting environmental practices (Qs1=3.25) and having low data management efficiencies (Qs2=2.75 and Qs3=4.0) due to lack of resources and technical expertise. NTU had made improvements concerning Scope 3 (Travel) mitigation procedures offering staff and students low cost bus passes and providing information of carbon emissions on business travel (Qs9=6.25). These procedures had offered NTU to initiate its objectives for lower travel carbon emission in the next 3-5 years (Qs10=6.25 and Qs8=5.75). Implementing strategic objectives are key strengths (Qs5=4.5) whereas strategic aims (Qs6=3.75) have not had the measured strengths concerning carbon emissions. However, NTU's organisational mission for carbon emissions reductions management had been more positive (Qs7=5.5). NTU has won accolades for its green initiative and had been perceived positively by external stakeholders as a key strength to taking a lead in Scope 3 (Travel) carbon emissions management. (Qs4=7.0)

(A) mRating Value - Strengths

Diagram 28 - Summary of EMS Strengths mRating Value of Efficiency (Data presented in Appendix 3A - p.371 and pp.373 - 375)



Average mRating Value Strength Rating = 6.88 (p.371)

Action Research Member	Kaiser-Meyer-Olkin Value	Mean Value	Standard Deviation
A	0.732	7.4	0.699
B	0.811	6.5	0.707
C	0.724	6.9	0.738
D	0.814	6.7	0.949

above figures in p.373

Cronbach's Alpha = 0.841 (p.373)

Kaiser-Meyer-Olkin Value = 0.763 (p.373)

Eigenvalues F1= 2.305 (Cumulative 61.803%) (p.374)

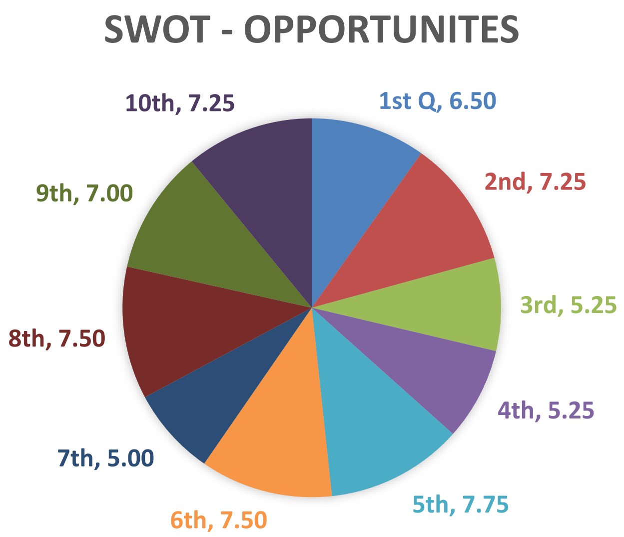
The data analysis of the EMS efficiencies mRating value (Strength) from the structured questionnaires are presented in Appendix 3A (p.371). The data analysis had presented the responses from members of the ARC quantitative responses to the effectiveness and efficiencies of NTU's EMS for managing its Scope 3 (Travel) carbon emissions accountability. Each member of the ARC presented their empirical quantitative responses from values 1 to 10 (10 being the best). The mRating value presented the quantitative empirical value responses that had best described the situational analysis concerning the effectiveness of NTU's domain 'Strength' efficiencies elements of NTU's EMS. The data analysis presented an average 6.88 mRating value (p.371) describing the current EMS Strength domain, an EMS efficiency value that is above average and has room for further improvement. The Cronbach Alpha value is 0.841(Appendix 3 C, p.373) implying that the scale of reliability of the EMS Strength domain qualitative values have a good consistent measure of consistency. This mRating value (Strength) had been broadly similar to the SWOT Strength values (Diagram 27, p.247) thus providing confidence that the qualitative measurements are not significantly dependent on the processes used. The KMO value of 0.763(p.373) and (Appendix 3 C, p.373) represents the strength coefficients as positive and in the upper middle sector. The Eigenvalues are 2.305 (Cumulative 61.803%)(p,374). The F1 eigenvalue of 2.305 represents the variance of mRating value variances. F1 is the predominant factor shows the covariance matrix of the mRating value as highly correlated, with the ARC having similar representations concerning the Strength factor of NTU's EMS. The eigenvalue F1 stated that mRating EMS efficiencies strengths do have strong long term objectives and the standard deviation being less than 1 in Diagram 28 (p.250) above.

NTU's EMS efficiency strengths are analysed in bands of strengths of mRating values greater than 7.0, greater than 6.0 and greater than 5.0 (Diagram 28, p.250). mRating values greater than 7.0 were attributable to questions, Qsm 1, 3, 4, 5, 7 and Qsm9. NTU's EMS internal strengths were attributable to implementing EcoCampus software to systems accountability to meeting the targets and carbon policies in meeting HEFCE compliances. Higher efficiencies had been derived by ensuring that the EMS had meet the shared value base for EMS operating effectively and was designed to meeting the long term Scope 3 (Travel) carbon abatement objectives.

Efficiency bands greater than 6.0 but less than 7.0 had indicated that NTU's EMS efficiencies required the use of the best resources in terms of technical and operational capabilities for developing core management systems and to meeting the demands of stakeholders. Lower than empirical value 6 had been attributable to NTU's average management practices for accounting for environmental impacts.

(B) SWOT - Opportunities

Diagram 29 - Summary of SWOT (Opportunities) Questionnaires (Data presented in Appendix 5, p.384 and pp.385 -388)



Average SWOT Opportunities Value = 6.63 (p.384)

Action Research Member	Kaiser-Meyer-Olkin Value	Mean Value	Standard Deviation
A	0.737	7.1	0.568
B	0.545	6.6	0.516
C	0.614	6.7	0.949
D	0.745	6.4	0.699

above figures in p.385

Cronbach's Alpha = 0.854 (p.385)

Kaiser-Meyer-Olkin Value = 0.539(p.385)

Eigenvalue F1=3.180, F2 = 1.062 (Cumulative 86.216%) (p.386)

Diagram 29 above, presents the SWOT (Opportunities) data analysis had indicated a mean of 6.63 above (p.384) indicating that NTU has limited scope to capitalise on its EMS opportunities. Scope 3 (Travel) EMS had above average SWOT Opportunity value that could provide NTU with opportunities externally as consultants when adopting environmental practices (QO1=6.50). NTU opportunities involved increased carbon reduction strategies with less complex and supportive carbon polices (QO5=7.75). Other opportunities are evaluating information systems, 'green' processes and financial challenges (QO2=7.25), implementing specific Scope 3 (Travel) Carbon management (QO6=7.5), implementing EMS systems that offer

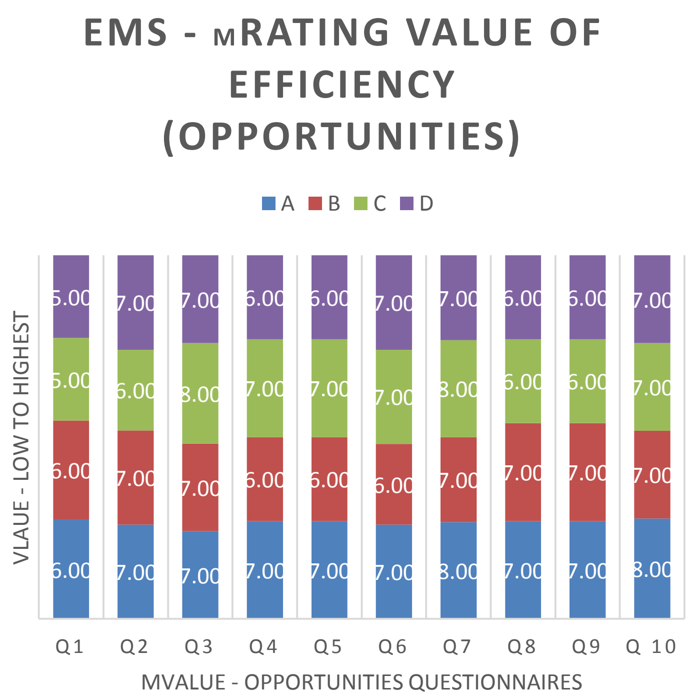
Scope 3 (Travel) carbon emissions monitoring and carbon audits for management purposes (QO8=7.5). The opportunities concerning NTU's EMS are high, the competitive position in the transition between less complex carbon policies and EMS that are specific to the HE Sector. There had been no direct relationship and implications for the development of an EMS that can incorporate the accountability and management of other carbon emissions of NTU as each type of emission requires a different mechanism (QO7=5.0). EMS practices within NTU need to be integrated with existing organisational practices to realise its full potential. NTU should undertake further research to measure any potential benefits of an efficient EMS system (QO3 add QO4 = 5.25).

The Cronbach Alpha coefficient for SWOT Opportunities was 0.854 (p.385) i.e., having a value greater than 0.7 or higher is considered acceptable measures of reliability (Soriano – Meier and Forrester, 2002). Cronbach's Alpha value is based on the average value correlations of the SWOT (Opportunities) questionnaires. The data analysis of the SWOT's (Opportunities) Kaiser-Meyer-Olkin (KMO) value presented a value of 0.539 (p.385) representing the partial correlations as indicative that the strength of the qualitative correlation of the SWOT Opportunities values. The KMO value represents the strength coefficients as positive and in an upper middle sector range. EMS is aimed at establishing environmental policies and procedures within NTU to ensure Scope 3 (Travel) accountability management and to comply with HEFCE policies in ensuring meeting its emissions targets. The Eigenvalues for F1=3.180 and F2=1.062 with a cumulative of 86.218% (p.386) NTU's SWOT Opportunities had distilled to have two factors of eigenvalues that were significant based on the analysis of the empirical data. These factors applicable to NTU's EMS opportunities involved the greater use of IT Infrastructure and management information systems.

The factor analysis described above represented the data reduction of the SWOT Opportunities empirical values that had a univariate option. The mean value of 6.63 (p.384) represents that the empirical values had indicated that NTU has opportunities for EMS target improvement strategies.

(C) mRating Values – Opportunities

Diagram 30 - Summary of EMS (Opportunities) mRating Values (Questionnaires (Data presented in Appendix 5, p. 384 and pp.389-392)



Average mRating Value Opportunities Rating = 6.70 (p.384)

Action Research Member	Kaiser-Meyer-Olkin Value	Mean Value	Standard Deviation
A	0.737	7.1	0.568
B	0.545	6.6	0.516
C	0.614	6.7	0.949
D	0.745	6.4	0.699

above figures in p.389

Cronbach's Alpha = 0.832 (p.389)

Kaiser-Meyer-Olkin Value = 0.674 (p.389)

Eigenvalues F1=2.368 (Cumulative 65.494%) (p.390)

Replies to the ten questionnaires (Appendix 5, p.384) presented the average mRating (Opportunities) Value of 6.70. This mRating value presented the overall average performance for the purposes of NTU's EMS efficiencies and quality. The 6.70 mRating value presented the current EMS Opportunities domain EMS can be improved incorporating carbon policies and targets. The Cronbach Alpha value is

0.832 above implying that the scale of reliability of the EMS Opportunities domain qualitative values have a good consistent measure of consistency. This mRating value (Opportunities) are slightly dissimilar to the SWOT Opportunities values, thus providing confidence that the qualitative measurements are not significantly dependent on the EMS systems. The KMO value of 0.674(p.254) represents a medium strength coefficients as positive and in the upper middle sector. F1 eigenvalue is 2.368 and a cumulative of 65.494% (p.389). The eigenvalue Factor 1 was dominant as the mRating efficiency value indicating NTU's EMS perceived some loss of essential aspects of efficiencies indicating skills and technical limitations. The factor analysis described above represented the data reduction of the mRating Opportunities empirical values as a univariate option. The standard deviations are the variables are less than 1 (p.254)(see Table) that indicated that were positive aspects of NTU's EMS efficiencies.

NTU's EMS efficiency opportunities are analysed in bands of strengths of mRating values greater than 7.0, greater than 6.0 and greater than 5.0 (Diagram 30, p.254). mRating values greater than 7.0 were attributable to questions QOm3, QOm7 and QOm10 as cluster responses. There are potential benefits for NTU to provide consultancy services to the HE Sector for implementing an efficient EMS for carbon accountability, pollution control management and skills development for integrating sustainability and EMS. Efficiency bands greater than 6.0 but less than 7.0 had concerned opportunities to evaluating information, systems, processes and challenges to establishing green campuses and financial challenges. Monitoring and carbon audits are key opportunities that can translate to providing evidence for eco labelling of campuses. The mRating value below 6.0 had been centred on NTU taking limited initiatives to examine the opportunities when examining such practices.

4.3.2 WEAKNESS AND THREATS ANALYSIS

The frequency order of weakness of NTU's EMS is as follows: NTU's building programme risks being unable to meet its compliance Scope 3 (Travel) carbon targets, capital funding, bureaucratic and burdensome process requiring complex processes and systems. A lack of trained staff and some with insufficient qualifications and skills amongst staff members were seen as a weakness. Financial resources have become critical and has been stated as a weakness. These scenarios had impacted on NTU to provide adequate Scope 3 (Travel) carbon emissions abatement capabilities. Budgetary constraints impeded to NTU complying with Scope 3 (Travel) abatement for the simple reason that costs of carbon accountability and reporting are increasing. Travel modes design technology had been acknowledged as a problem with Scope 3 (Travel) as these are continuing to using fossil fuels. The problem of management issues was concentrated with too few staff having to deal with long and complicated carbon accounting matters. Other weaknesses concerned the minimal IT facilities, internal carbon auditors and lack of leadership qualities of environmental staff. There had been no prior studies in the HE Sector. However, there are some similarities consisted with the results of previous studies in other sectors. Nikolou and Evangelinos (2010) research with the Greek Mining Industry had indicated several weaknesses such as limited funding resources, limited environmental management systems deployment and limited personnel with the appropriate environmental management skills.

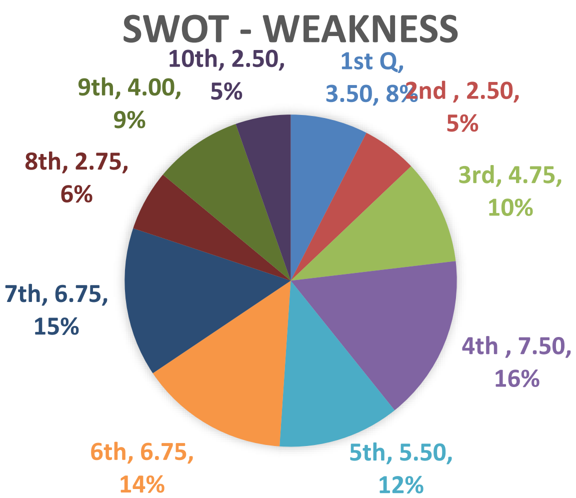
The SWOT (Weakness) analysis had shown that NTU's Scope 3 (Travel) carbon policies had lacked compliance with the Climate Change Act (2008)(Cca,2008) for limiting NTU's carbon footprint to 43% of by 2020 with reference to the base year of 2005. There was no coordinated strategy beyond the normal reliance on current

Scope 1 and 2 carbon emissions. This had resulted to a lack of coherence. There had been no long term strategies for sustainable resource management applicable to NTU's transport carbon impacts. Instead, the main Scope 3 (Travel) carbon emissions factors have been current consumption and based on travel modes.

In terms of climate policies, NTU had committed itself to reducing its GHG emissions in compliance with HEFCE (Hefce, 2012). However, NTU's position had not been fully compliant with the emissions targets of the Climate Change Act (2008) and HEFCE (Hefce, 2013) by not declaring its total carbon footprint, carbon targets nor implementing carbon reduction strategies's as per NTU's carbon management plan (Ntu, 2014). This situation highlights the lack of coherence of HEFCE and the Climate Change Act (2008)(Cca, 2008) targets and is likely to exacerbate these potential conflicts. The uncertainty of fossil fuel reserves, alternative fuels, technological innovations and huge capital costs have a direct effect on consumption and NTU's Scope 3 (Travel) carbon emissions planning uncertainty.

(D) SWOT – Weakness

Diagram 31 - Summary of SWOT (Weakness) Questionnaires (Data presented in Appendix 4, pp.376 and 377 - 379)



Average SWOT Weakness Value = 4.65 (p.376)

Action Research Member	Kaiser-Meyer-Olkin Value	Mean Value	Standard Deviation
A	0.797	4.7	2.111
B	0.894	4.2	1.989
C	0.849	4.8	1.814
D	0.925	4.9	1.969

above figures in p.377

Cronbach's Alpha = 0.972 (p.377)

Kaiser-Meyer-Olkin Value = 0.862 (p.377)

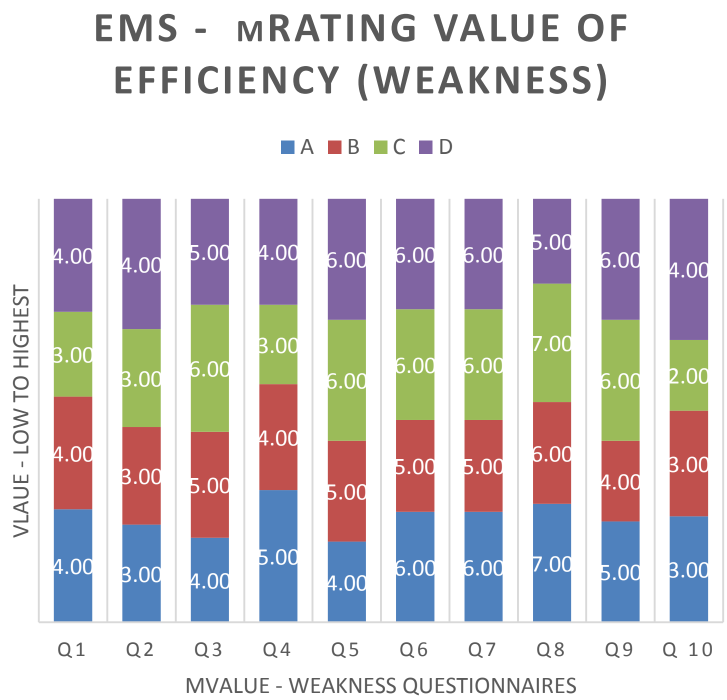
Eigenvalue F1=3.593 (Cumulative 90.287%) (p.377)

Diagram 31 (p.257) above presents the SWOT (Weakness) data analysis indicated a mean value of 4.65 indicating that NTU's below average ability to implement an effective EMS. Adopting environmental policies and practices requires greater resources from NTU (QW1=3.50). Interpreting HEFCE's compliances and evaluating EMS performance measures had been difficult in the absence of clear guidelines (QW2 & QW10 =2.5). Whereas long term challenges by HEFCE had an effect on EMS efficiencies (QW8=2.75). Record keeping that are specific for carbon emissions accountability are described as difficult (QW9=4.0) where there are still difficulties in understanding and recording Scope 3 (Travel) carbon emissions (QW3=4.75). Increasingly, NTU is subjected to increasing bureaucratic requirements involving reporting to HEFCE and other Stakeholders, each with different reporting requirements. NTU's Environmental Management Services Department is a separate entity, with few personnel, who lacked the appropriate experience in management and in managing carbon management and developing strategies for meeting NTU's carbon reduction targets (QW6 & QW7 = 6.75). The weakness aspects of the SWOT analysis centred on lack of systems analysis concerning environmental management and carbon impact mitigation. Weaknesses had been identified concerning aspects of overcoming cost barriers and limited prior knowledge when implementing an efficient EMS at NTU.

The Cronbach Alpha value 0.972(p.377) indicating there is high correlations of the SWOT (Weakness) qualitative replies to the questionnaires. The data analysis of the SWOT's (Weakness) Kaiser-Meyer-Olkin (KMO) Value presented a value of 0.862(p.377) represents high correlations as indicative that the strength of the qualitative correlation of the SWOT Weakness Values. EMS is aimed at establishing environmental policies and procedures within NTU to ensure Scope 3 (Travel) accountability management and to comply with HEFCE policies in ensuring meeting its emissions targets. The F1 egenvalue was 3.593 and the cumulative was 90.287% (p.377). The F1 value demonstrates severe weaknesses with NUT's EMS concerning the attributes for an efficient EMS for Scope 3 (Travel) carbon emissions accountability and management. The cumulative value indicates there are less common variances of weakness of the correlations regarding NTU's EMS weakness. NTU's inability to committing resources are key weaknesses. The factor analysis described above represented the data reduction of the SWOT Weakness values. The standard deviations are the variables used in the factor analysis with values greater than 1 (p.257 and p.377).

(E) – mRating Value - Weakness

Diagram 32 - Summary of EMS (Weakness) mRating Value (Questionnaires (Data presented in Appendix 4, p.376 and pp.380 -383)



Average mRating Value Weakness Rating = 4.73 (p.376)

Action Research Member	Kaiser-Meyer-Olkin Value	Mean Value	Standard Deviation
A	0.847	4.7	1.337
B	0.624	4.4	0.966
C	0.613	4.8	1.814
D	0.602	5.0	0.943

above figures in p.380

Cronbach's Alpha = 0.914 (p.380)

Kaiser-Meyer-Olkin Value = 0.653 (p.380)

Eigenvalue F1=2.961 (Cumulative 78.959% (p.381)

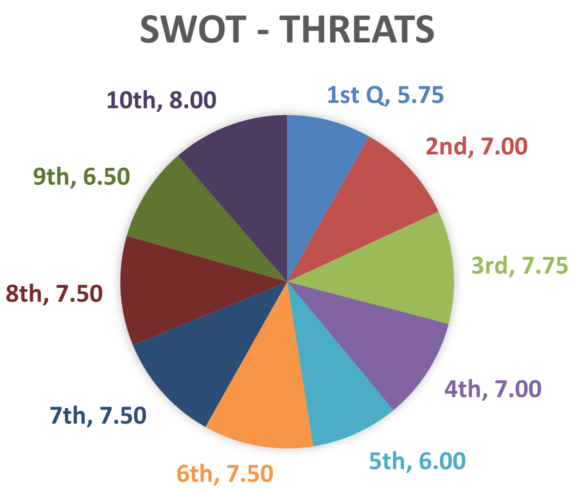
Diagram 32 above presents the EMS (Weakness) mRating value of NTU's EMS weakness data analysis indicated a mean value of 4.73. This mRating weakness Value is indicative of NTU's weaknesses concerning NTU's inability to undertake

EMS performance measurements concerning carbon reporting to stakeholders (QWm1=3.25) and Scope 3 (Travel) carbon emissions mitigation (QWm10=3.0). Adopting environmental management practices had concerned interpreting environmental carbon emissions mitigation (QWm2=3.75) and weaknesses in examining the effectiveness of EMS system that had been dependent on an effective IT infrastructure. Evaluating NTU's Scope 3 (Travel) carbon emissions had stemmed from NTU's strategic carbon emissions targets (QWm4=4.0) and that required having the necessary skilled staffing levels. This scenario had enabled NTU to be fairly able to manage the complexities that are demanded (QWm3=5.0) and ensuring that EMS operational objectives are achieved. Keeping appropriate records for Scope 3 (Travel) carbon accountability for carbon audit had been cumbersome and difficult to collate and produce (QWm5 & QWm9=5.25). Weakness had been encountered with ensuring EMS operational objectives (QWm6=5.75) are complex, difficult in preparing detailed procedures that had fed into procedural plans (QWm7=5.75). Long term EMS challenges had led to inefficiencies concerning NTU's EMS adoption (QWm8=6.25).

The Cronbach Alpha value 0.914(p.380) indicating there are high correlations of the mRating value (Weakness) quantitative replies to the questionnaires. The data analysis of the EMS MRating Values (Weakness) Kaiser-Meyer-Olkin (KMO) value presented a value of 0.653(p.380) represents low correlations as indicative that the weakness of the qualitative correlation of the mRating Weakness values. EMS had been aimed at establishing environmental policies and procedures within NTU to ensure Scope 3 (Travel) accountability management does become a broadly used tool that can comply with HEFCE policies and in ensuring meeting its emissions targets. The eigenvalue F1 was 2.961 and with a cumulative value of 78.959% (p.259 and p.381). The factor analysis presented one main factor as significant as a major EMS Weakness analysis of NTU's EMS. Communalities of the Factor Analysis and the proportion of the variances of each observed variable are relatively small in significance. NTU's EMS weakness are numerous for an effective management and accountability system.

(F) SWOT - Threats

Diagram 33 - Summary of SWOT (Threats) Questionnaires (Data presented in Appendix 6, p.393 and pp.394-397)



Average SWOT Threats Value = 7.05 (p.393)

Action Research Member	Kaiser-Meyer-Olkin Value	Mean Value	Standard Deviation
A	0.755	7.5	1.075
B	0.871	7.3	0.823
C	0.736	6.9	0.994
D	0.853	6.5	0.850

above figures in p.394

Cronbach's Alpha = 0.943 (p.394)

Kaiser-Meyer-Olkin Value = 0.711 (p.394)

Eigenvalue F1=3.239 (Cumulative 82.905%) (p.395)

Diagram 33 above presents the SWOT (Threats) data analysis having a mean of 7.05 had indicated that NTU is exposed to above average future problems and obstacles from not implementing any environmental management practices. Adopting environmental management practices requires continuous funding (QT3=7.75) which has an impact on NTU's budgetary controls (QT1=5.75). NTU is in a competitive educational industry where NTU has to compete for research grants from other universities for a greener university (QT5 = 6.0). Support for HEFCE had been indicative of a measure of (QT2=7.0) stemmed from the guidance notes that had been provided to NTU had contained limited explanations of the complexities of managing Scope 3 (Travel) carbon emissions. Threats to the severe changes in

Climate Change can have future serious impacts for NTU to manage emissions and meeting new stringent carbon targets (QT9=6.50). NTU's SWOT Threats had concerned the barriers from the development of efficient transportation technologies that can impede on lower transport emissions (QT4 = 7). NTU had experienced difficulties in interpreting Scope 3 (Travel) carbon emissions reduction standards, which are difficult to implement and costly (QT6=7.50 and QT10=8.0). Future changes concerns emissions factors of hydrocarbons for travel (QT7=7.50) can have an impact on future carbon mitigation planning difficult. There are adverse political concerns for mandatory legislation for implementing an EMS and accountability (QT8=7.50).

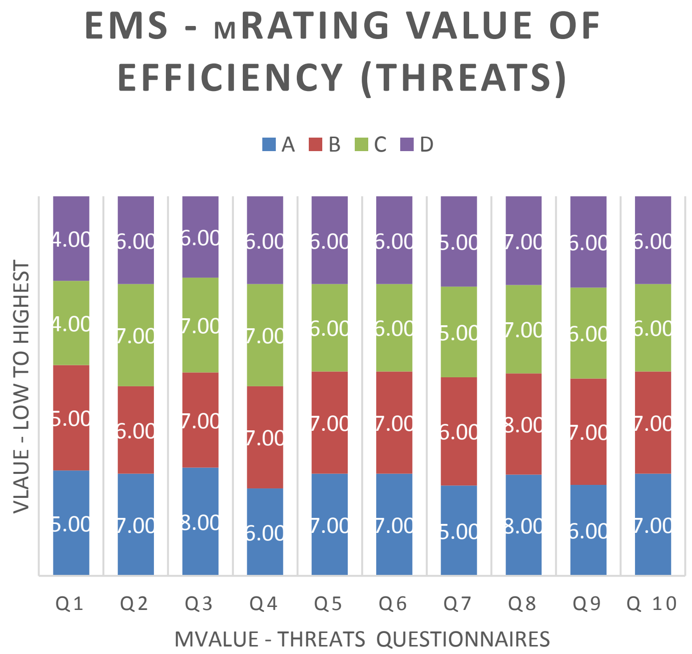
The Cronbach Alpha value 0.943(p.394) indicating there is high correlations of the SWOT (Threats) qualitative replies to the questionnaires. The data analysis of the SWOT's (Threats) Kaiser-Meyer-Olkin (KMO) value presented a value of 0.711(p.394) represents high correlations as indicative that the strength of the qualitative correlation of the SWOT Threat values. EMS Threats are external factors, effective environmental regulations for the HE Sector and long term funding costs.

The eigenvalue F1=3.239 and the cumulative is 82.905% (p.261 and p.395). The overall cumulative value accounted of a large proportion of the factors facing NTU's EMS Threats from the quantitative values obtained. The inadequacy of NTU to respond to the EMS Threats from Stakeholders are significant especially from HEFCE. F1, eigenvalue provides a focussed measure of how the SWOT Threats had been perceived. The emergent issues from the ARC/Researcher's answers to the SWOT Threats had identified that the main characteristics of the Threats were identified as funding, technical skills and reporting.

The factor analysis described above represented the variables used for the SWOT Threats analysis indicating a high level. The standard deviations are the variables used in the factor analysis with values less than 1 (see p.46) indicating less disagreement concerning NTU's deficiencies to implementing an efficient EMS.

(G) mRating Value - Threats

Diagram 34 - Summary of EMS (Threats) mRating Value Questionnaires (Data presented in Appendix 6, p. 393 and pp.398-400)



Average mRatingValue Threats Rating = 6.30 (p.393)

Action Research Member	Kaiser-Meyer-Olkin Value	Mean Value	Standard Deviation
A	0.955	6.6	0.707
B	0.660	6.7	0.823
C	0.699	6.1	0.994
D	0.634	5.8	0.789

above figures in p.398

Cronbach's Alpha = 0.913(p.398)

Kaiser-Meyer-Olkin Value = 0.795 (p.398)

Eigenvalues F1=2.911 (Cumulative 76.057%) (p.399)

Diagram 34 above presents the EMS (Threats) mRating value of NTU's EMS weakness data analysis indicated a mean value of 6.30. This mRating Threat value is indicative of NTU's delaying the implementation of an effective EMS for the accountability of Scope 3 (Travel) carbon emissions management (QTm1=4.50 and QTm7=5.25). Analysing the lack of sustainability attitudes of staff and students at NTU (QTm=6.25) are threat that had concerned the mitigation management of carbon emissions accountability and efficient EMS. Involving top management (QTm10=6.50) was a key driver. Data security management and security of IT systems (QTm4&QTm5 = 6.50) are critical threats faced by NTU for not implementing an effective EMS. Budgetary constraints and lack of development of long term EMS planning for NTU's carbon policies are key threats (QTm4=7.0). Not meeting long term stakeholder demands (QTm3=7.0) and planning for future legislations and additional capping of capital expenditure are perceived as major threats. Increasing complexities of carbon management and skills shortages for an effective EMS are long term threats.

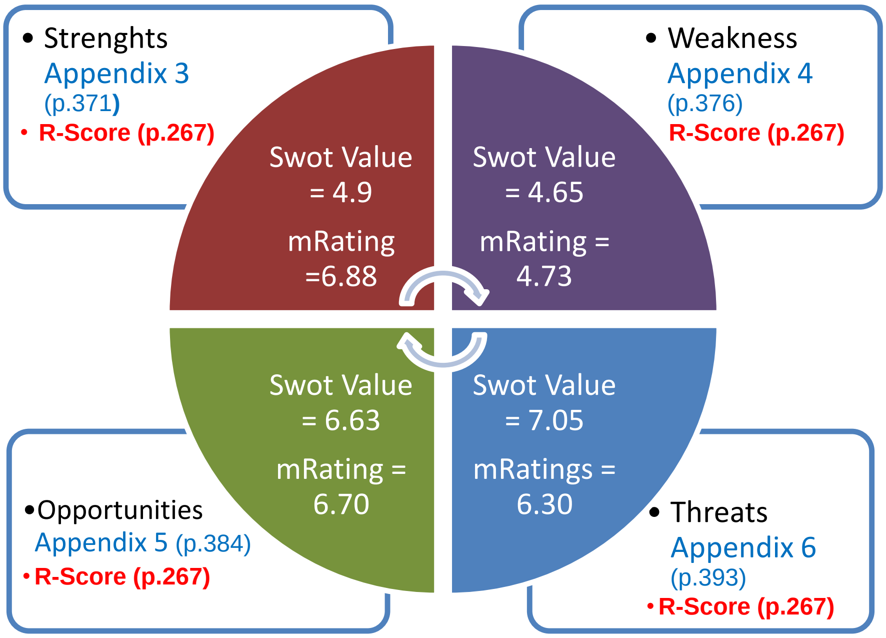
The Cronbach Alpha value 0.913(p.398) indicating there is high correlations of the mRating Value (Threats) qualitative replies to the questionnaires. The data analysis of the EMS MRating Values (Threats) Kaiser-Meyer-Olkin (KMO) value presented a value of 0.795(p.398) represents low correlations as indicative that the threats or weakness of the qualitative correlation of the mRating Threats values.

The eigenvalue F1=2.911 and the cumulative is 76.057% (p.399). The overall cumulative value accounted for the mRating value efficiency factors facing NTU's EMS Threats from the quantitative values obtained. The inadequacy of NTU to respond to the EMS Threats regarding data security and budgetary cuts are significant. The factor analysis described above represented the data reduction of the mRating efficiency empirical values. The F1 eigenvalue pointed out the important weight of technology innovation as a major weakness The standard deviations are the variables used in the factor analysis with values is closer to 1

4.4 SWOT AND mRATING VALUE DATA ANALYSIS SUMMARY

Diagram 35 (p.265) below presents the summary data of SWOT and mRating values indicating the biggest influences to NTU current EMS strategies. The following are key analysis inferences. The red sector indicates a relatively minimum Strength (4.9) and the green sector show the relevant opportunities (6.63) available to NTU. The diagram presents the average factor values of each of the SWOT Impacts identified as internal and external categories. The threats are the dominant factor at 7.05 indicating the NTU would be facing external threats ranging from budgetary constraints, skills staff, IT systems integration to external legislations. The weakness factor is 4.65. SWOT analysis showed that both opportunities, weakness and threats are critical factors affecting NTU and strongly related to each other.

Diagram 35 - Summary data of SWOT and mRating Value for Turnaround Recommendation



The severity of the decline of NTU's EMS concerns the 'total EMS failure' to meeting the legislative and legal compliances is imminent, it is relevant that NTU take decisive decisions to ensure the viability of a long term robust EMS. This research used the analysis recommended by Smith and Graves (2005) who used multiple discriminant analysis to developing a model to identifying new management potential. Smith and Graves found support that the severity as similar to this case

NTU's EMS management state of affairs and the availability of resources determine the extent to which the EMS decline stemming strategies are applied and a revival is effective. This Research adopted Smith and Graves recommendation of using a value card analysis of SWOT and mRatings where inefficient values should adopt efficiency orientated recovery strategies each with a benchmark value. A proprietary R-score model developed for this research has been used in the identification and evaluation of 'distressed' HEIs as it is recognised as a simplistic and reliable measurement to predicting the HEIs EMS recovery strategy. This research's R-scores (p.267) are single measurements values empirically similar to the analysis of the SWOT and mRating values summarised in Diagram 35 (p.265) derived from the quantitative values analysed in Appendix 3 (pp.371-373), Appendix 4 (pp.376-380), Appendix 5 (pp.384 -389) and Appendix 6 (pp.393-398). The benchmark value of 5.0 had been used as a stepwise linear discriminant analysis to analysing the model that was able to discriminate effectively between the four recovery strategies indicative from a HEI's EMS 'management health'. Analysis of the R-score (p.267) of less than 5.0 represents a relative magnitude value representative of that particular SWOT and mRating attribute. Analysis values that differ from the benchmark figures have an EMS that is in distress and in danger of EMS failure, while those with a higher benchmark figure are classified as having an efficient EMS.

The dependent variable chosen for this research is a four variable classification into four groups derived from the SWOT/mRating analysis domain. These groups are (1) Aggressive Strategy – considered when the preformed analysis suggest that opportunities exist for greater improvement of the HEI's EMS (2) Reconfigure Strategy – considered when the weak attributes of the EMS overcome the stronger attributes (3) Turnaround Strategy – considered when the HEIs EMS is in the least advantages in an unfavourable environment (4) Diversity Strategy – considered when the HEI's has to consider building stronger EMS accountability relationship within the HEI

Table 26 - SWOT and mRating R-Score Analysis

R – Score [From Diagram 35, p.265]			**Strategies** [SWOT Perspectives Analaysis]			
	SWOT	**mRatings**	**Aggressive**	**Reconfigure**	**Turnaround**	**Diversity**
Strengths	4.90	6.88	No technical skills	Difficult to realign Management	Minimal strengths	Limited internal strengths
Weakness	4.65	4.73	Complex Reporting Regimes	Slow to respond to Stakeholder demands	Extremely Weak EMS infrastructure	Poor internal management infrastructure
Opportunities	6.63	6.70	Limited resources	Internal systems minimise expansion	Declining performance measures	Limitation of financial and skills resources
Threats	7.05	6.30	Budgetary cuts	Internal EMS strengths weak	Increasing legislation and penalties	Stakeholder requirements difficult to comply

Developed by the researcher (Chelliah, 2015)

From the Table 26 above the recommended strategy for NTU is TURNAROUND based on the severity of the limitations of NTU's EMS. Turnaround means developing strategies from implementing an efficient EMS. Leveraging on NTU's current EMS implementation with EcoCampus (Eco, 2013) could present leadership in carbon management, but NTU has a strong weakness concerning resources and technical expertise could prevent NTU to fully realise its opportunities. NTU currently has embarked in a new environmental management initiatives encouraging more public transportation use but do not have the resources to fully implement carbon management strategies. Seoketsa (2014) stated that Turnaround is to implement improvement strategies to underperforming scenarios to regain stakeholder support and to overcome internal constraints. This implies that NTU would require greater budgetary and skills resources that facilitate the best choices for impacting on the success of the Turnaround EMS strategy.

4.4 (a) Research Recommendations based on Turnaround Strategies [Based on Pretorius, 2008]

The following are the researcher's main recommendations:

- Developing strategies, systems and processes to reducing 'weaknesses', which are preventing NTU from utilising its opportunities.
- Focusing on NTU's key strategic 'opportunities' and exploiting these to the fullest.
- Replacing weaknesses by developing innovative strategies and converting these to 'strengths' that will allow NTU to capitalise on its 'opportunities.'

The turnaround mission statements above are primarily essential to effectively establishing definitive objectives and formulating effective strategies to establishing a new EMS. The turnaround factors critical to the success of NTU's EMS involves the analysis of the external opportunities and threats and the internal strengths and weakness. The SWOT Turnaround empirical quantitative dimensions in Diagram 35 (p.265) can be described within the four quadrants as competitive (strength), conservative (weakness), aggressive (opportunities) and defensive (threats). The two internal dimensions are: new EMS implementation and carbon emissions accountability and management, and two external dimensions – HEFCE requirements, can be considered most important determinants of NTU's overall strategic position. Diagram 35 performance and analysis presents declining EMS Strength and high weakness due to inadequate IT resources and funding. Threats of weak management and lack of vision. These numbers suggest NTU to warrant turnaround strategies and invoke more resources to establishing an efficient EMS.

The above turnaround traits for Scope 3 (Travel) emissions EMS accountability evaluation would enable NTU to formulate EMS strategies. The major failing of the TURNAROUND is to be complacent with the current EMS operations, that NTU no longer considers the evolving requirements of stakeholders. The TURNAROUND strategies are able to change dynamically with the new EMS preferences as NTU is operationally required to do so. Hopkins (p.5, 2008) in his research of corporations stated that "A successful turnaround seems to require correctly identifying the problem and causes and then selecting the appropriate turnaround strategies to counter the cause of the problem". Seoketsa (2014) stated that Turnaround strategies can be long involving training and development of staff with effective efficient skills that are key attributes to a successful Turnaround implementation. Pretorius (2008) stated that Turnaround goes hand in hand with communications with key personnel and stakeholders of the specific strategies that suit the specific conditions.

Table 27 (p.270) below presents the turnaround strategies that had been initiated following the SWOT analysis for implementing the new EMS strategies and procedures. This research had highlighted the growing pressure to implementing a systematic carbon accountability operational procedures. Savely et al (2007) stated that HEIs are increasing obliged to implement EMSs specific to their specialised settings. Clarke and Kouri (2009) stated that the principal features for a campus EMS involves continuous improvement managements systems cycles, has management structures that complements decision making and has a HE Sector specific environmental assessment audit strategies for validation.

The following are the turnaround strategies for NTU's new EMS are presented in detail in Table 27 (p.270) below.

Table 27 – Turnaround strategies for the new EMS implementation Model

Policy	Strategies for Successful Turnaround
Crisis Stabilisation	NTU details its current strategies, evaluating these using SWOT and mRating values that determines the development of a turnaround plan and a time frame to restructure NTU's EMS for Scope 3 (Travel) carbon management and accountability.
Leadership	The objective is to use the researcher and the action research committee during restructuring period and when implementing the new EMS at NTU
Strategic Focus	The objective is for NTU to redefine its EMS strategies by redeveloping the EMS restructuring strategic planning for a successful turnaround. This involves EMS refocusing and implementing procedures, Scope 3 (Travel) carbon emissions operational alignment and outsourcing on non-core activities.
Operational Change	Implementing the new EMS requires adjustments in organisational structure, developing new carbon accounting skills and build on capabilities.
Critical EMS Processes for Scope 3 (Travel) Management	Ensuring the core processes for Scope 3 (Travel) accountability are in place supporting IT mechanisms. Ensuring that the EMS is more responsive and flexible optimising processes to reduce variable and fixed costs. Focussing on improved and lean processes.

Developed by the researcher (Chelliah, 2015)

Each policy stated om Table 27 provided the Turnaround Strategies and EMS design restructuring i.e., crisis stabilisations, leadership, strategic focus, operational change and critical EMS processes for Scope 3 (Travel) management as means to implementing NTU's EMS Turnaround. At the same time, the researcher expresses caution to anticipating risks that the strategies may be less effective or ineffective or poorly implemented. Bachmann (2009) stated that strategic turnaround implementations is linked to change management and top management behavioural communications connected to turnaround initiatives.

4.4.1 THE PROCESS OF TURNAROUND FOR NTU'S ENVIRONMENTAL MANAGEMENT SYSTEM

The key factors affecting NTU's EMS Turnaround can be aligned along two perspectives i.e. factors external to NTU. NTU EMS accountability and management are exogenous and endogenous to NTU. This can be described as external and internal factors that affect NTU's EMS and the key Turnaround driver would for NTU to understand the root causes for the inadequateness of its current EMS and respond to correcting any deficiencies.

The following are the major steps for the implementation of a Turnaround [adapted from Pretorius, 2008]

I. Setting up a turnaround committee to liaise with the action research committee and development of an action plan
II. Identifying the key EMS deficiencies both internal and external
III. Communication of the Turnaround strategy to management and staff and stakeholder management
IV. Organisation and allocation of budgetary and personnel resources
V. Implementing the Turnaround Solution recommendations of this research thesis as described in Table 27 (p.270)
VI. Turnaround review and update

NTU would embark on a series of effective management actions strategies based on the above leading to an improvement of its EMS performances and efficiencies during the Turnaround process. These would include NTU's initiatives concerning effective use of financial and IT resources allocation in the Turnaround processes.

The Researcher had been the Turnaround Leader with regard to ensuring that NTU has sufficient resources for the implementation of the Turnaround Process. Planning are key requisites, setting out in detail the specific actions required for Implementing the new EMS described in Chapter 4.5 below.

4.5 TURNAROUND DATA ANALYSIS - NEW NTU ENIVIRONMENTAL MANAGEMENT SYSTEM

Figures 4 to 9 (pp. 262 - 269) below presents the clustered strategies and data analysis of the qualitative to quantitative semi structured questionnaires developed by the researcher based on best practice recommendations of ISO 14001 attributes for implementing a robust EMS (Iso, 2009). These various different data analyses had presented the key empirical findings that had contributed significantly to improving NTU's new EMS (nEMS) concerning carbon management and accountability. Hopkins (2008) stated that turnaround strategies must fit the 'cause', whilst Schoenberg et al (2013) stated that key drivers for a successful turnaround is concentrating on fundamentals: focusing on the most viable and developing clear competitive strategies.

This research had adopted Pretorius (2008) turnaround research strategies to NTU's EMS as follow: (i) implementing the key determinants to NTU's EMS configurations (ii) implementing the complementary strategies associated with each of the turnaround situation in the matrix (Diagram 36, p.275) (iii) ensuring that the strategic practices are associated with each of the turnaround matrixes (iv) ensuring that NTU derives value from the new EMS.

The process involved incorporating the new key EMS attributes that had been selected by the researcher for the development of the hybrid EMS that focuses on the key requirements of an effective EMS specific to NTU. Each Turnaround strategy involves data analysis from the specific set of questionnaires from qualitative to quantitative to determining the appropriateness and fit of the selected attributes and their empirical magnitudes from the semi structured questionnaires.

The empirical data sets from the analysis of the questionnaires are in Figure 4 - Data Analysis of Material Risk Management (p.277), Figure 5 - Data Analysis of Environmental Performance Assessment (p.278), Figure 6 - Data Analysis of Stakeholder Demands (p.279), Figure 7 - Data Analysis of Legal Compliance (p.280), Figure 8 - Data Analysis of Consistency with ISO 14001 (p.282), Figure 9 - Data Analysis for EMS Confidence and Credibility (p.284). No thematic analysis or factor analysis were used in the data sets as in (figures 4 to 9)(pp.277-284).

The turnaround matrix presents the summary of new NTU EMS combining the strategies and resource munificence and causality results within the four cells as shown in Diagram 36 (p.275). The four cells describe the requirements for NTU's EMS predetermined preconditions developed by the researcher as 'cluster strategies'. Each of the four cells will be representing a set of preconditions and this research presents the EMS Turnaround configuration and data analysis are presented in Figures 4 to 9 (pp.277 - 284). The following summarises the new NTU EMS Turnaround Strategies implemented in a sequential clockwise format. The expert opinions of the ARC furnished definite qualitative to quantitative empirical validity to the models and NTU's support for its application bodes well for the acceptance by the Researcher concerning the practical applications of the EMS. Diagram 36 (p.275) is a cluster matrix that will assist NTU to get NTU's Management on board earlier.

- Material Risks (Figure 4, p.277) is an area of data transition from HEFCE's requirements that NTU's EMS has taken into consideration.

- Environmental Performance Assessment (Figure 5, p.278) measures the environmental impact and targets for the new EMS Turnaround. Detailed performance measurements for HEFCE is a requirement.

- Stakeholder Demands (Figure 6, p.279) are part of the new EMS environmental policies for Scope 3 (Travel) carbon emissions abatement management and commitment

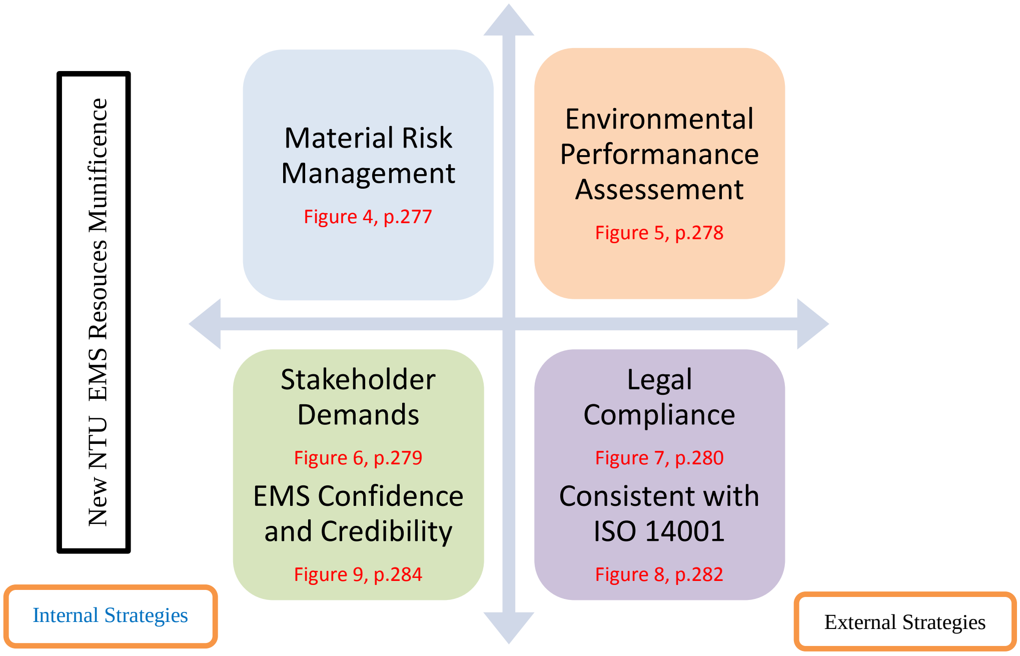
- Legal Compliance (Figure 7, p.280) is part of the nEMS and legal requirements are identified and changes implemented. Overall EMS objectives are put into management practices.

- Compliance of ISO 14001 (Figure 8, p.282) are key compliances with Environmental Standards and objectives.

- EMS confidence and credibility (Figure 9, p.284) are part of the vital EMS development policies requiring efficient EMS project management and management support. Correct documentations are generated, data review procedures and operational controls implemented throughout.

Turnaround strategies are concentrated on the strategies identified by the Researcher (Table 26, p.267) for NTU's new EMS that focusses on IT technology, changing environmental legislations and detailed reporting requirements. Tikici et al (2011) stated that turnaround involves key resources and strategic flexibility. According to Kazozcu (2011) turnaround strategies face challenges to selecting the most optimal turnaround strategies to recovery from a crisis. Whilst, Westhyssen (2014) placed more emphasis on risk profiles of a turnaround, poor planning and execution that can have detrimental impact on an organisation. Westhyssen, also indicated that turnaround offered an ideal context for optimising assets, implementing strategies for reduce energy consumption and improving sustainable operations management.

Diagram 36 - Summary of NTU's New EMS Strategies and Processes Matrix to respond to the Turnaround Recommendations



To establishing the Turnaround, the Thesis evaluated the specific qualitative to quantitative open semi-structured questionnaires developed by the tesearcher for a new hybrid EMS as presented in Figure 4 (p.277), Figure 5 (p.278), Figure 6 (p.279), Figure 7 (p.280), Figure 8 (p.282) and Figure 9 (p.284) based on ISO 14001 requirements for a robust EMS. Each figure analysed the specifics for the new EMS, each with different and specific questionnaires to developing a hybrid EMS suitable for NTU. These questionnaires were developed by the researcher independently.

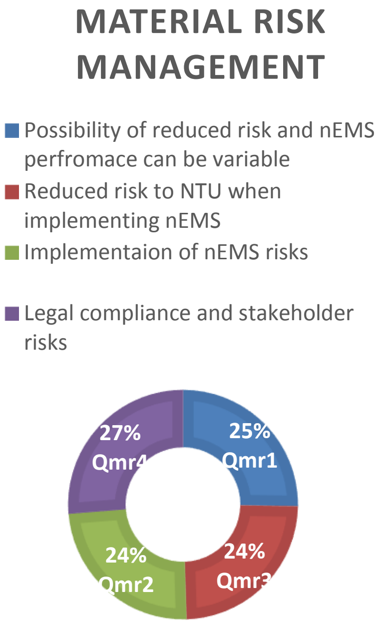
The Turnaround analysis of Figures 4 to 9 (pp.277-284) presents the mRating empirical data value)(mRv) data analysis that empirically had examined the relationships between the requirements of the turnaround matrix as above involving the new EMS ISO 14001 characteristics and turnaround performance under HEFCE requirements for Scope 3 (Travel) emissions accountability and management. Diagram 36 (p.275) generic hybrid EMS can be replicated to other HEIs to meeting their key EMS efficiency and legal attributes.

Analysis of Figure 4 (p.277) below had stated that there was a Qmr3=24% (mRv) of risks associated with legal compliances and stakeholder risk. Implementing the nEMS provided a mechanism for meeting NTU's obligations for a regulatory framework for Scope 3 (Travel) carbon emissions management. Qmr2+Qmr3+Qmr4=75%(mRv) of the inherent material risks had been associated when implementing new systems derived from environmental legislations risks that are changing rapidly, originating from the UK and EU. Bracci and Maran (2013) stated that implementing an EMS has the potential to make carbon management 'visible' and measurable when being proactive to solving the urgency of environmental problems. The quantum risks management concerning carbon data had presented the risks management of implementing a nEMS as an 'internalisation' by NTU. Internalisation had involved NTU's obligations towards carbon emissions management and accounting – whose management complexities are difficult to manage. Foo (2013) stated that materiality applicability to HEIs implies that core activities of HEIs are linked to the impacts of carbon emissions. The concept of materiality Qmr2=24%(mRv) tackled the need for inclusion of different stakeholders in the EMS processes. NTU's risk assessment stated that properly constructed and effective EMS had provided credibility for the development of the most significant environmental performance indicators.

The management risks involving issues such as whether Scope 3 (Travel) emissions information will be sufficed, whether the EMS structure can meet the NTU's obligations for carbon emissions accountability, management and reporting. Qmr3=24%(mRv) had indicated that there will be reduced risks to NTU. The percentage is low due to NTU is in continued negotiations for more resources.

Implementation risks are Qmr2=24%(mRv) regarding the EMS implementation milestones have to be identified to provide measurability and accountability.

Figure 4 - Data Analysis of Material Risk Management

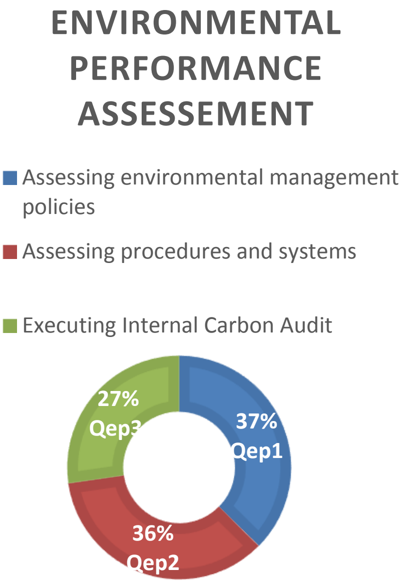


Q	nEMS - Material Risk Management Data Analysis	nEMS mRating Value Ratings (Qualitative to Quantitative)				
ARC / Questions developed by Researcher		1	2	3	4	Av
Qmr1	Possibility of reduced risks and EMS performance can be variable	8	9	8	8	8.25
Qmr2	Reduce risk to NTU when implementing nEMS	8	8	8	8	8.0
Qmr3	Implementation risks	7	8	8	8	7.75
Qmr4	Legal and Stakeholder risks	9	9	8	8	8.50

[Rubic 1 to 10(being the best) used as a quantum analysis of the figures above]

Data Analysis presented in Figure 5 (p.278) below, had stated that Qep1 + Qep2 =73%(mRating empirical data value)(mRv) had indicated that continuous and increasing awareness of Scope 3 (Travel) carbon emissions issues had been the key drivers for the implementing a new EMS by NTU. Qep2=36%(mRv) stated that the evaluation of environmental performance by NTU had required further development, when selecting appropriate indicators. Qep1=37%(mRv) indicated that an effective EMS had been monitored and managed using empirical indicators to mitigate the different interest of stakeholders (Mascarenhas et al, 2014). NTU’s had used of environmental performance assessments that had offered greater accountability and comparisons with other HEIs. Marquez-Ramos (2015) stated that environmental assessments indicators seeks to highlight the empirical value of the indicator derived from summative environmental decision making. For NTU, Qep1+Qep2=73%(mRv) had specified its Scope 3 (Travel) carbon emissions priorities within the nEMS had served as a practical tool for environmental decision making and policy design.

Figure 5 - Data Analysis of Environmental Performance Assessment

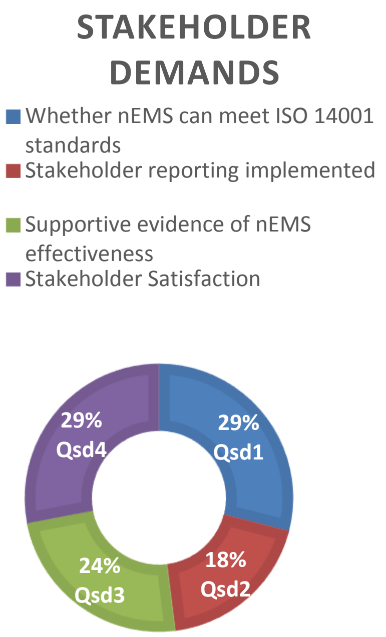


Q	**nEMS – Environmental Performance Assessment Data Analysis**	**nEMS mRating Value Ratings (Qualitative to Quantitative)**				
ARC / Questions developed by Researcher		**1**	**2**	**3**	**4**	**Av**
Qep1	Assessing environmental management policies	8	7	8	8	7.75
Qep2	Assessing procedures and systems	7	8	8	7	7.50
Qep3	Executing Internal Carbon Audit	6	6	5	6	5.75

[Rubic 1 to 10(being the best) used as a quantum analysis of the figures above]

Data Analysis of Figure 6 (p.279) below, presented responses to Stakeholder Demands. Qsd1=29% (mRating empirical data value)(mRv) had indicated as favourable that significant number of stakeholder requirements had been incorporated in the nEMS by NTU. The responses had also included supportive evidence for nEMS effectiveness Qed4= 29%(mRv), stakeholder reporting requirements Qsd2=18%(mRv) and Qsd1=29%(mRv) agreeing that the nEMS had met the demands of ISO 14001. It is evident Qsd1+Qsd3+Qsd4=82%(mRv) that NTU had incorporated Scope 3 (Travel) accountability and carbon abatement management into its institutional framework. Incorporating stakeholders into NTU's nEMS had significantly increased efficiencies and effectiveness Qsd1+Qsd3=532%(mRv). Stakeholder pressure Qsd2+Qsd4=47%(mRv) had a significant effect that had intensified the implementation of an appropriate EMS specific to NTU. Gonzalez-Benito et al (2011) stated that there is empirical evidence of the importance of stakeholder pressure as promoters for an effective EMS. Qsd3+Qsd4=53% (mRv) of the data indicated that stakeholder power and nEMS implementation had offered significant influence to NTU's proactive environmental management. For NTU, EMS had identified the mechanisms and understanding concerning the formulation and implementation of environmental strategies and evaluating the effects of policies.

Figure 6 - Data Analysis of Stakeholder Demands

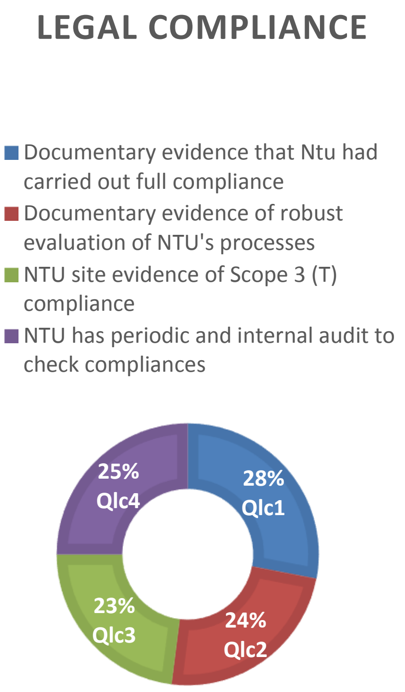


Q	**nEMS - Stakeholder Demand Data Analysis**	**nEMS mRating Value Ratings (Qualitative to Quantitative)**				
ARC / Questions Developed by Researcher		**1**	**2**	**3**	**4**	**Av**
Qsd1	Whether nEMS can meet ISO 14001 standards	7	9	8	7	7.75
Qsd2	Stakeholder reporting implemented	5	4	5	6	5.0
Qsd3	Supportive evidence of nEMS effectiveness	7	7	6	6	6.50
Qsd4	Stakeholder satisfaction	7	6	7	7	7.75

[Rubic 1 to 10(being the best) used as a quantum analysis of the figures above]

Data Analysis of Figure 7 (p.280) below, presented the data analysis of Legal Compliances that had an effect on NTU for implementing and effective nEMS. Qlc1=28%(mRv) of the responses had indicated that implementation of a nEMS had presented NTU having documentary evidence for full compliance for reporting its carbon emissions. The themes most recognised by the respondents where legal compliances that had been in implemented within NTU's nEMS. Qlc2=24%(mRv) stated that NTU had an effective and robust procedures that had been capable of managing the complexities of Scope 3 (Travel) accountability. Qlc3=23%(mRv) had stated that Qlc1=28%(mRv) of the responses had argued that the legal compliances are increasingly critical NTU had produced an evidence trail and Qlc4=25%(mRv) for undertaking internal carbon audit procedures. Legal compliances are similar to mandatory environmental disclosures that NTU had to comply with and that the efficacies of regulations had been understood. Iraldo et al (2009) stated that an EMS together with legal compliances improves the competitive position and has a positive effect on environmental performance improvements. Zorpas (2010) stated that through the implementation of EMS, organisations are able to integrate relevant laws, directives and regulations for an effective system. For NTU, there are positive external benefits for an EMS meeting legal compliances and stakeholder demands.

Figure 7 - Data Analysis of Legal Compliance

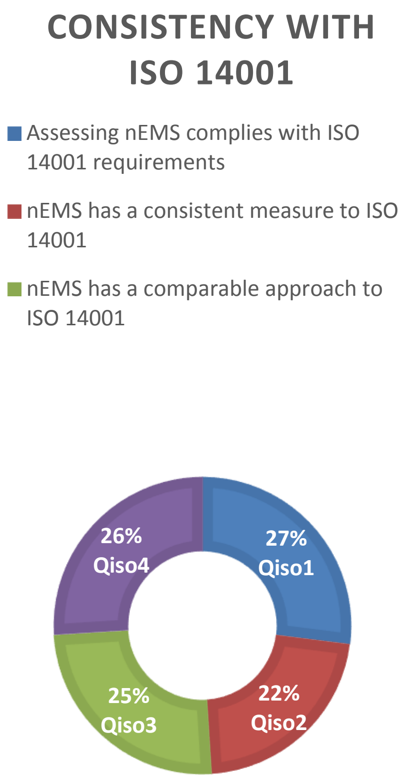


Q	**nEMS Legal Compliace Data Analysis**	**nEMS mRating Value Ratings(Qualitative to Quantitative)**				
ARC / Questions Developed by Researcher		**1**	**2**	**3**	**4**	**Av**
Qlc1	Documentary evidence that NTU had carried out full compliance	8	7	8	8	7.75
Qlc2	Documentary evidence of robust evaluation of NTU's processes	6	7	7	6	6.50
Qlc3	NTU site evidence of Scope 3 (T) compliance	7	6	6	6	6.25
Qlc4	NTU has periodic and internal audit to check compliances	7	6	7	7	6.75

[Rubic 1 to 10(being the best) used as a quantum analysis of the figures above]

Data analysis of Figure 8 (p.282) below had presented the data responses concerning NTU's nEMS consistency with ISO 14001. Qiso1+Qiso4=53%(mRv) of the responses stated that the motivation adopted by NTU nEMS practices had remained competitive and had followed the same environmental standards as applied in the HE Sector. Qiso2+Qiso3=47%(mRv) of the responses had indicated that NTU's environmental characteristics (size, student population and overseas travel) had added necessities for adopting the international standard, ISO14001. Singh et al (2015) stated that larger organisations that are pollution intensive had adopted the more comprehensive EMS practices similar to the recommendations of ISO 14001. Qiso2=22%(mRv) of the responses viewed ISO 14001 EMS efficiency provisions for NTU would promote Scope 3 (Travel) emissions reductions. For NTU, ISO 14001 represents a global compliance standard. However, Qiso4=26%(mRv) of the responses had identified that focusing on this ISO can detract from NTU's environmental processes and performance. Qiso3=25%(mRv) indicated that ISO 14001 compliance had offered NTU standardised documentation and data records for undertaking environmental audits to check for compliances and communication of environmental knowledge and commitment. Qiso1+Qiso3+Qiso4=78%(mRv) of the responses had explored the relationship of ISO 14001 requirements of a specific EMS for the HE Sector that would offer more informed choices concerning environmental management. Boiral and Henri (2012) proposed a hybrid model, enabling HEIs to better understand the implementation of certain environmental management practices (i.e. Carbon emissions targets) that can be aligned to ISO 14001. The data identified that Qiso1=27%(mRv) that management can positively influence the impacts of ISO 14001 implementation with strong internal motivation, stakeholder involvement and communication with NTU's management.

Figure 8 - Data Analysis of Consistency with ISO 14001



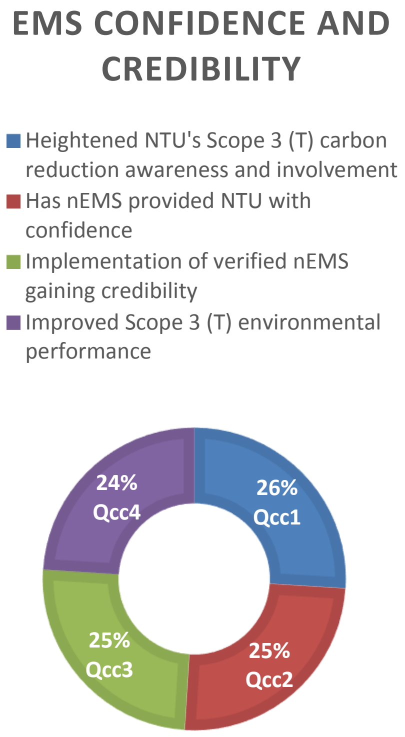
Q	**nEMS - Material Consistency with ISO 14001 Data Analysis**	**nEMS mRating Value Ratings (Qualitative to Quantitative)**				
ARC / Questions Developed by Researcher		**1**	**2**	**3**	**4**	**Av**
Qiso1	Assessing nEMS complies with ISO 14001 requirements	8	9	8	8	8.25
Qiso2	nEMS has a consistent measure to ISO 14001	6	7	7	7	6.75
Qiso3	nEMS has a comparable approach to ISO 14001	7	8	8	8	7.75
Qiso4	nEMS has different approach for the HE Sector but conclusions are consistent with ISO 14001	8	7	8	8	7.75

[Rubic 1 to 10(being the best) used as a quantum analysis of the figures above]

The data analysis on the confidence and credibility of NTU’s New EMS are shown in Figure 9 (p.284) Qcc1=26%(mRv) had indicated that NTU’s Scope 3 (Travel) carbon emissions reductions and abatement awareness for its footprint accountability. The efficiencies of environmental management had been measured by the effectiveness of environmental management processes and environmental performance measurement (Tung et al, 2014). Qcc1+Qcc2+Qcc3=76%(mRv) of the responses had stated that there being more confidence of NTU’s new EMS in carbon management. Qcc2=25%(mRv) had responded that the impact of stakeholder pressures on NTU had contributed to its certification aspirations for environmental proactivity. These findings had highlighted the importance of organisational factors that had contributed to the effectiveness of NTU's nEMS. There are pressures from HEFCE and legal compliances for an uncertified EMS. Lannelongue and Gonzalez-Benito (2012) stated that EMS certification is a valuable shield against most stakeholders' demands. Qcc4=24%(mRv) for the responses stated that EMS had been a powerful supportive tool for building confidence, credibility and enhancing the operational environmental performances by creating the paradigm shift within all the dimensions of NTU's nEMS. Qcc1+Qcc2=51%(mRv) of the responses had supported the idea that environmental management had positively influenced NTU's environmental performance in the long run. Qcc3=25%(mRv) agreed that it had been crucial that NTU's top management had support and commitment had been key drivers for implementing an ISO 14001 certification by implementing the nEMS that had secured credibility. Tung et al (2014) indicated that efficiencies and the effectiveness of an environmental management system required the mediation effects of the environmental management mechanisms, processes and internal organisational factors for improved environmental performance.

The analysis of Qcc2=25%(mRv) of the data indicated that, improving environmental performance is one of the primary objectives of NTU's EMS, the implementation of these systems is often the confidence and credibility together with management involvement. Qcc1+Qcc2+Qcc4=75%(mRv) of the data stated that the EMS is a positive tool for NTU to convey environmental competencies. Amores-Salvado (2015) stated that EMS play an important role in environmental management to better coordinate the processes to solving problems. Bero et al (2012) research at a US University, stated that confidence and credibility of an EMS involved strong management commitment, IT infrastructure for data collection and analysis and reporting to stakeholders.

Figure 9 - Data analysis for EMS confidence and credibility



Q	nEMS - Confidence and Credibility Data Analysis	nEMS mRating Value Ratings (Qualitative to Quantitative)				
ARC / Questions Developed by Researcher		**1**	**2**	**3**	**4**	**Av**
Qcc1	Heightened NTU's Scope 3 (T) carbon reduction awareness and involvement	8	9	8	8	8.25
Qcc2	Has nEMS provided NTU with confidence	9	7	8	8	8.0
Qcc3	Implementation of verified nEMS gaining credibility	9	7	8	8	8.0
Qcc4	Improved Scope 3 (T) environmental performance	7	8	8	8	7.75

[Rubic 1 to 10(being the best) used as a quantum analysis of the figures above]

4.5.1 DISCUSSION OF THE RESULTS OF SWOT AND mRATING VALUES

The aims of this case study research was to examine the magnitude to which the current EMS systems accountability to the impacts of HEFCE and other Stakeholder pressures on the adoption of a specific new EMS by NTU. These research methodologies had used an EMS evaluation tool incorporating the SWOT analytical framework and mRating value framework in empirically evaluating NTU's existing EMS efficiencies. NTU's new EMS implementation had been evaluated using key measurement metrics that had complied with the key strategic requirements for a hybrid EMS (Figures 4 - 9)(pp.277-284). The data analysis results presented NTU's

EMS's present strengths and opportunities including weakness and threats posed by non-carbon management accountability of Scope 3 (Travel) carbon emissions at a strategic level. The SWOT and mRating values had provided this research with the necessary mechanisms for empirically measuring NTU's EMS in a simplistic and useful manner. Adopting this empirical evaluation model had enabled NTU the ability to measure and evaluate carbon abatement strategies in a more meaningful and efficient manner with increased cost benefits. Empirical measurement values had provided key environmental information to HEFCE (Hefce12, 2012), HESA (Hesa, 2014) and comply with the directors' strategic reporting of the Companies Act 2006 (Regulation 2013, S141-415)(Gov, 2013b). Lopez-Gamero et al (2009) research of organisations resources as mediating relationships for a proactive environmental performance stems from early adoption of a robust EMS. Erdas et al (2015) from their research stated that, there is a direct relationship between environmental management and environmental performance from the perspective that includes a relationship between environmental strategy and targets. The EMS evaluation of this research had identified the environmental management characteristics and the importance of empirical measurements attributable to environmental management performance indicators (EMPI) and their use for evaluating NTU's overall EMS performance. Pesonen and Horn (2014) stated that SWOT tool was an important tool for raising awareness of the different EMS attributes and engaging in long term strategic planning scenarios.

The results from this research suggested three main inferences. Firstly, the management importance of empirical measurement of EMPIs using SWOT and mRating values from empirically measuring NTU EMS performances. These empirical measurements, offered planning mechanisms when implementing the new

EMS at NTU. As a consequence, the new EMS efficiency targets had been associated with NTU embarking on a more proactive environmental strategy that had enabled meeting HEFCE’s carbon emissions targets. Secondly, the use of EMPIs had been associated with a more active environmental management efficient strategies that had offered micro-management and incorporating quantitative empirical measurements presented by this research. Thirdly, the specific use of EPIs is associated with (i) NTU’s objectives in monitoring ISO compliances, management and audit (ii) to motivate NTU to commit to continuous improvement of the EMS (iii) qualitative to quantitative empirical measurements by NTU offered management decision making that can be associated with active carbon abatement strategies and (iv) presented NTU with the external reporting tool and information that are associated and complimentary to the requirements of large public companies. The SWOT and mRating values had assisted NTU to incorporate implementation recommendations by HEFCE (Hefce10, 2012) and other stakeholder involvement concerning new EMS policy frameworks and incorporating these to meeting NTU’s carbon emissions targets.

The SWOT Analysis Diagrams 27(p.247), 29(p.252), 31(p.257), 33(p.261) and mRatings Diagrams 28(p.250), 30(p.254), 32(p.259), 34(p.263) underlines the importance of EMS policy level frameworks that had been adopted when implementing NTU’s new EMS. These frameworks were important EMS aspects derived from the data analysis which had been incorporated into the nEMS as important quality perspectives for NTU’s Scope 3 (Travel) EMS policy implications and carbon emissions management. This research’s EMS efficiency framework had presented the possibilities to combining environmental issues into EMS design. Pesonen and Horn (2014) stated this EMS design had been largely ignored by HEIs.

This evaluation tool has made a contribution to the EMS development in the HE Sector with less resources when adopting this framework enabling HEIs to take appropriate management actions.

This case study has presented the empirical development knowledge within the field of EMS evaluation, design and implementation which is currently underdeveloped. This research presents the 'management potential' of empirical measurements when measuring an abstract concept regarding the efficiencies of an EMS. This research has also taken the opportunity to solve the urgency of measuring the effectiveness and efficiencies of EMS applicable to NTU. The analysis had concentrated on the SWOT evaluation methodologies for NTU's EMS as gateways to implementing a specific hybrid EMS for NTU that can be replicated within the HE Sector. This research had identified the empirical measurement potential for NTU to respond to Scope 3 (Travel) carbon emissions mitigation and other environmental accountability issues. This research had been aimed to contributing to the continuing research concerning HEI EMSs through a detailed and in-depth analysis using SWOT and mRating values evaluation frameworks for environmental management issues.

This research has presented the environmental management benefits offering HEI managers a mechanism for undertaking empirical measurements to (i) implementing EMS performance indicators for the management and communication of environmental strategies. Henri and Journeault (2008) stated that there are advantages for measurement and use of environmental performance indicators when evaluating an organisation's EMS. (ii) supporting and ensuring compliance to ISO 14001 recommendations (iii) presents a simplification framework for evaluating the complex environmental processes and procedures (iv) complying and meeting the requirement of HEFCE and other Stakeholders. The SWOT and mRating value evaluation frameworks can be considered as a useful tool in re-structuring and investigating NTU's current EMS and developing new EMS strategies for carbon management. The principal application focuses would include, the development of EMS strategies, carbon management and accountability management action planning, communicating empirically NTU's EMS efficiencies and awareness, with emphasis on carbon abatement activities.

SWOT and mRating values are qualitative in nature that have been transposed to quantitative measurement that are numerical measurements of non-financial in nature providing key information about environmental impact and regulatory compliance, stakeholder relations and EMS (Henri and Journeault, 2008). SWOT analysis have been criticised for its oversimplification (Pesonen and Horn, 2014) and within its framework there are high numbers of assumptions, subjectivities and interpretive qualitative measurements that can contribute to the inaccuracies in the data. Rachid and Fadel (2013) had offered caution that data from SWOT analysis requires careful consideration. They also stated that empirical measurements of the various different environmental characteristics are qualitative in nature. The measurements elicited in this research had been focused on Scope 3 travel carbon emissions and if interacted with other carbon emissions within NTU's other EMS perspectives may be leading to different results. This research had used ten separate semi structured SWOT and mRating questionnaires within its evaluation framework. This may be considered small and imprecise to form an evaluation opinion with such a low number of evaluative questionnaires. Using the qualitative interpretive survey results of one small group composition of the Action Research Committee (p.156), whose interpretive data had been transposed to quantitative empirical values by the Researcher, can create a potential bias due to limited objectivity and precision. The data obtained had been subjected to internal and external validity to ensure confidence concerning the reliability of the data sets obtained. There had been no evidence of causality with the qualitative data obtained from the action research committee (p.156) with respect to any evidence that had been inconsistent with theoretical arguments and predicted relationships. Martini et al (2014) stated that travel emissions data are multi modes and each mode have different matrixes concerning emissions. Caution must be emphasised that the qualitative data analysis formative assessments may not be generalised from the data of a single case study. The variables presented in this research do not cover all the determinants of an efficient EMS that may be available in larger and more diversified HEIs. Other aspects of environmental management involving students, staff and management's sustainability values that may influence environmental management performance had not been considered.

4.5.2 SWOT AND MRATING VALUE RECOMMENDATIONS

However, this research presents many potential opportunities for future research. There are many other EMS characteristics such as organisational structure, 'green' focus strategies, pressures from HEFCE, funding, interaction with the overall internal control systems and availability of skill management personnel that could contribute to the efficiencies of NTU's EMS. Measurement of different SWOT and mRating value characteristics and interaction among NTU's EMS characteristics could be explored with more qualitative measurements elicited for better results. The other dimensions of SWOT and mRating Environmental Management Performance Indicators (EMPI) could be incorporated and evaluated to determine how these attributes are influenced by NTU's carbon abatement characteristics. The recommended functional approach to SWOT analysis should be matched with NTU's EMS requirements for environmental accountability and management specifics. Therefore, a template for formal synthesis of SWOT characteristics is proposed with core attributes for the management and abatement of Scope 3 (Travel) carbon emissions. In terms of utility of the SWOT and mRating value tool, some further refinement could improve the usability in terms of Scope 3 (Travel) carbon emissions policy impact considerations and incorporating these into the final assessment framework. This procedure would offer the framework to be more simplified and less arbitrary. Novicevic et al (2004) stated that the SWOT framework can be proposed as a research tool that may have the potential to becoming a standard guidance for HEIs' EMS efficiency evaluation research.

This case study research had enabled the researcher to facilitate investigating NTU's EMS efficiencies using SWOT and mRating value evaluation tools for strategic level analysis. A standardised framework for HEIs would be recommended both for carbon mitigation (reduction of impacts) and abatement strategies (diminishing) standpoints. A robust framework is a key requirement as an encouragement for NTU's participation to achieving a holistic approach for an efficient EMS.

4.6 DATA ANALYSIS OF NTU's STAFF AND STUDENT TRAVEL SURVEY

The online travel survey received 1,336 replies from students from a student population of 24,534 representing 5.44%. There were 1,079 replies from staff members out of a staff population of 4,893 representing 22.05%. Online travel and self-reported surveys faced problems of small sample sizes (Stopher and Greaves,

2007) and increasing apathy for completing on line surveys (Rissel et al, 2014). The travel survey research data analysis had been elicited from the different travel modes (Bohte and Maat, 2008) during seven days' travel commencing 25 February 2013 detailing the travel data between home and the three NTU campuses at Brakenhurt, City and at Clifton (Ntu. 2014).

The online travel survey questionnaire has been reproduced in Appendix 1 (p.364). The research questionnaires design, (travel survey question number 5)(p.364) and question (6)(p.365) and question 18 (367) had requested distances from the individual's start post code, requesting journey modes and distances. Travel surveys done by NTU previously were of the same format. For Scope 3 (Travel) journey purposes, staff and students completed their mode of travel and distanced travelled by car, bus, rail, trams and taxi from their starting post codes. Appendix 7 (A) (p.401) presents the travel data analysis undertaken by NTU's staff and Appendix 7 (B) (p.402) by NTU Students and the correspondingly the quantification of their Scope 3 (Travel) carbon emissions. The methodology used for cars were uniquely different based on the maximum mileage and distance travelled from their starting post codes. Average journey travelled were: bus (5 miles), Trams (5 Miles), Rail (6 miles) and Taxi (4 miles). The travel distance travelled was multiplied by the specific travel mode's CO_2 emissions factors obtained from DEFRA (Defra, 2012b). The CO_2 emissions data were adjusted for small, medium and diesel cars CO_2 emissions and assigning all emissions to the driver only as there was insufficient detailed data available to apportion the emissions with passengers. All measurements were in CO_2e or CO_2 equivalents as recommended by DEFRA and used consistently. The substantive analysis was presented in Appendix 7 (A) & (B) pp.401 - 402) and the summary analysis is presented in Table 28 (p.293) below.

Table 28 (p.293) below presents the data summary concerning students and staff Scope 3 (Travel) carbon emissions consolidated from the data computed in Appendix 7 (pp.401-402) from data analysis from the travel survey. The data obtained represented a week's travel information that was uplifted using a simple dynamic transformation that reflected NTU's projected travel circumstances if all students had replied. The academic year for students had been taken as 37 weeks and staff at 40 weeks, using the uplift factor recommended by NTU (p.222)

The travel survey had been completed per person (individually from their NTU e-mail account) stating their individual journey distances as described in the methodology (Chapter 3.13.2, p.218). This methodology was explained in (p.166) (c) and (d) describing the reasons for the construction of the travel survey questionnaires as being journey trips to determining 'journey distances and travel modes.

Appendix 7 (A)(p.401) and Appendix 7(B)(p.402) represents each individual's journey travel mode from a specific distance band that were less than 5 miles where the majority of NTU students lived. The next band was between 5 and 9 miles with was the next highest. The other bands were 10 miles apart and represented a very small portion of Individuals. Stratifying the journey distances into the most populous bands of individuals living was mathematically the best estimate with respect to journey distances without any averaging for greater accuracy is used in the computations in Table 28 (p.293).

Chapter 3.10.3 (p.191) states 'journey trips' (used for the computation) and in (p.197) detailing the travel survey assumptions made adopting De Montfort University carbon management planning as 'journey distances' as used in this research's for its methodological tool. There was no data available (p.291) to apportion the emissions to the number of passengers travelling in a particular car. This research had used each car journey as single passenger journeys for the computation of the student and staff commute.

4.6.1 TRAVEL SURVEY RESULTS AND DISCUSSIONS

Table 28 - Students and Staff Scope 3 (Travel) carbon emissions for 2012-13

NOTTINGHAM TRENT UNIVERSITY SCOPE 3 (TRAVEL) CARBON FOOTPRINT				
SCOPE 3 (TRAVEL) CARBON EMISSIONS 2012 - 13 [From Web Travel Survey]				
STUDENTS (Data from Appendix 7(B)(p.402)				
Campus Site	Brackenhurst	City	Clifton	Total Scope 3 (Travel) GHG Kg CO2e
Travel Survey CO2 kg Emissions	1,258	2,605	2,822	
**Uplift from 5.44% to 100%	23,125	47,889	51,872	
Extrapolate to 37 weeks per Academic Year	855,622	1,771,878	1,919,248	**4,546,748**
*Only 1,336 replies were received out a student population of 24,534				
STAFF [Data from Appendix 7(A)(p.401)				
Travel Survey CO2 Kg Emissions	923	7,251	3,452	
**Uplift from 22.05% to 100%	4,186	32,882	15,657	
Extrapolate to 40 weeks per academic year	167,422	1,315,291	626,289	**2,109,002**
*Only 1,079 replies were received out of a staff population 4.893 personnel				
**Uplift to compensate the % of replies to the total sample population as Per NTU Carbon Management Plan 2013				

As shown in Table 28 above, NTU Students were responsible for 4,546,748 Kg of CO2e (or 4,546.75 tonnes of CO2e) representing about 185.32 Kg of CO2e per pupil. NTU Staff were responsible for 2,109,002 Kg of CO2e (or 2,109 tonnes of CO2e) representing about 431.02 Kg of CO2e per staff member. There is no comparison data available from other HEIs at the moment to make any comparisons. However, preliminary assumptions can be made from these figures inferring that the majority of staff and students lived within commuting distances to the three campuses. NTU's Clifton campus had the largest student car journeys (322) followed by City (266) and Brackenhurst (199). Clifton and Brakenhurst campus sites had a large car parking areas whilst City used private car parking nearby. Whilst staff car journeys were City (971), Clifton (559) and Brackenhurst (168)[Appendix 7, pp.401 - 402]

Student car journeys to the Clifton campus were higher as expected since this campus was situated away from the City Centre. Staff car journeys to the City and Clifton campuses were significant as main centres for NTU Staff concentration for both administration and teaching.

The data summary for car journeys were segmented into journeys of less than 5 miles, between 5 and 9 miles, between 10 and 19 miles, between 20 and 29 miles, between 30 and 39 miles, between 40 and 49 miles and greater than 50 miles. The car journey data collected by the travel survey proved useful as inputs for the algorithms in the interpretation and quantification processes. Bohte and Maat (2014) indicated that travel modes required additional detailed information to further validation which could be burdensome to the respondents.

Appendix 7 (A)(p.401) travel survey sample analysis summarised NTU Staff journeys, buses : Brakenhurst (38), City (1451) and Clifton (325) : Trams, Brackenhurst (0), City (434), and Clifton (27) : Rail journeys were, Brackenhurst (1), City (210) and Clifton (42)

Appendix 7 (B)(p.402) travel survey sample analysis summarised the NTU Students journeys, buses: Brakenhurst (150), City (791) and Clifton (915). Trams, Brackenhurst (5), City (356), and Clifton (36) : Rail journeys were, Brackenhurst (5), City (123) and Clifton (55).

Data analysis of Appendix 7 A & B (pp.401-402) analysis showed that home-NTU campuses distance is strongly associated with higher CO2 emissions for car journeys being higher from both students and staff respondents living less than 10 miles away. NTU’s transport management advised that 80% of student cars were small (less that 1400cc)[due to high insurance costs if Under 25 with large engines], 15% (between 1401 and less than 2000cc) and 5% on average were diesel cars between 1700 to 2000cc in accordance with DEFRA’s intensity factors banding (Defra, 2012a)

The travel survey method for travel data collection of NTU’s Staff and Students travelling modalities and journeys represents the primary data for the quantification of Scope 3 (Travel) carbon emissions. The methodology adopted for this case study of NTU involves a large scale data collection utilising NTU’s IT resources. The main contribution of this research concerns the development of the travel survey tool and incorporating procedures, processes and systems that can be used for collecting travel modes and distances travelled as accurately as possible with minimum inconveniences to the respondents. The use of the internet had facilitated the development tool for the quantification of Scope 3 (Travel) carbon emissions.

This case study undertaken within Nottingham City had consisted of numerous travel modes and has an extensive transportation network. The data analysis had considered the different engine sizes of commuter travel and distance travelled and presented a realistic travel scenario. To differentiate those travel modes and distances travelled that are spatially clustered, appropriate best estimation of distances travelled were used ie. Bus journeys were estimated as: bus (5 miles), Trams (5 Miles), Rail (6 miles) and Taxi (4 miles). These estimations had been provided by NTU's transport manager. Although, the samples sizes are small, the travel survey data is representative in terms previous surveys under taken by NTU. As there are no similar studies estimating transport CO2 emissions applicable to HEIs are available. Hence, and such detailed accurate travel data are not available, it had been difficult to validate the results concerning the Scope 3 (Travel) carbon emissions.

4.6.2 TRAVEL SURVEY RECOMMENDATIONS

The Scope 3 (Travel) Survey analysis represents the mechanisms concerning Staff and Students commuting to NTU campuses and the associated CO2 emissions. This methodology had presented NTU with the methodological processes in using a travel survey for Scope 3 (Travel) carbon emissions accountability. The travel survey methodologies can in future provide HEIs to construct travel questionnaires that are particular for their institution, travel modalities and the how much detailed travel information can be obtained from respondents without making the survey laborious and painstaking. The detailed travel survey information can provide more accuracy in determining the HEIs' carbon footprint. The travel survey analysis can enable opportunities for lower carbon transport scenario analysis in the future when determining NTU's future staff and student growth, increasing transportation modalities and car parking facilities. The methodology offers scenario analysis that can be conducted to explore how travel mode commuting shifts may impact upon aggregate travel behaviour and lower transport carbon emissions. By modifying travel mode to using 'electric vehicles', closer student dormitories, street network design for walking and cycling, and greater accessibility to public transportation. NTU's travel carbon emissions footprint benchmarking presents management to examine various transport planning interventions that are relevant to NTU and contributing to the development of more sustainable and low carbon travel.

Appendix 1 (travel survey) question number 9 (p.366) seeks to enquire about staff and students' car parking scenarios for future planning. Information received from this travel survey will be providing NTU car parks management with appropriate information for which NTU Parking Policies can be determined with the council.

Car parking policies are under review with Nottingham Council to reducing congestion and harmful emissions (Ntu, 2015). NTU is continuously incentivising public transport for its staff and students with reduced annual fare passes. Park and Ride Schemes are free and future travel surveys with regard to NTU car parking should be evaluated. The majority of car parking is situated at Clifton and Brakenhurst campuses away from the City campus (No car parking there).

4.7 DATA ANALYSIS OF NTU’S BUSINESS TRAVEL

This research’s data analysis of NTU’s business travel Scope 3 (Travel) carbon emission had been obtained from NTU’s contracted third party (Ian Allen) travel agent providing travel data analysis information undertaken by NTU staff during the academic year ending 2013. The data presented in Part A had been independent from the researcher. The contracted travel survey was broken up to UK air and rail plus overseas air, rail and travel by motor vehicles.

Part A of Table 29 (p.299) below presented Scope 3 (Travel) carbon emissions data by UK Rail travelled of 690,666 kilometres and accounting for 46,378Kg CO2e business air travel including both UK and overseas were 6,407,064km accounting for

1,398,304 KgCO2e. The total business travel accounted by NTU's contracted agent is 1,444,682KgCO2e (or 1,444.68 tonnes of CO2e absolute emissions).

Business travel primary data capture methodology focussed on the procurement travel analysis from NTU's preferred travel contractor providing the primary data.

The following data analysis assumptions were made (refers to Table 29, p.299):

- Travel data spend is derived from NTU's ledger analysis on UK travel modes converted to distance travel. Distance travelled data accounting policies applied must be stated and be consistent for all years

- Travel agents' best estimates of overseas business travel spend converted to distance travelled is recommended and actual travel distance data are acceptable. Emissions are analysed and summarised with the following reporting format as Africa, Asia, Australasia, Caribbean, Europe, Middle East, North America, South America and United Kingdom. The researcher developed this format as a recommendation of this research.

- UK travel modalities and carbon emissions should be identified as a separate category, as the carbon intensity factors from DEFRA (Defra, 2012b) are applicable within the UK only (there are no similar factors overseas)

- Reducing carbon emissions by modal shift adoption should be reported as part of the carbon reduction commitment as a motivation to addressing business travel.

It is clear the NTU is becoming more accountable of its personnels' travel policies and carbon emissions both in the UK and overseas arranged by travel agents. Travel agents should be to providing more transparencies with regards to the travel mode, distances travelled and emission factors used in the individual countries. Individual staff members should also provide their UK/Overseas carbon information for each trip (Ntu, 2014).

Table 29 - Summary of business travel Scope 3 (Travel) Carbon emissions

[Original Data Provided by Ian Allen Travel Agency]

NOTTINGHAM TRENT UNIVERSITY SCOPE 3 (TRAVEL) CARBON FOOTPRINT

Carbon Footprinting - Business Travel 2012 - 2013

Period: 01 August 12 - 31 July 13

[Information provided via contracted NTU Travel Management Company - Ian Allan]

PART A (By 3rd Party)	Mileage (Km)	**Emission Factor Per Km	Scope 3 CO2 Kge			
Rail (UK) A	690,666	0.06715	46,378			
Air						
			Air Co2***	Rail Co2***	Car Co2***	Data Provided By NTU Travel Agent
Africa	337,991		65,024	1,814	6,270	
Asia	3,195,896		616,963	7,407	25,546	
Australasia	350,885		67,839	349	1,204	
Caribbean	17,776		3,429	42	142	
Europe	660,365		122,713	21,860	75,301	
Middle East	356,950		68,876	904	3,114	
North America	1,276,383		246,476	2,912	10,050	
South America	85,061		16,368	374	1,304	
United Kingdom	125,757		24,228	1,759	6,034	
B	6,407,064	1,398,304	1,231,916	37,422	128,966	
Total Mileage A + B	7,097,730					
Total Kg CO2 C		1,444,682				

Other areas where mileage and CO2 information is unavailable. Spend data extracted from financial ledger:

PART B (By Researcher)	*Spend (£)	**Emission Factors Per £ spent	Total Scope 3 GHG Kg Co2e
Air	155,382	2.86	444,391
Rail	52,759	0.93	49,065
Taxi Hire	84,364	0.95	80,146
Coach Hire	270,444	0.95	256,922
Car Hire	68,718	0.95	65,282
Hotel (Scope 3 Travel)	679,085	0.49	332,752
TOTAL CO2 D			1,228,558
GRAND TOTAL CO2			2,673,240

Excludes : student travel undertaken on - field trips etc / buses / boat hire / conference

*Non contract flight spend - data extracted from 11/12 annual expenditure report

** Data from (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69554/pb13773-ghg-conversion-factors-2012.pdf\)

{Page 3** stated that Emission Factors are Specfic to the UK only}

*** Data Provided by Travel Agent as best estimates only. There is NO data available from Internal Business Travel emissions in the areas mentioned.

Reporting format designed by the Researcher

The researcher had reviewed and accepted the data from the travel agent in Part A, noting no accurate data was available overseas. Part B of Table 29 above presented the Scope 3 (Travel) spend data obtained by the researcher from NTU's financial ledger. Scope 3 (Travel) UK air, land transport and hotels business travel is 1,228,558Kg CO2e (or 1,228.56 tonnes of CO2e) The grand total of NTU's Scope 3

(Travel) carbon emissions for business travel for the academic year ending 2103 is 2,673,240 Kg CO2e (or 2,673.24 tonnes of CO2)

4.7.1 BUSINESS TRAVEL RESULTS AND DISCUSSION

The travel data presented the findings of carbon emissions obtained from overseas and UK business travel that had been analysed into the different travel categories and corresponding carbon emissions incurred. Although, the Part A (Table 29) (p.299) was provided by a NTU third party travel agent. The researcher had abided by the guidelines for social research and data protection act (Ntu, 2014) that the data can be considered primary data for the purposes of this research. Table 29 (Part A and B) had illustrated that business travel contributed substantially to travel journeys in the UK and overseas transport networks, emitting large amounts of carbon emissions incurring large financial costs to NTU, the economy and depletion of hydrocarbon reserves. NTU's Part A and Part B (Table 29) business travel kilometres can be considered as significant, by incurring large financial expenses and emitting significant carbon emissions of 2,673.24 tonnes of CO2e.

Business travel (UK and overseas) and staff and employee commute are voluntary reporting emissions under Scope 3, within the Greenhouse Gas Protocol Standard (GHP, 2012). However, HEFCE (Hefce4, 2012) and stakeholders have made a requirement for HEIs to report business travel as part of their carbon footprint effective 2015 (Hesa, 2014). Business travel carbon emissions may no longer be treated as an externality. With this prospect for compliance reporting, HEIs should take the initiatives for accountability and carbon mitigation (Roby, 2014).

There are limitations to the data presented in Part A (Table 29). Different regions of the world have different carbon emission factors for the different travel modes. This anomaly could cause distortions. More accurate business travel information should be reported by geographical regions to identify where business travel emissions are incurred. UK organisations with overseas subsidiaries or branch campuses must report these emissions separately, as part of their corporate governance reporting.

4.7.2 BUSINESS TRAVEL RECOMMENDATIONS

The data collected for business travel had provided NTU with carbon emissions data for developing business travel policies that can encourage reducing spend costs and reduce carbon emissions. NTU can make improvements to its travel strategies, whilst adopting new working practices derived from the use of IT and the internet. NTU had incurred a quantum of 2,673.24 tonnes of CO2e (Table 29)(p.299) must consider strategies to reduce costs and institute carbon emissions targets without impeding working practices and their links to staff/student recruitment or essential development knowledge.

Business travel cost and carbon emissions can be reduced by switching from business to economy class travel voluntarily (as carbon factors are lower) when possible and motivating NTU to utilise video conferencing as alternatives to physical presence. Fewer compulsory business trips based on Table 29 (p.299) expenses data showed that, NTU's business travel journey trips can be significantly reduced. Travel time is seen as unproductive and substituting business journeys with virtual meetings would improve productivity (Roby, 2014).

NTU should consider that having business travel policies that shows that NTU cares about the environment can help attract the best talent to the university can be an important. NTU should recommend a 'carbon cap' attributable to the various faculties and departments as part of NTU's travel management programme to meeting NTU's carbon targets.

4.8 DATA ANALYSIS OF NTU'S OVERSEAS STUDENTS TRAVEL CARBON IMPACT

The data presented that over 70% of the overseas student flights were long haul that provide strong incentives for NTU to reduce its Scope 3 (Travel) carbon emissions. Trips were categorised by distance from major cities to the UK as long haul and short haul defined as two trips per year. The distance calculations were available from DEFRA (Defra, 2012).

Table 30 (p.303) below presents the summary data of overseas student travel carbon emissions. The overseas student population 2012/13 data had been provided by NTU admissions department (data protection rules) analysed as per the geographical zones. Scope 3 (Travel) data included UK rail and overseas air travel to London Heathrow from the overseas students' capital cities furthest within the geographical zone. This zoning method had similarly been adopted by NTU's travel agent for business travel. NTU Housing provided the data stating that overseas students made 2 trips per year (arriving and returning). NTU Housing had advised the researcher, that overseas students accommodation has been based on 'contracted housing' and must vacate after the summer term. students living elsewhere are ignored.

NTU Graduating Office stated that three tickets (£25 each) were sold in advance to overseas students for attending their childrens graduation each year. NTU admissions advised that China represented the largest overseas students with 2,502 followed by EU Students at 589, Africa 258, Australasia 74, Caribbean 74, North America 74, Middle East 72 and lastly 37 students from South America (Table 30, below). NTU had provided the overseas student data as per NTU's data protection act compliances for the purposes of this collaborative case study research. The researcher had reviewed this data to be within the materiality factors (i.e. less that 2% of total) of the research and had accepted the representations and data provided by NTU's Housing and Graduation Office for the purposes of this research.

UK rail carbon emissions are 494,237 Kg CO2e and air travel emissions were 41,817,737 Kg CO2e, giving a grand total of 42,311,974 Kg CO2e.

Table 30 - Summary Data of Overseas Students Travel to the UK

[Original Data Provided by NTU]

NOTTINGHAM TRENT UNIVERSITY SCOPE 3 (TRAVEL) CARBON FOOTPRINT						
Carbon Footprinting - Overseas Student and Family Travel 2012 - 2013						
Period: 01 August 12 - 31 July 13						
[Info collated by the Reseacher]						
Total Student Population 2012/13	**24,534**					
Overseas Student Population 2012/13 Data Provided by NTU Adminstration	**3,680**					
		Mileage (Km)	****Emission Factor**		**CO2**	
Rail (UK) 2 journeys to Airport A		**2,944,080**	**0.0672**		**197,695**	
Rail (UK) Graduation Family of 3 A		**4,416,120**	**0.0672**		**296,542**	
Air Travel to NTU (From A City Furthest in the Geographical Zone)to Heathrow Airport UK	**O/S Student Numbers. Data Per Geographical Zone Provided By NTU Admissions**	**2 Student Trips per year (Km). Data Provided by NTU Housing**	**Graduating Family of 3. Data Provided by Graduating Office**	****Scope 3 Total GHG Emission Factors per Km**	**Students Kg CO2e**	**Family Kg CO2e**
					Air CO2	**Air CO2**
Africa (5,000 km)	258	5,160,000	7,740,000	0.13143	678,179	1,017,268
Asia (9,700Km)	2,502	97,077,600	145,616,400	0.13143	12,758,909	19,138,363
Australasia (17,000 km)	74	5,032,000	4,306,800	0.13143	661,356	566,043
Caribbean (7,500Km)	74	2,220,000	4,306,800	0.13143	291,775	566,043
Europe (1,500 Km) Short Haul	589	3,534,000	34,279,800	0.11486	405,915	3,937,378
Middle East (5,500Km)	72	1,584,000	4,190,400	0.13143	208,185	550,744
North America (7,000 Km)	74	2,072,000	4,306,800	0.13143	272,323	566,043
South America (9,400)	37	1,391,200	2,153,400	0.13143	182,845	16,368
B		**118,070,800**	**206,900,400**		**15,459,487**	**26,358,250**
Total Mileage A + B		**121,014,880**				
TOTAL CO2e Kg		**42,311,974**				
** Data from (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69554/pb13773-ghg-conversion-factors-2012.pdf\)						
Air milage taken from Defra						
** Data from (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69554/pb13773-ghg-conversion-factors-2012.pdf\)						

Assumptions found in pages 197 - 198

4.8.1 OVERSEAS STUDENTS TRAVEL RESULTS AND DISCUSSION

Overseas students Scope 3 (Travel) aviation carbon emissions had been previously ignored by many HEIs carbon foot print accountability. HESA (Hesa, 2014) has recommended that overseas student travel should be reported as part of the HEI's carbon footprint i.e. Scope 1, 2 and 3. The travel CO2e values in isolation are strongly driven by the students' origin. Table 29 above shows a breakdown that carbon emissions had emanated 67% from Asia, 16% from Europe and the rest from Africa. Average annual emissions per NTU overseas student is substantial at 11,497 Kg CO2e. If amalgamated with other Scopes, the CO2e per student could be a considerable factor of the NTU's carbon footprint. Roy et al (2008) that the HE Sector had neglected to acknowledge the environmental implications by overseas students in the UK. The contribution Scope 3 (Travel) carbon emissions from students' air travel represents a growing risk to NTU when these amounts are 5.6 times the emissions of NTU's staff and student commuting emissions [Overseas 42,311,974 CO2e[42,311.97 tonnes CO2e] (Table 30, p.303) : 7,537,298 CO2e [7,537.30 tonnes CO2e](Table 29, p.299)]. The data shows that there the lucrative overseas students sector can have a detrimental effect on NTU's carbon footprint.

There are limitations to the methodology used concerning the distances travelled by overseas students with respect to air miles. Air miles are calculated from point to point or from geographical zonal cities to the UK. GHGs incurred by radiative co-efficient (G, p.12) to account for the climate change effects of other direct or indirect CO2 GHGs) was not considered. No 'uplift factor' (to account for non-direct routes and delays/circling) or radiative co-efficient had been considered in the estimation of air related emissions as recommended by DEFRA/DECC (Defra, 2012b).

4.8.2 OVERSEAS STUDENTS RECOMMENDATIONS

In terms of mitigation, one option for which NTU has already made some preliminary development is to extend the reach of its 'worldwide' programmes consisting of distance learning schemes with teaching hubs that are located in China, Greece, Dubai and Malaysia can be boosted. No doubt air travel costs would inevitably increase over time. NTU can consider a limited level of physical teaching and exploiting the electronic delivery of teaching in their home countries using the internet has great potential. Increasingly, with more educational demand from overseas students, NTU should embark with more twinning programmes offering NTU degrees that can be undertaken in their home countries.

Another option is for NTU to develop more e-learning programmes similar to that The Open University had pioneered many years ago. At the present time, many UK Universities are sharing internet platforms and webinar models to deliver on line classrooms and content, that can be delivered to overseas students.

The other option is to shrink the undergraduate study period to two years and add more summer programmes deterring students from going home. Many UK universities have already pioneered a two-year degree programme very successfully, notably University of Buckinghamshire.

The carbon emissions derived from international flights arriving and departing from the EU are to be adopted into the ETS from 2012 (Europa2, 2013). As a proposal an offset programme by NTU's overseas students (and all air passengers) as consumers (Lenzen et al, 2007) could pay an offset EU carbon levy as one recommendation by (Atmosfair)(Atmos, 2015). Carbon accounting boundaries (p.23) and reporting recommendations by GHG Protocol, CDSB, CDP and ACCA (Diagram, 10, p.103) offers both UK/International Reporting of Scope 1, 2 and 3. These reporting bodies have impact on the internal policies of HEIs, to disclosing their carbon accounting policies and there are relevant needs with respect to carbon accounting perspectives.

NTU is unable to predict the number of overseas student intake for the next few years although central government policy (Gov, 2013c) foresees an annual increase. However, new visa regimes (Guardian, 2015) and Times Higher Education (Times, 2016) had predicted that overseas student number falls could be a ‘significant risk’ to HE Sector’s funding and growth.

The Climate Change Act 2008 and HEFCE have legislated that HE Sector carbon footprint have to be at 43%% of their 2005 base level (p.20) by 2020. These are legislative compliances regarding Scope 1 and 2 for which NT|U must strive to meeting these targets OR fall into the CRC (p.24)[consumption of Scope 1 and 2 limited to 6000 KMWh with regard to Cap and Pay (p.24) at £15.60 per tonne of CO2e penalty]. The legislative pressures from the CCA2008 and HEFCE funding (p.19) have also tied NTU’s emissions to its budgetary funding. If more expansion is sought by NTU, New Buildings will have to meet with LEED Rating as mentioned in (p.186) for lower Scope 1 emissions. If more Staff are to be recruited and more student numbers. These individuals will need to be incentivised to use more public sustainable transport, to meeting NTU Targets. NTU's Public Transport Pass Incentives are very attractive financially.

4.9 NTU’s SCOPE 3 (TRAVEL) CARBON EMISSIONS UNICARBON INDEX (KPI) AND REPORTING

The UniCarbon index had been developed from the STARS governance structure used by North American HEIs to evaluating campus sustainability index that had ensured that each and every lower carbon emissions credit is transparent, empirically measurable and further improvements can be implemented. The STARS sustainability index credits had been developed by “evaluating reviewing campus lower carbon emissions and sustainability assessments, environmental reports published from similar types of HEIs using the sustainability rating and ranking systems" (Aashe, 2014, p.9). Table 31 below presents the summary of the Scope 3 (Travel) emissions index derived from the quantification methodologies described in Chapter 3.11, pp 189-201.

Table 31 - Summary data of Scope 3 (Travel) Emissions Index

NOTTINGHAM TRENT UNIVERSITY SCOPE 3 (TRAVEL) CARBON FOOTPRINT 2012/13					
SCOPE 3 (TRAVEL) SUSTAINABILITY INDEX (Using the STARS Formulation)					
	*Factor derived from STARS	Number of Vehicles the meet the criteria	Total Number of Vehicles in Fleet	Total Percentage of Vehicles Meeting Clean Fuel and Technology	Total Points Earned
1. Campus Fleet - Managed by Nottingham Transport (OP18, p.206	1.00	0	8	0	0
				Total Percentage of students using more sustainable commuting option (0-100)	
2. Students Commute Modal Split (OP19, p.206)	0.02			62	1.24
				Total percentage of staff using more sustainable commuting options (0-100)	
3. Staff Commute Modal Split (OP20, p.199)	0.02			43	0.86
4. Support for Sustainabile Transportation for Staff and Students				Total percentage of staff and students using more sustainable commuting options (0-100)	
PART 1 , p.209					0.375
PART 2 , p.209					1.250
				Total percentage of staff and students using more sustainable commuting options (0-100)	
5. Business Travel Encouraging sustainable transportation - OP21A, p.209	0.02			70	1.400
6. Oversea Student Travel OP21B, p.210	0.02			15	0.300
Total					5.425
UNICARBON INDEX FOR TRANSPORTATION ONLY					0.49

Assumptions found in Appedix 10 (pp.413-419)

* STARS Technical Manual 2.0 (2013)http://www.aashe.org/files/documents/STARS/2.0/stars_2.0_technical_manual.pdf

** Maximum STARS transportation points is 7 (for this Research + 4 = 11 (ie Business Travel and Overseas Student Travel had been included)

*** Unicarbon Index calculated as Total 5.404 Divided by 11**= 0.49

4.9.1 SCOPE 3 (TRAVEL) EMISSIONS INDEX RESULTS AND DISCUSSION

NTU’s campus fleet managed by Nottingham city transport had been award no points. The primary reason it the transport company had no vehicles that utilised cleaner technologies although, green busses were available. Students commute was awarded 1.24 points, whereas Staff were awarded 0.86 points (Table 31, p.307) Analysing Students sustainability initiatives: 10% of students lived on campus, 10% walked or used non-motorised transportation, 40% took campus shuttles or public transportation and 2% had carpool arrangements. Staff: 2% walked or used non-motorises transportation, 40% used public transportation and 1% had carpool arrangements (OP20, p.208)

Support of sustainable transportation facilitation is 0.375 for Part 1 and 1.250 for Part 2 (p.209). Part 1 was lower as NTU had offered more biking facilitation (bike sharing) and had involved parking in secure locations at various location on Campuses. Other incentives involved using public transport, Part 2 involved business air travel.

Encouraging sustainable Business Travel transportation has been awarded 1.4 points for using alternative transport. Whilst overseas student travel had a low point award of 0.3 that was exclusively air travel (Table 31, p.307)

NTU’s Scope 3 (Travel) sustainability index specifically computed concerning sustainable transportation is UniCarbon Index as 0.49 or 49 (Table 31, p.307). This index value presented a numerical value of Scope 3 (Travel) sustainability that simplifies the value measurements from a variety of complex calculations. This empirical value is specific to NTU Scope 3 (Travel) in responding to NTU’s needs or levels of implementation of its environmental transport management. The UniCarbon Index presents the empirical value as a summative communication value to stakeholders concerning NTU's commitment to transport sustainability. Gomez et al (2014) stated STARS benchmarking and sustainability index is appropriate when implementing advanced environmental sustainability efforts. They also stated that this tool is compliant with GRI Performance Indicators for reporting (Globalreporting, p.27, 2011)

The STARS environmental sustainability tool offered NTU a mechanism to respond to a successful implementation of environmental sustainability initiatives. The empirical value of 5.404 (out of the total transport sector of 11.0) (Table 31, p.307) shows that NTU has made some sustainability initiatives towards Scope 3 (Travel) environmental sustainability. NTU UniCarbon Index could fallow the creation of an international rankings already used by over 300 HEIs in North America. Katiluite and Neverauskas (2009) stated that aggregate tool used to develop indicators can be used to communicate the most important information to stakeholders. UniCarbon Index has a role for evaluation of NTU's environmental performance as suggested by Lozano (2011). UniCarbon Index is an appropriate way to integrate environmental performance with NTU's transport policy planning and operations. Carbon indexes have the potential as a screening tool for identifying sustainable transportation and an analytical tool to explore potential transport strategies (Townsend and Barrett, 2015). This also increases sustainability across NTU's stakeholders and communicating progress achieved and the value of the sustainability agenda. The nature of Scope 3 (Travel) carbon impacts are previously unknown but can be clarified through the provision of quantitative results as a UniCarbon Index.

NTU's Scope 3 (Travel) corporate carbon emissions sustainability assessments and reporting are part of NTU's overall environmental performance management processes. These procedures lead efforts for developing an integrated environmental evaluation performance evaluation tool and processes. Scope 3 (Travel) UniCarbon index reporting presented to stakeholders the empirical value of the screening assessments and the corresponding environmental impacts of the different transportation modes. The quantitative value informs stakeholders and NTU management of an empirical value that requires a 'greener agenda' to be in place.

Townsend and Barrett (2015) stated that benchmarking Scope 3 (Travel) carbon emissions requires a robust quantification methodological foundations which similarly can be applied to NTU, for influencing by the various faculties within NTUs' three campus sites spread across Nottingham. NTU in particular is predominantly a social science/humanities university with a smaller technology/scientific faculty base. The major sources of Scope 3 (Travel) emissions include staff and student commute and the large proportion of carbon emissions have been derived from overseas business and student travel. Methodological inconsistencies have been eliminated by using the STARS standard format by HEIs when analysing various percentages using sustainability travel (Townsend and Barrett, 2015). This would result in more accurate HEI carbon index in the HE Sector leading to quality environmental reporting (Hahn and Kulmen, 2013).

4.9.2 SCOPE 3 (TRAVEL) CARBON EMISSIONS INDEX RECOMMENDATIONS

NTU should be in discussions with Nottingham city transportation to facilitating demand for cleaner fuel efficient vehicles that would contribute to reductions carbon emissions and promote cleaner air quality in the vicinity of NTU's City Campus. Diesel-electric hybrid buses are in operation in London and NTU can assist in stimulating demand for these buses by promoting special bus passes for the academic year. NTU has over 28,000 personnel that can be encouraged to use busses. Staff and student commute using public transportation can further be incentivised by NTU with discounted annual travel cards for greater uptake. The card can be amalgamated with credit cards receiving up to ten percent cashback from purchases in city stores.

NTU could offer third parties to access certain designated area or within its car parking sites facilities for electric vehicle charging stations to encourage demand for these innovative vehicles. Many third parties offer revenue sharing whose income streams could be used to develop and improve bicycle facilities at campuses.

Bike sharing can be amalgamated with Nottingham City Council for sharing bike park and ride facilities within five miles from the City Centre. NTU can share the capital costs involved with Nottingham Council and NET for securing commercial sponsorship for the bicycles (i.e. similar to Santander Bank with London bike sharing).

There are advantages for NTU staff to be involved in telecommuting when the internet video technology is at present very developed and available at low costs. NTU can incentivise these initiatives and encouraging less commuter travel.

4.10 CONCLUSIONS

This chapter presented the collaborative action research enabling the empirical quantitative analysis using SWOT perspectives to evaluating NTU's EMS Strengths, Weakness, Opportunities and Strength attributes that resulted with implementing

Turnaround strategies at NTU. The mRating empirical values evaluated NTU's EMS efficiencies which lead to the development of a new hybrid EMS implementation specific for NTU requirements for carbon emissions accountability and management. Both the SWOT and mRating empirical values were subjected to statistical factor analysis presenting the research with data integrity perspectives.

This Chapter presented the data analysis collected from the internet travel survey concerning staff and student commuting travel to and from NTU's three Campus sites. The travel survey data consisted of the distances travelled and the travel mode used for commuting. The travel survey data was then mapped to a full academic year. Staff business travel data had been provided by NTU's travel agent. Other travel data obtained from NTU's monetary nominal ledger that were converted emissions data using DEFRA's 2012 intensity factors based on distance travelled, mode and fuel type. An effective quantification tool was developed for quantification and reporting of Scope 3 (Travel) carbon emission.

This Chapter had presented the mechanisms for the development of the UniCarbon Index as a summative empirical measurement attributable to Scope 3 (Travel) carbon performance that would be a model for a ley performance indicator for legal and stakeholder reporting matrix.

The next Chapter 5, presents the summary analysis of Chapters One to Four and considers the research questions conclusions, implication of this research, contribution to management practice, limitations of this research and finally opportunities for future research in this field of study.

5. CONCLUSIONS

SUMMARY

This chapter presents this Thesis's conclusions of this collaborative case study research. This chapter describes in summary analysis of the main key perspectives of chapters 1 to 4. Chapter one described the research problem and questions. Chapter two, presented the literature review and identified the research gaps and developing the research questions within the existing body of knowledge in the management, quantification and reporting of Scope 3 (Travel) carbon emissions. Chapter three, described the research design and methodologies used to answering the research questions. Chapter four, described the data analysis and discussed the research implications.

This chapter presents the summary analysis this Thesis answering the research questions as presented in Chapter one. This chapter presents the research adoption of new management processes using SWOT and mRating tools for developing a robust EMS accountability adopting ISO14001 attributes. The chapter also presents this Thesis's contribution of new knowledge for development of methodological tools for the quantification and reporting of Scope 3 (Travel) emissions. This chapter discusses the recommendations to NTU/HE Sector, the implications of this research, the research limitations and finally this chapter presents the opportunities for further research in this field of study

5.0 INTRODUCTION

Chapter 1.1 (p.27) introduced the research problem "What are the key determinants of best practice for the management, quantification and reporting of Scope 3 (Travel) carbon emissions" within the Higher Education Sector with particular focus to the case study of Nottingham Trent University. The problem justified the need for this research for developing a Scope 3 (Travel) carbon emissions quantification tool on the basis that the existing international frameworks for carbon emissions footprint reporting may not be appropriate for universities. The existing frameworks require changes to address and reflect the requirements of the HE Sector. Furthermore, the appropriateness depends on whether NTU has the appropriate environmental management accounting strategies, expertise, organisational systems and structures, the tools and mechanisms for quantifying and reporting its carbon footprint to complying with HEFCE and legal requirements.

In Chapter 2 (p.57) this research had presented a focused systematic literature review concerning carbon accountability from the various different knowledge perspectives that had been applied to this case study. The literature review explored the background theories concerning Scope 3 (Travel) carbon emissions management, accounting and reporting. The review identified the various environmental management system frameworks, quantification tools and global reporting initiatives currently being used as best practise outside the HE Sector and discussed whether these had any applicability to NTU. This chapter justified the relevance of this case study research by identifying the research gaps and developing the research questions within the existing body of knowledge in the management, quantification and reporting of Scope 3 (Travel) carbon emissions.

In chapter 3 (p.130), the research design and methodologies had described new insights both in theory and for practice implementation for executing the management, quantification and reporting of NTU's Scope 3 (Travel) carbon emissions. The chapter justified the need for mixed methodological adoption of qualitative and quantitative approaches by numerically converting the qualitative replies to quantitative numerical data values to evaluate both the exploratory and descriptive research attributes for the case study's environmental management systems evaluation research. The chapter addressed the reliability and validity of the data sets obtained by using factor analysis for statistical analysis of the data values obtained. The research developed an online travel survey of staff and students travel modalities and distances travelled in one particular week for developing the quantitative tool application. The chapter addressed the various methodologies available and the justifications for the choice of methodologies used to answering the research questions presented in chapter 1. This chapter addressed issues pertaining to data collection and analysis, data reliability and validity. Issues addressing the ethical considerations of this case study research were also addressed.

Chapter 4 (p.235) presented the collaborative processes, systems and action research operational findings from collating and analysing NTU's environmental management systems. This chapter analysed the management system using SWOT and mRating qualitative values transcribed to quantitative data analysis sets. The chapter presented an improved efficient environmental management system for adoption by NTU in compliance to meeting the requirements of ISO1400 core attributes. The chapter detailed the data analysis and findings from the research design and methodologies as presented in chapter 3 previously. Analysis from the primary travel data collected from NTU's staff and students from the online travel survey were extrapolated using the mapping model for the quantification of Scope 3 (Travel) carbon emissions for an academic year.

This Chapter consists of seven section as follows:

Section 5.1 describes the conclusions on the research questions

Section 5.2 summarises the conclusions on the research questions

Section 5.3 summarises the conclusions of the EMS for NTU

Section 5.4 describes the contribution of the development of the methodological tolls in this research

Section 5.5 describes the implication of this research

Section 5.6 presents the contribution to management practice

Section 5.7 describes the limitations of this collaborative case study research

Section 5.8 describes the opportunities for further research

5.1 CONCLUSIONS ON THIS THESIS'S RESEARCH QUESTIONS

This section presents the conclusions drawn from the data analysis and discussions as presented on chapter 4 above in response to the five research questions from chapter 1, (p.32)

5.1.1 CONCLUSIONS ABOUT THE RESEARCH QUESTION 1

The first research question is "*What are HEFCE and legal requirements for the accounting management and reporting of Scope 3 (Travel) carbon emissions for NTU?"*

The literature review revealed that HEFCE was a statutory body entrusted by the UK government to measuring the impact of its environmental policies post the Kyoto Protocol commitments of carbon emissions policies, programmes and initiatives towards carbon emissions, sustainable development and combating climate change in the HE Sector. The requirements of HEFCE together with the Companies Act 2006 (Regulation 2013) allows for the following conclusions to be drawn.

(a) The HE Sector consists of researched based institutions who have a unique position in influencing stakeholders and their graduates concerning the impacts of Scope 3 (Travel) carbon emissions. Many UK universities have developed comprehensive carbon mitigation strategies in response to stakeholder demands to managing their carbon footprint management as a business risk and as a reputational risk as a research grant receiving body. NTU and other HEIs' have a significant social, environmental and economic impact and have a responsibility for demonstrating leadership in carbon mitigation, environmental management and overall carbon footprint abatement.

(b) Presently NTU/HEIs are being subjected to legislative challenges from Higher Education Statistical Agency (HESA) for HEIs reporting their total carbon footprint. Scope 3 (Travel) carbon emissions reporting are complex, legislative compliances are costly, difficult to manage and control. In order to manage these challenges, NTU is seeking to develop best practice methodologies for carbon emissions management and accountability as key management priorities or endure financial risks imposed by HEFCE. However, NTU is placing limited resources concerning environmental and sustainability strategies due to NTU's deficiencies in technical skills to developing a Scope 3 (Travel) carbon emissions quantification tool and implementing environmental management systems for accountability.

(c) NTU has a large population and is a significant contributor to Scope 3 (Travel) carbon emissions that have become one of their core mitigation tasks. NTU is an education establishment with a different ethos and have limited management skills in carbon emissions accountability. As a consequence, there has been no research concerning EMS implementation, carbon emissions quantification and reporting.

(d) Implementing EMS and carbon accounting mechanisms for Scope 3 (Travel) carbon emissions by NTU is a relatively new challenging management accountability phenomenon. NTU is an autonomous entity with complex management structures which are different from other organisational structures of similar size. NTU does not have the specialised technical skills, organisational structure nor financial resources.

(e) NTU is not leading the way to finding answers to the crucial phenomena of carbon emissions management and accountability and not utilising corporate social responsibility reporting by leveraging its campus strategies, attracting quality student applications and seeking third party investments and research grants. NTU’s capital budgeting and costs of adaptation for lower carbon emissions are becoming serious NTU policy issues in meeting the HE Sector carbon target of 43% by 2020 of its base year of 2005.

(f) Scope 3 (Travel) carbon emissions reductions can be considered a derivative of sustainability, offering much less flexibility when it concerns NTU’s travel operations and complying with HEFCE carbon reduction targets. The transition of carbon emissions accountability for NTU can be a very complex process, requiring NTU to shift its priorities and perspectives for greater transparencies. NTU must invest in technical skills development and acquire qualitative and quantitative training for effective carbon emissions mitigation strategies and implementations.

(g) As from 01 January 2015 HESA had followed the Companies Act 2006 (Regulation 2013) requiring NTU to report their carbon footprints. As consequence, Scope 3 (Travel) carbon emissions reporting has been included as part of the carbon footprint, driven by current compliances and stakeholders demanding for more environmental information. Carbon emissions reporting are ‘new’ areas for academic research that have the potential to affect future government policies on climate change, future carbon emissions and identifying new business opportunities. Also, legislations, environmental groups and HE stakeholders have been exerting pressure on NTU to fast track its Scope 3 (Travel) carbon emissions footprint for assessing climate change related business risks and environmental impacts.

(h) Research on energy efficiencies in UK Universities and legislations for setting carbon emissions targets would provide the impetus for the development of environmental management practices by NTU. Setting organisational carbon targets, offers practical results as well as efficiencies. Also improving environmental management benefits by effectively measuring, evaluating and reporting the impact of the different carbon reduction policies and regulations in the future. However, on a practical level, Scope 3 emissions targets does not take into account the extent to which transport demand patterns change in the future.

These conclusions suggest that the research question is valid and reciprocated by HEFCE, legal and stakeholder compliances concerning Scope 3 (Travel) carbon emissions. The literature review has been able to identify the gaps that has be obtained from the body of knowledge concerning the management, quantification, and reporting practices of Scope 3 (Travel) carbon emissions at HEIs in England with reference to Nottingham Trent University as a case study. These knowledge gaps formed the initial basis for developing appropriate research questions and formulating relevant research propositions. This was presented in Chapter 2.7, Table 3, p.122-124 of the literature review having identified the necessary gap analysis.

5.1.2 CONCLUSIONS ABOUT THE RESEARCH QUESTION 2

The second research question is "*What are the 'best practices' either in the Public or Private Sector concerning Scope 3 (Travel) carbon emissions quantification and reporting applicable to the NTU"?*

This research inferred that NTU is currently facing unprecedented challenges from HEFCE Companies Act 2006 (Regulation 2013) and the Climate Change Act 2008 in establishing process and systems for the quantification of Scope 3 (Travel) carbon emissions. Under these requirements, NTU is legally obliged to implement various management procedures, adapt its organisational structure, environmental management systems for the accountability and reporting of Scope 3 (Travel) carbon emissions. This would be including advancing more sustainability practices, adopting the protocols recommended by DEFRA for applying the carbon intensity factors for the different transport modes and distances travelled and NTU/HEIs to report their carbon foot print. However, this research review states that the current issues of quantification and reporting of carbon emissions are criticised as simply a compliance exercise without sufficient pertinent carbon emissions data information and contributing little to substantive reporting. Also the NTU is not responding to reporting travel carbon emissions and key carbon reduction performance indicators as a measureable quantum to stakeholders as role models to industry. In order to manage these challenges, HEIs including NTU should be seeking to develop best practice methodologies. Taking account of the finding in Chapters 2, 3 and 4 the following conclusions may be drawn:

(a) NTU is placing limited resources concerning environmental and sustainability strategies due to NTU's deficiencies in technical skills concerning quantification and environmental management reporting. NTU and other HEIs are education establishments having a different ethos and have limited management skills in carbon emissions accountability. As a consequence, there has been no research concerning the Scope 3 (Travel) carbon emissions accountability.

(b) The principles of transparency are key drivers for NTU to publish clear and understandable information concerning their environmental impacts to stakeholders. The quantification of Scope 3 (Travel) carbon emissions provides NTU with an empirical value and a numerical goal which can assist in abatement strategies. Quantification requires new carbon emissions data collections, carbon accounting, implementing guidance procedures for transparency, accountability, developing policies and abatement strategies.

(c) HESA requires NTU to quantify and report their carbon footprint and Scope 3 (Travel) quantification is part of the overall HEIs' carbon foot print. These quantification procedures contribute to better environmental management, efficiently managing total carbon footprint and contributing to increasing eco-efficiencies when using transportation. The quantification provides a framework for NTU to negotiating the challenges concerning uncertainties in carbon management, managing the cost benefits of carbon reduction policies and reporting as already applied in other sectors. However, there are carbon quantification complexities and challenges with regard to its measurement accuracy, consistency and certainty that have applicability to NTU's Scope 3 (Travel) carbon emission quantification.

(d) The Greenhouse Gas Protocol launched a broad technical recommendation derived from multi-stakeholder partnerships with a mission statement to recommending Internationally accepted Standards in order to achieve lower Scope 3(Travel) emissions worldwide. GHG Protocol Standards will ensure that organisations carbon emissions quantification accounting practices are based on the best practice available and would ensure consistent reporting practices that have relevance for NTU to implement.

(e) The Companies Act 2006 (Regulation 2013) had stated that large carbon emitting organisations like NTU must voluntarily comply also with the quantification and reporting guidelines recommended by quoted companies. Environmental reporting by NTU is essential to deflect criticisms and intense scrutiny from environmental pressure groups. NTU does not have the resources both technically and financially. Furthermore, NTU lacked clear and concise reporting formats, uncertainties concerning quantification issues and difficulties in establishing assessment boundaries.

(f) DEFRA stated that ‘KPIs should be quantifiable measurements that reflect the environmental performances’ of an organisation and as such KPIs would mitigate the need for lengthy reporting. These KPIs have summative values that are easy to understand by stakeholders. However, DEFRA offered no descriptive methodologies for the quantification of KPIs, especially reporting of NTU’s Scope 3 (Travel) carbon emissions. Best practices recommended by GHG Protocol and other worldwide bodies were also vague and NTU requires more detailed information concerning emissions reporting both for legal compliances and voluntary disclosures within NTU’s annual reports and financial statements. Furthermore, there are no reporting guidance that has been provided concerning organisational boundaries, emissions scope boundaries, intensity factors, identification of risks and opportunities.

These conclusions support the research question 2, that NTU faces significant challenges in adopting available quantification models and reporting formats. NTU’s carbon emissions quantification and legislative reporting have become increasingly important management functions.

The research design and methodologies presented linkages concerning both theory and corporate practice that had effectively addressed legislative target compliances. Scope 3 (Travel) carbon quantification had made significant contributions to the scientific and governmental levels by supporting decision makers in developing carbon emission regulations, international agreements and carbon emissions targets. This contribution is relevant to DEFRA’s pollution climate mapping assessment of the “effectiveness of emission abatement measures is essential for informing policy making in order to improve air quality and human health” (Defra4, p.1, 2015). This contribution also has profound relevance as a methodological tool for assessing the pollution levels and UK air quality index especially in London due to traffic pollution. The adoption of empirical measurements are key drivers for carbon reductions planning and management for the development and implementation of strategies for a lower carbon university at NTU.

5.1.3 CONCLUSIONS ABOUT THE RESEARCH QUESTION 3

Research Question 3 states: *"What are NTU's Scope 3 (Travel) carbon emissions information processes, management systems and procedures that are recommended for complying with HEFCE compliance recommendations that contribute to efficient carbon reduction management?*

Information systems concerning NTU's carbon footprint has become a major management focal issue for decision making and complying with HEFCE's recommendations. Stakeholders are demanding that NTU strives to lower its carbon emission by demonstrating its environmental stewardship by adopting an efficient information management system. EMS is a management tool providing universities with the necessary systems, processes, procedures, monitoring data in managing their campus environmental accountability and targets. The appropriateness of an EMS for monitoring emissions data, reporting mechanisms and ability to take remedial actions are key drivers towards environmental stewardship behaviour. To achieve this, requires NTU to adopt an effective EMS to managing its Scope 3 (Travel) carbon emission impacts, prioritise NTU's carbon reduction management strategies and determine effective appropriate actions concerning carbon reductions.

(a) Focussing on disclosures by NTU of its campus Scope 3 (Travel) emissions environmental performances and other environmental metrics would be assisting carbon emissions management and stakeholder engagement. The HE Sector must take a lead in disclosing key carbon emissions information, compliance policies and emissions targets achieved or achievable.

(b) Information systems efficiency status can be determined by attributing empirical measurements that present meaningful interpretations of carbon abatement efficiencies that can track HEFCE compliance recommendations. Carbon data obtained from these systems can be used to redesign a new EMS for management decision making. To effectively measure these efficiencies, NTU is well placed to develop empirical measurements to determining environmental management efficiencies empirically. This empirical efficiency is measured using qualitative to quantitative empirical values.

(c) Empirically rating the efficiencies of environmental information provided NTU with the measurement quantum to measuring the degree of efficiencies that benefit management information systems evaluation strategies. Empirical measurements for policy making and for communicating complicated environmental information as a simplified value that can be easily be understood by stakeholders. mRating values are transparent and have a self-reporting framework that is able to evaluate the subjective nature and multi criteria attributes concerning Scope 3 (Travel) carbon emissions and policy management. This tool will enable NTU to communicate its environmental management system performances to HEFCE and other stakeholders concerning carbon emissions performance management in a meaningful way.

(d) HEFCE requirements for NTU's building programme risks NTU being unable to meet its emissions targets. These processes are bureaucratic and burdensome procedures requiring complex processes and systems. NTU Estates has IT infrastructure constraints, a lack of trained staff and specialised skills that have impeded NTU's compliance reporting.

(e) Budgetary constraints and lack of development of long term EMS planning for NTU's carbon policies are key limitations and not meeting long term stakeholder demands. NTU will have to develop a quantification tool that takes into account planning for future legislative reporting requirements and additional capping of capital expenditure its IT infrastructure to do the work.

These conclusions support the research question 3. The findings had suggested that increasing complexities of carbon management and skills shortages within NTU for implementing an effective EMS. NTU does not have the management systems to collate carbon emissions data for formulating Scope 3 (Travel) carbon reduction policies and carbon emissions reporting.

5.1.4 CONCLUSIONS ABOUT THE RESEARCH QUESTION 4

This Research Questions 4 states: *What and how efficient are NTU's current environmental management systems for Scope 3 (Travel) carbon emissions for the following?*

(a) carbon emissions management accounting

(b) carbon data capture

(c) carbon emissions reporting to stakeholders

The management research question relates to determining environmental management practice efficiencies, carbon emissions data collections processes and reporting systems. The research question aims to determining empirically the effectiveness of NTU's environmental management identifying NTU's core environmental attributes, identifying their strength and weakness, communicating carbon performances and mechanisms for taking responsive action.

The literature review suggested that, Universities are well placed to alleviate the challenges of Scope 3 (Travel) carbon emissions via technical and management research. There are a number of reasons for NTU to undertaking this research as a case study. NTU has a large personnel body that uses various transportation modes for commuting purposes. Therefore, evaluation of what and how NTU's environmental management systems efficiently manages its carbon emissions for both compliance and reporting purposes. The collaborative action research investigated NTU's organisational specificity concerning Scope 3 (Travel) carbon emissions management systems and data collection efficiencies using Strengths, Weakness, Opportunities and Threats (SWOT) analysis together with an empirical mRating value rubric.

There are increasing awareness of what knowledge, skills and awareness that HEIs require to developing greater environmental responsibility that have an impact on internal carbon reduction policies. HEFCE has recommended NTU to publicise their carbon management plans every five years that is focussed on the continuous pursuit of environmental sustainability. However, funding and expertise was severely lacking by NTU to establishing an efficient and systematic environmental management approach to carbon emissions accountability. As a consequence, NTU is delaying or not undertaking developing quantification, management and reporting methodologies due to uncertainties and confusion

The conclusions drawn from this research question 4 are as follows:

(a) NTU recognises the demands of HEFCE and other stakeholders concerning the regulatory requirements for managing campus carbon emissions management. However, environmental management systems are complex management systems to design, implementation and the collation of travel emissions data. NTU are in their early stages in developing new environmental management systems for campus emissions accountability that had not been given much high priority as demanded by HEFCE. Under those circumstances, NTU is legally obliged to implement various management procedures, improving its organisational structure, environmental management systems for the accountability and reporting of Scope 3 (Travel) carbon emissions. This would also be including advancing more sustainability practices.

(b) Currently, NTU's adaptation of carbon emissions has been through carbon policies rather that emphasis on environmental management systems and carbon accountability. NTU is promulgated by legal and stakeholder requirements that are inhibiting for an effective response towards carbon emissions accountability and management. NTU's carbon footprint management are a business risk concerning financial penalties for not meeting its carbon targets and a reputational risk as a research grant receiving body. NTU has a responsibility for demonstrating leadership in environmental management and carbon footprint abatement. As a consequence, there had been no research concerning environmental management and carbon data capture. For effective carbon emissions mitigation requires an efficient environmental management system assisting NTU to establish carbon abatement strategies.

(c) NTU has become aware of the campus's environmental impact and management to stakeholders concerning the adoption of an Environmental Management System (EMS) being a key management requisite. EMS are procedural systems applicable for carbon emissions data management and collection for managing environmental accountability management. NTU is at various stages of adopting ISO14001 as a preferred EMS. Adopting ISO 14001 is indicative to stakeholders that NTU is meeting the challenges of regulatory and competitive pressures in managing carbon emissions. NTU would have to integrate their environmental management practices into a coherent framework by adopting ISO 14001 compliance principles. Implementing ISO14001 would assist NTU to reduce its operational environmental impacts, increase awareness of carbon reduction amongst NTU personnel and to establishing a strong image of corporate responsibility. However, the ISO 14001 series is too broad, its frameworks confusing, difficulty in understanding the procedures and cost benefits uncertain.

(d) NTU is required by Stakeholders to be accountable for their carbon emissions management. Compliance to this requirement demands an integrated environment management system for addressing the multi-disciplinary complexities of carbon management, data and reporting by NTU. NTU has indicated that an EMS is a valuable business tool with a suite of management accountability advantages beneficial to NTU for benchmarking, emissions data collection, setting targets and reporting its environmental impacts. An

EMS is a management information infrastructure that offers credibility for the implementation and maintenance of the individual HEIs' carbon policies and strategies. However, NTU carbon management can be considered to be a complex management system managing numerous environmental considerations that are complex and difficult to administer. NTU is only taking limited advantages of the workings of an EMS and not addressing the carbon emissions risks assessments, carbon abatement planning, and carbon monitoring, disclosure communication, carbon performance reporting, reviewing carbon policies and executing appropriate decisions concerning carbon reduction achievements. EMS development at campuses can be difficult due to complicated carbon management policies and environmental emissions data that are often incomplete or inaccurate.

(e) EMS are key management tools for NTU and stakeholders (Alshuwaikhat and Abubakar, 2008) as successfully applied in other sectors. Campus size, financial strength and navigating the complexities concerning carbon emissions had been significant factors in campus adoption of an EMS. NTU's carbon footprints are major environmental factors that NTU needs to be concerned when developing an effective EMS. Stakeholders have demanded that campus carbon footprints must be independently audited. With this legal requirement and environmental stewardship. EMS has become a major factor for the evaluation of data and quantification integrity of NTU's carbon accountability management. No research concerning an effective EMS that can measure empirically the efficiencies and effectiveness which would be essential for carbon management planning.

5.1.5 CONCLUSIONS ABOUT THE RESEARCH QUESTION 5

Research Question 5 states: "*What are the Scope 3 (Travel) carbon emissions quantification tool recommendations for adoption by NTU as best practice for the following?*

(a) carbon footprint accounting

(b) tracking NTU's carbon emissions reduction against HEFCE carbon reduction target

Quantification requires new carbon emissions data collections, carbon accounting, instituting guidance procedures for transparency, accountability, developing policies and abatement strategies and an empirical quantum measurement. Apart for the identification of these constraints, there has been limited or no investigation to analysing the distinct carbon emissions data information flow within a carbon reduction management system. The quantification tool contributes to better environmental management, efficiently managing total carbon footprint and contributing to increasing eco-efficiencies when using transportation. The quantification tool provides a framework for NTU to negotiating the challenges concerning uncertainties in carbon accounting and tracking. Carbon reporting act as triggers for NTU for better management of their carbon reduction strategies. However, there are no definitive guidelines for HEIs to implement concerning the measurement of Scope 3 (Travel) carbon emissions hampered by campuses lack of an effective EMS for effectively measuring and evaluating carbon emissions impact. Similarly, there has been no carbon emissions disclosure practices for NTU.

(a) Setting carbon emissions targets would provide the impetus for the development of carbon emission quantification practices. However, on a practical level for a quantification tool that takes into account the multiple travel modes, types of fuels burnt and the actual carbon emissions emitted. Reporting and actively managing carbon emissions would have significant management benefits and helps promoting the ethos of sustainability throughout the university. The quantification tool is described as a decision making and planning tool used in this research for the systematic evaluative approach concerning the complexities relating to Scope 3 (Travel) carbon emissions quantification. Establishing and effective quantification tool by NTU has been viewed as a strategic compliance requirement by HEFCE and HESA for carbon emissions data integrity.

(b) The scope for NTU carbon and environmental reporting is expanding with climate change becoming increasingly a major concern in recent years. DEFRA had promoted the benefits of reporting environmental performance that would translate to lower resource costs, better understanding of climate risks, leadership and organisational goals. The future benefits for NTU can accrue when implementing carbon emissions abatement strategies and competitive advantages of its campus's green ethos.

(c) The quantification tool embodies the use of best resources in terms of technical and operational capabilities for developing core management technical to meeting the demands of HEFCE and stakeholders.

(d) Reporting environmental sustainability and carbon emissions are an evolution of responsible stewardship and corporate governance. NTU has failed to capitalise of the benefits of developing a quantification tool that could lead to reputational and brand improved customer loyalty and supply chain management. Carbon emissions reporting can drive down costs by highlighting NTU's carbon performance and efficiency savings and helping to minimise business risks.

Within the HE Sector carbon emissions reduction is emerging rapidly as an important management discipline for campus corporate governance and reporting. The review discussed several governance models and reporting frameworks, each having a different applicability but none was specifically applicable to NTU.

These conclusions to the research question 5 reinforce the idea that developing a quantification tool that offers the mechanism to make carbon emissions accountability and management more 'visible' and measurable. These actions being more proactive to solving the NTU's environmental reporting problems as being significant influences.

5.2 SUMMARY CONCLUSIONS ON THE RESEARCH QUESTIONS

The research questions in chapter 1 (p.32) and SWOT and mRating questionnaires had been developed from gaps synthesised from the literature review (Chapter 2.7. pp.122-127 concerning NTU's Scope 3 (Travel) EMS accountability, management, quantification, management and reporting. This led to this Thesis's development of a conceptual framework, focussed research questions, research aims and objectives for undertaking this collaborative action research led by the researcher to answering the research questions, evaluation of NTU's EMS efficiencies towards developing a new EMS Model and developing new management tools and processes. The summary findings and evaluations are presented in Table 32, p.335.

Based on the research findings, this research concludes the following with regard to answering the stated research questions (p.32):

(a) The effectiveness of the environmental management systems had been measured in terms of the effectiveness of environmental management accountability processes and environmental performance. Establishing theses mechanisms had impacted on HEFCE and stakeholder pressures for NTU to be accountable for its Scope 3 (Travel) emissions and NTU's total carbon footprint (answered research questions 1, 3, 4 and 5).

(b) NTU's EMS implementation has a powerful supportive tool for building confidence, credibility and improving carbon management performances and also creating a paradigm shift within Scope 3 (Travel) carbon emissions abatement strategies (answered research questions 2, 3, 4 and 5).

(c) The EMS has a link between environmental management accountability and environmental performance. These perspectives include relationships between environmental strategy and carbon emissions targets achievable during the time five-year time frame as recommended by HEFCE (answered research questions 1, 2, 3, and 4)

(d) The implementation of an environmental management systems, identifying its accountability characteristics and the adoption of empirical measurement tools have been attributable to the development of environmental management performance indicators and engaging in long term Scope 3 (Travel) carbon abatement planning (answered research questions 2. 3. 4 and 5)

Table 32 - Summary Conclusions of the Research Questions of this Research

Research Questions (p.32)	**Summary Conclusions**
Research Question 1 What are HEFCE and Legal requirements for the accounting management and reporting of Scope 3 (Travel) carbon emissions for NTU"?	**Supported** The research question had been developed from the literature review (pp.122-124). The data sets had been developed from research design (part 3)(p.190) methodology. The reporting frameworks (diagram 9, p.90) clearly defined the reporting boundaries. The researcher infers that legal requirements require compliance by NTU concerning reporting Scope 3 emissions. There are reporting requirements from the Companies Act 2006 (Regulation 2013), Global Reporting Initiative 4 and many others bodies. Apart for reporting to HESA there has been no appropriate format specific to HEIs to report Scope 3 carbon emissions performances.
Research Question 2 What are the 'best practices' either in the Public or Private Sector concerning Scope 3 (Travel) carbon emissions quantification and reporting applicable to NTU"?	**Supported** The literature review identified the gaps and presented the research question development (pp.122 -124). The quantification methodologies of GHG Protocol (diagram 22, p.190) and carbon reporting perspectives (diagram 10, p.103) had been key to best practices for adoption by the HE Sector but no specific best practices for emulation by NTU.
Research Question 3 What are NTU's Scope 3 (Travel) carbon emissions information processes, management systems and procedures that are recommended for complying with HEFCE compliance recommendations that contribute to efficient carbon reduction management?	**Supported** The literature review presented the research, SWOT and questionnaires development (pp122-124). The SWOT (p.169) and mRating qualitative to quantitative tool (p.182) developed the new EMS processes (diagram 19, p.172) for a hybrid EMS in compliance with HEFCE. Data sets analysed using factor analysis. The STARS (OP18 to OP21B (pp.206-210) and quantification methodologies (p.193) had presented an Index and measurements for carbon abatement progress and contributes to better carbon management and resource allocation. Targets are published in NTU's carbon management plans every 5 years.
Research Question 4 What and how efficient are NTU's current environmental management systems for Scope 3 (Travel) carbon emissions for the following? (a) carbon emissions management accounting (b) carbon data capture (c) carbon emissions reporting to stakeholders	**Supported** The SWOT and m Rating semi structured questionnaires had been developed from the literature review (pp.122-124)). The action research analysis (p.238) and the SWOT and mRatings data analysis (p.264) evaluated NTU's EMS status and efficiencies from qualitative to quantitative empirical measurements that had been subjected to factor analysis. NTU's EMS Turnaround strategy (p.258) enabled an efficient EMS. The reporting tool methodologies identified in (diagram 10, p.103) have reporting applicability. HEIs have no carbon emissions reporting formats to comply with HESA, CA 2006 (Regulation 2013) and Global Reporting Initiative G4.
Research Question 5 What are the Scope 3 (Travel) carbon emissions quantification tool recommendations for adoption by NTU as best practice for the following? (a) carbon footprint accounting (b) tracking NTU's carbon emissions reduction against HEFCE carbon reduction target	**Supported** The literature review (pp.122-124) had identified the knowledge gaps and question development (p.32). Data analysis using tools for quantification measurements of staff/student (Web Survey) (p.293), overseas students (p.303) and business travel (Table 29) (p.299) had provided the data sets. The STARS credit methodology (p.205) provided the data for the calculation of the UniCarbon Index of NTU (p.205). The reporting requirements are governed by the GHG Protocol Standard (p.90). These tools enable carbon foot printing, benchmarking, planning and emissions management.

5.3 SUMMARY CONCLUSIONS OF THE ENVIRONMENTAL MANAGEMETN SYSTEM FOR NOTTINGAM TRENT UNIVERSITY

The environmental management system presents NTU with a management tool for managing organisational environmental aspects and management systems to proactively manage the NTU's environmental strategies. EMS planning by NTU had involved the key operational systematisation for Scope 3 (Travel) carbon accountability management. It was ascertained that there are direct and indirect attribute influence relationships between the ISO 14001 requirements and the hybrid EMS developed for NTU. The hybrid EMS had two important stages (1) Planning, evaluation and feasibility and (2) Hybrid EMS implementation opportunities.

This research had directly evaluated the relationship that represents the contribution of an EMS for the compliance of good governance of emissions accountability. This field had been empirically investigated by using the SWOT EMS evaluation tool to determining the 'state' of the current EMS. The mRating rubric evaluation of the current efficiency of the EMS. The summary of the evaluation of the SWOT and mRatings (Diagram 36, p.275) enable NTU to take management improvement actions to implementing a new hybrid EMS.

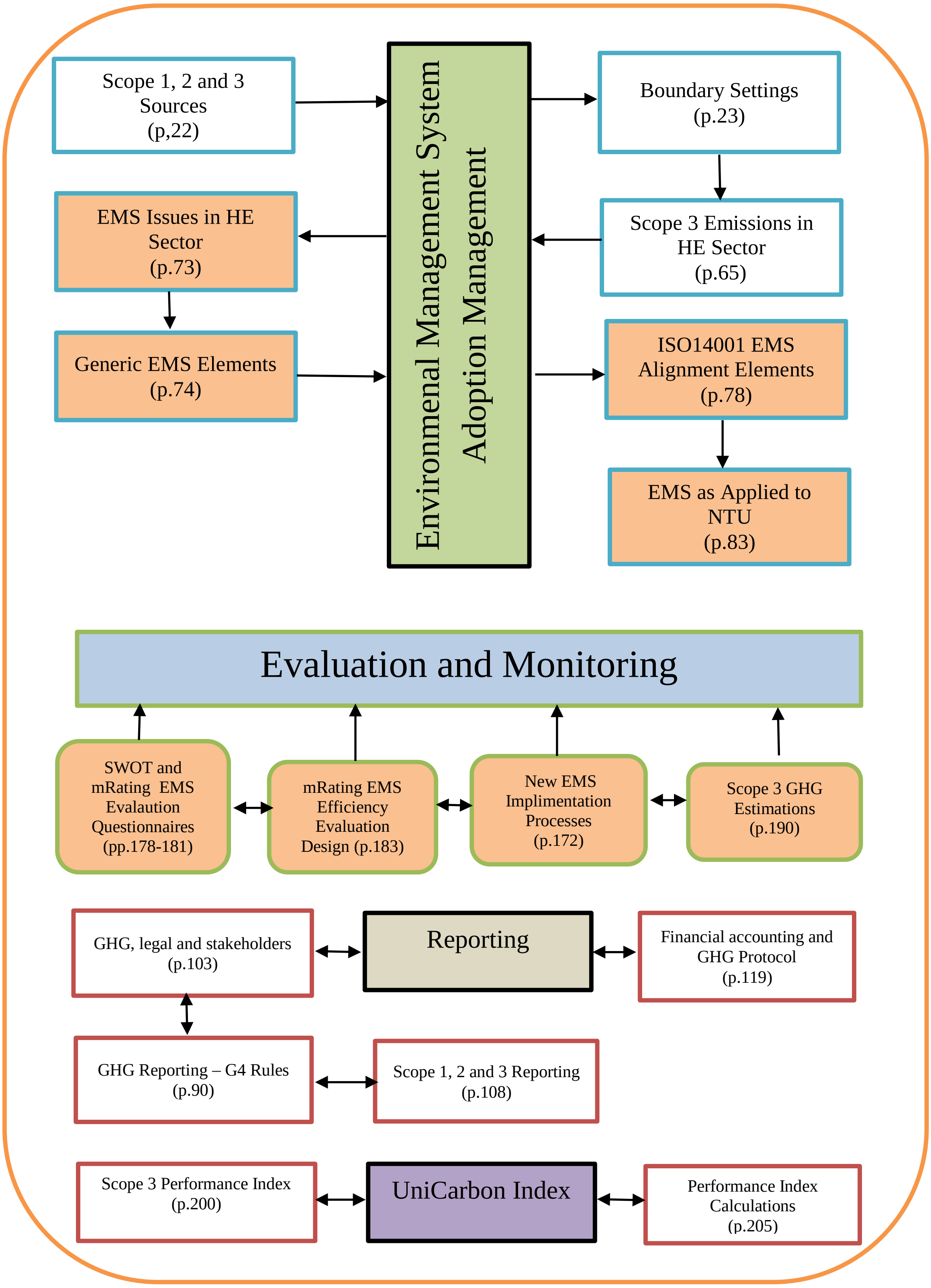
It is concluded that a hybrid EMS makes a significant contribution to NTU with the adoption of environmental management accountability practices that contribute to systematic allocation of resources and executing environmental management decision making. The adoption of an EMS provides an opportunity to other HEIs within the HE Sector who may be considering that the systematisation of environmental management practices can be a significant contribution to the advancement of campus environmental performance.

This Thesis fills the gap identified in the literature review (pp. 122-124) that rests within an enormous field yet to be discovered in order to identify empirically the various forms of influences (legal and stakeholder compliances, including ISO14001) for implementing a robust EMS for carbon accountability and management. The EMS attributes shown in this research presents a 'preferred' guide to optimising the EMS efficiencies and management processes, including minimising costs. The diagram 37 (p.338) presents the robust EMS adoption flowchart EMS information infrastructure regardless of its domain and synthesises from this research as a recommended 'Model EMS'. The EMS flowchart structure contributes to an effective and robust EMS management and incorporates the adopting practices that aim to meeting the ISO 14001 attributes (without certification) while at the same time adopting environmentally proactive practices.

Diagram 37 (p.338) illustrates the EMS adoption flowchart as applied in this research. The content of the flowchart can be cross referenced to the individual EMS procedures and application principles described within their respective references. This flowchart presents the management information infrastructure derived from this research for an EMS for Scope 3 (Travel) carbon emissions accountability, management and reporting. The procedures are integrated into three sections: (i) EMS adoption management requirements (ii) EMS evaluation and monitoring and (iii) Reporting. This diagram presents the core EMS mechanisms for a comprehensive and practical managements processes for integrating specific EMS management sub-systems for establishing a robust EMS.

The EMS adoption management systems aligns its processes to ISO 14001 for its operating procedures that are adaptable for the requirements of NTU's new EMS adoption that can be replicated to other HEIs and organisations.

Diagram 37 – Flow Chart Summary of EMS Adoptions Management as applied in this research



Developed by the Researcher (Chelliah, 2015)

EMS Strengthening Mechanisn flow chart (See Chapter 5.3.1 (p.339)

5.3.1 GUIDANCE ON HOW THE EMS CAN BE STENGTHENED TO PROVIDING A ROBUST SYSTEM FOR MONITORING, REPORTING AND REDUCING SCOPE 3 (TRAVE) EMISSIONS

Nottingham Trent University is increasingly being expected to operate in a responsible manner and addressing its environmental responsibilities towards Climate Change (Cca, 2008) and reporting its emissions to HESA (Hesa, 2015). HEFCE have mandated that HEIs address Scope 3 (Travel) environmental management as part of the HEIs' management responsibilities of good governance (Hefce, 2012). This research had asserted that NTU's role in Scope 3 (Travel) emissions management accountability is crucial to ensuring NTU's commitment to lower carbon emissions in response to the CCA2008 and HE Sector Targets. A prominent concern raised by this research involves NTU developing an EMS for which that has been an absence of a definitive EMS development and implementation framework applicable to HEIs. This research has presented a host of research findings based on this collaborative case study with NTU based on empirical performance measurements of NTU's EMS determining the Strength, Weakness, Opportunities and Threats and Efficiencies determined from the results of the SWOT and mRating evaluation questionnaires.

Detailed below, describes the adoption framework based on the findings of this research and best practices that contribute to a robust system for monitoring, reporting and reducing Scope 3 (Travel) Emissions for HEIs that can be replicated to other industry sectors. References are made to Diagram 37 (p.338).

(i) The Thesis describes in Diagram 5 (p.73) the adoption drivers concerning the issues facing the HE Sector detailing the 'framework' developed from this research study as a recommended guidance for the implementation for Scope 3 (Travel) carbon emissions EMS accountability, management and reporting. The adoption drivers come from CA2013, CCA2008, and HEFCE that ensures that the EMS reporting framework meets the compliance requirements for a robust reporting system. The reporting frameworks consists of stakeholder requirements from GHG Protocol, GRI, CDSB, CDP and HESA. The adoption recommendations from above represents the key compliance requisites for a robust EMS framework by implementing and incorporating the principal features and detailed procedural requirements as guidance to establishing a robust EMS.

(2) To implementing a robust EMS, requires the recommendation of the adoption ‘Document Flow’ mechanisms and procedure of a ‘Generic EMS’ applicable to the HE Sector as illustrated in Diagram 6 (p.74) developed by this research. The recommended implementation guidance focusses on the management systems developed from the ISO14001 Standard attributes as recommended for adoption by this research. The recommended guidance document management flow procedures and systems are (a) the environmental policies (b) evaluation processes (c) systematic operations (d) audit trails and (e) review processes. These management principal procedural systems feature enable strengthening a robust EMS implementation

(3) Diagram 6 (p.74) presents the flowchart recommendation adoption guidance of the key EMS operational management systems and procedures for the implementation applicable to HEIs that encapsulates the informational management infrastructure for a robust EMS. The key management procedures recommendations are denoted by procedures i.e., [A] Emissions capture management planning [B] Operational support mechanisms [C] Emissions benchmarking [D] EMS review and

improvement. Diagram 7 (p.78) presents the adoption recommendations the EMS management flowchart guidance for incorporating the key ISO 14001 EMS elements for an effective procedural management flow of documentation and environmental accountability information. Diagram 7 presents the key intended outcomes of the environmental management system, the internal and external management and accountability issues. that provides a clear guidance for a generic EMS for an effective procedural management flow of documents and information.

(4) The specific adoptive recommendations for a robust EMS as applied in this research is derived from the Waste and Resources Action Programme (WRAP) (p.71). The adoptive recommendations should include (i) designing, developing and implementing a specific EMS applicable (ii) incorporating the guidelines of ISO 14001 attributes and certification procedures. The advantages to HEIs are (i) increases commitment to quality management procedures concerning Scope 3 (Travel) accountability (ii) certification ensures credibility of management and organisation. The above are key EMS recommended guidance mechanisms to enabling HEIs to establishing a robust EMS.

(5) In Diagram 8 (p.83) presents the flow chart adoption recommendations guidance for management and implementing a robust EMS that involves (i) the adoption paradigms concerning emissions management systems accountability, management review and updates to continuously monitor, evaluation and updating to meeting environmental targets (ii) ensure adoption requirements of HEFCE/HESA Scope 1, 2 and 3 emissions incorporating legal compliance of CA2013 and directors' enhance reporting with regard to benchmarking of CO2 emissions (iii) recommendation adoption of EcoCampus software management that incorporated ISO14001 attributes

and reporting mechanisms of GHG Protocol Standard, Global Reporting Initiative G4, Carbon Disclosure Standards Board and the Carbon Disclosure Project.

(6) To ensure evaluation and continuous monitoring of an EMS involves the recommended management adoption procedures as illustrated in Diagram 19 (p.172). These management procedures require the development of semi structured questionnaires (as in Table 12, pp.178-181) to determining the SWOT (EMS state of affairs) and mRating (determining the EMS efficiencies) by interpreting the qualitative replies into quantitative empirical measurements using a rubric scale of 1 to 10 (10 being the best). The empirical measurements of SWOT and mRating enables a simplicity measurement mechanism using the R-Score measurement as show in Table 26 (p.267) and also in Diagram 35 (p.265) for management decision making for ensuring a robust EMS. The adoption of empirical measurements provides management greater credibility for measuring the robustness of the EMS. Empirical measurements enable the setting and measurement of EMS targets.

(7) The Empirical Values of SWOT and mRating values are to be subjected to statistical factor analysis to ensure data integrity i.e. calculating its Cronbach Alpha (to determining data correlations), Kaiser-Meyer-Olkin Value (for data sampling integrity) and Eigenvalues (determining the Factors are most reliable). The research output would consist of a verified EMS efficiency evaluation summary model (similar to Diagram 35, p.265) and assists with the development of a new hybrid EMS model for the HEI. The adoption recommendation procedures ensure empirical measurements providing credible matrixes for management decisions making for establishing an efficient and robust EMS.

(8) Implementation adoption and scheduling for a robust EMS requires a strategic implementation strategy. Management should setup a ‘steering committee’ with a definitive terms of reference that’s will act as a governing body for the implementation. This steering committee with be preparing environmental policy targets and EMS adoption progress reporting and audit evidence to making an informed EMS decision to implementing a robust EMS. This governing body (similar to the ARC in this research, p.156) will be coordinating and providing leadership and governance oversight with the delegated authority to making key environmental management decisions that in accordance with the objectives, management procedures and scope for implementing a robust EMS. The steering committee will be empowered with summary powers and fiduciary oversight sanctioned by top management.

5.4 THE CONTRIBUTION OF THE DEVELOPMENT OF THE METHODOLOGICAL TOOLS IN THIS RESEARCH

The purpose of the methodological tools had enabled the collection and analysis of the data using particular quantification computational mechanisms and management practices. The tools are widely varied in their scope, assessment criteria and depending on their specific goals. This research aim was to recommend the suitable evaluation tools for a robust EMS and benchmarking tools for quantification, management and reporting Scope 3 (Travel) emission at NTU. Evaluating the research questions require tools and processes that are ‘right’ for undertaking the research. The purpose of each tool allows for the identification and evaluation of processes of 'interest' for the collection of relevant data. Tools are methods of collecting data that reveals the reality of the quantification or management processes in a specific context. In this research, the SWOT and mRating methodological tools are the ‘primary tools’ for the collection of qualitative to quantitative data sets with respect to NTU's EMS evaluation. The online travel survey tool for staff and student commute enabled Scope 3 Travel commute quantification. Other travel emissions quantification tools are business (including travel agent’s data) and overseas student travel (including families). The purposes of these tools had enabled (1) The Scope 3 (Travel) benchmarking of travel emissions (2) Complying with the CCA2008 emissions reduction together with the HE Sector reduction of 43% by 2020 (base year 2005) and (3) Reporting of Scope 3 (Travel) emissions to HESA for budgetary finance allocation. The quantification tool for calculating the sustainability index enables assessing the index concerning travel sustainability of NTU and reporting this as part of the directors' enhanced reporting requirement to comply with CA2013.

The purpose of developing the research’s methodological tools have a wider appeal and application to the HE Sector and other industry sectors with respect to Scope 3 (Travel) carbon emissions accountability. This research’s empirical methodological tools have provided new management processes with regard to (a) Management leadership tools enabling empirical measurements for the qualitative to quantitative evaluation of NTU’s EMS (b) Benchmarking tools offering opportunities for NTU for continuous monitoring and carbon reduction strategies (c) A tool for the quantification of an empirical Unicarbon index that will be contributing to lower carbon emissions and sustainability initiatives (Aashe, p.1, 2013)(p.202). The UniCarbon index has two functionalities. (1) Benchmarking the current sustainable transport (2) As a summative reporting value as part of the CA2013 for companies enhanced reporting requirements with regards to sustainability and climate change.

This Thesis had explained the purpose and relevance of UniCarbon index with reference to DEFRA's standardised seven reporting principles (p.114) for which one, must represent the organisation's key performance indicator (KPI). DEFRA had stated that 'KPIs should be quantifiable measurements that reflect the environmental performances of an organisation and as such, the UniCarbon index tool analysis would mitigate the need for lengthy reporting of complex information. The UniCarbon index is a ’summative value’ that is easy to understand by stakeholders [(p.53) : (p.97) and (p.114)]. The UniCarbon index tool purpose is a contribution to new knowledge and management processes that can offer compliance with DEFRA’s requirements and also contribute to the enhanced reporting requirements of the CA2013.

The Thesis had illustrated in Diagram 10 (p.103) the carbon reporting requirement perspectives, for which the various methodological tools had been developed via this research to comply with the various reporting requirements for Scope 1 and 2 and in some instances Scope 3 separately or voluntary (p.22). The tools developed in this research show 'leadership' and makes a contribution to new knowledge with regard to Scope 3 (Travel) emissions accountability. These tools have a meaningful impact on corporate responsibility reporting and emissions abatement strategies to meeting the CCA2008 and HEFCE’s targets for a lower carbon HE Sector.

In this Thesis, each methodological tool had been developed as new knowledge and new management systems processes for executing this research. The purposes of these tools, had enabled determining the Scope 3 (Travel) carbon emissions quantification, management and reporting to complying with the reporting requirements of HESA. This research’s tools enable NTU to show leadership in developing methodologies for Scope 3 accountability and contributing to enhanced reporting (p.357)(point d) impacting on internal carbon reduction policies.

The purposes of these tools enables NTU/HEIs and other organisations with a ‘tool kit’ for ‘equation building’ for the quantification of Scope 3 (Travel) carbon emissions and contribute to the total carbon footprint calculation (Scope 1, 2 and all fifteen categories of Scope 3). Benchmarking Scope 3 (Travel) carbon emissions enables HEIs to manage, monitor and implement carbon reduction strategies to comply with both legislative and stakeholder requirements. The purposes of this tool enables HEIs to execute benchmarking as a management tool with regard to sustainability measurements, review and implement reduction strategies to meeting CCA2008 and HEFCE's Targets. Benchmarking offers comparability (p.114). Most importantly in (p.116), the GHG Protocol Reporting Standard and Global Reporting Initiative 4 emphasises on benchmarking. The UniCarbon index tool as presented in this research enable HEIs to leverage their carbon reduction strategies with this empirical management quantum that can be reported every 5 years in the HEIs carbon management plan (p.327). The EU Accounts Modernisation Directive (p.198) and directors' enhanced reporting (p.63) require large companies to report their KPIs for which UniCarbon index tool is purposeful. HEFCE and HESA reporting rules exceed CA13 requirements (p.128).

Each tool is independent, specific and the tools application has been justified to answering the research questions. Each tool adoption and implementation emphasises the specific stages of the tools deployment processes within this research in a sequential manner for making these tools objects of performance to answering the research questions. These tools are independent and not integrated with each tool being specific, generating its own sets of data and information and with one outcome.

5.4.1 THE ADOPTION OF SWOT AND mRATING VALUE SCALE TOOLS TO HEIs' STRENTENING THEIR OWN ENVIRONMENTAL MANAGEMENT SYSTEMS

An EMS enables HEIs at planning and administrating management processes for managing their HEI's environmental aspects and processes. This initiates the requirements for the implementation and management for a robust EMS that takes into consideration the attributes of ISO 14001 that has a positive and direct influence on environmental accountability that leads to environmental improvement of its processes. This further leads to HEIs complying with HEFCE, increases the HEIs green credentials, increased research funding, reduced Scope 3 (Travel) emissions and waste minimisation.

The research questions on which this Thesis study had been based, are there significant influences of an EMS on Scope 3 (Travel) emissions accountability. What are and to what extent does SWOT and mRating values strengthens the HEIs EMS?

The Thesis had explained in Chapter 4.5.1 (p.284) recommending SWOT and mRating value as EMS evaluation tools that incorporate the SWOT analytical framework analyses for determining the EMS perspectives of Strength, Weakness, Opportunities and Threats. The SWOT questionnaires are semi structured questionnaires specifically developed to eliciting answers to evaluating the state of the current HEI's EMS. The SWOT represents both internal and external micro and macro qualitative interpretations that are transposed to quantitative empirical measurements. The mRating value framework analyses the EMS efficiencies with semi structured questionnaires from qualitative to quantitative measurements. The recommendation is to use the analysis from these empirical perspectives for evaluation and strengthening an EMS System. These quantitative measurements are subjected to statistical factor analysis as applied in this research to reduce data bias and increase data integrity (p.47 and p.223). Factors and empirical measures identified can be considered as key for the EMS improvements that are required. Using the above mentioned methodological tools enable HEIs to be able to evaluate and take appropriate management action to strengthening their EMS.

The recommended management adoption procedures to other HEIs for strengthening their EMS are (1) developing key questionnaires that are specific to eliciting answers evaluating the HEI's current environmental management characteristics using the SWOT Methodology - Strength, Weaknesses, Opportunities and Threats as a holistic and cost effective mechanism (2) mRating Value enables other HEIs to measure empirically their EMS efficiencies. To execute this evaluation, this Thesis recommends adopting the recommended format as presented in Table 12 (A-D)(pp.178-181) with regard to the semi structured questionnaire development and structure for subsequent statistical analysis. HEIs intent on strengthening their EMS should consider the adoption tools with regard to the HEIs developing specific evaluation questionnaires based on a literature review, management targets or from a scoping study. This will enable the HEI to develop specific EMS strengthening questionnaires and to elicit the appropriate answers and empirical measurements of the HEI's EMS 'state of management affairs. This Thesis recommends that adoption of SWOT and mRating evaluation methodological tools by eliciting qualitative to quantitative measurements presents more technical credibility to management research.

The SWOT and mRating value (p.284) presents HEIs with the empirical development knowledge within the field of EMS evaluation, design and implementations of a hybrid EMS particular to the needs of the HEI that enables strengthening EMS. Also in (pp.284 - 290) offering detailed and in-depth analysis using SWOT and mRating values evaluation frameworks for environmental management issues. The Thesis recommends that adopting these tools enables HEIs the mechanism to evaluate, measure and take action to strengthen their EMS. Importantly, adopting these tools is cost effective, simplistic and can be undertaken periodically to continuously monitor, review and implement new EMS strategies for continuous improvement.

These methodological tools enable the HEI to embark proactively to developing and improving their EMS strategies (p.285). The Thesis describes that in (p.289) to replicate the recommendations from this Thesis to other HEIs. This Thesis's recommendations for strengthening the HEIs' EMS are as follows (1) objectively monitoring ISO compliances attributes, EMS systems and audit (2) qualitative to quantitative empirical measurements of management decision making and associating with active carbon abatement strategies (3) presenting the HEI with compliances to external reporting tool and to meeting HEFCE's requirements. The above are key recommendations for strengthening EMS efficiencies and good corporate governance.

The SWOT Tool enables the HEI to evaluate the different SWOT attributes of its EMS and consider leveraging on the EMS's long term strategic planning for Improvement. The mRating Value enables HEIs to initially measure its EMS efficiency and with management involvement set NEW EMS efficiency targets. The Thesis recommends the adoption of using the summary format as illustrated in Diagram 35 (p.265) to determining management actions to strengthening the HEI's EMS. This will be based on the empirical figures obtained from the SWOT and mRatings questionnaire analysis matrix. The HEIs should evaluate the matrix results to decide on the best course of action to strengthening the HEI's EMS. The EMS strengthening course of action would be with the FOUR Strategies i.e. Aggressive Strategy, Reconfigure Strategy, Diversify Strategy or Turnaround Strategy) as key EMS Strengthening management actions by adopting the R-Scores (Table 26, p.267).

5.5 IMPLICATION OF THIS RESEARCH

The Higher Education Funding Council for England recommended carbon emissions target of 43% (by 2020) of the 2005 base year that covers Scope 1, 2 and 3 emissions (Hefce, 2012) are significant and demanding targets for HEIs to comply with regard to the HEIs' overall carbon footprint. Scope 3 greenhouse gas emissions are from travel (this research) and from thirteen other indirect Scope 3 emissions (p.22) for accountability to determining the total carbon footprint quantum. The implications of this research is attributable to the contribution of tools and methodogies that would facilitate the benchmarking of the the remaining thirteen other Scope 3 emissions and evaluating the related climate change impacts demands new and holistic carbon accountability and management strategies to be implemented. NTU's Scope 3 (Travel) carbon emissions are incurred indirectly and beyond NTU's control, but this research has implications for the quantification of pollution levels from vehicles in inner cities. As a consequence, NTU's carbon emissions management, quantification and legislative reporting have high relevance in this research case study.

The outcome of this research have implications for NTU to implementing an effective environmental management system for Scope 3 (Travel) carbon emissions accounting and the need for effective carbon footprint reporting. Recommendations arising from this case study research have been broadly categorised under two significant headings. The first category presents the specific recommendations to NTU and the second to the HE Sector.

5.5.1 RECOMMENDATIONS TO NOTTINGHAM TRENT UNIVERSITY

The following recommendations are made to NTU to implementing an effective environmental management system, developing Scope 3 (Travel) carbon abatement policies, implementing the quantification tool, implementing regulatory and compliance frameworks that would result in NTU reporting more effectively on its carbon footprint.

(a) Having an effective environmental management system for NTU's carbon emissions accountability should be a key management requisite offering environmental accountability and to legitimise carbon data integrity. Establishing a clear corporate environmental governance structure within NTU. This will require management commitment to Scope 3 (Travel) carbon reduction strategy and accountability for the achievement of carbon emissions reduction at every management and operations levels.

(b) The use of empirical measurements for SWOT and mRating Value concerning EMS efficiencies would be seen as an efficiency measurement tool that goes beyond operational aspects to implementing an efficient EMS at NTU.

(c) The EMS would be considered as important management tool among campus environmental accountability initiatives and enhancing environmental management practices and accountability. Designing and implementing a Scope 3 (Travel) carbon emissions accountability mechanism for tracking whether NTU's carbon emissions targets have been achieved as stated in its carbon plan.

(d) Benchmarking Scope 3 (Travel) carbon emissions would be major drivers for reducing NTU's carbon footprint, change in NTU's business travel, staff and student travel policies. Securing the input of stakeholders' engagement at the operations levels that can offer valuable insights for environmental policies development and carbon emissions risk management.

(e) Implementing the Scope 3 (Travel) carbon emissions sustainability index (UniCarbon Index) enables NTU to improve its Scope 3 (Travel) carbon emissions dialog with stakeholders with key empirical information and comparing NTU's carbon efficiencies with other HEIs.

(f) Developing a clear environmental and business case for why Scope 3 (Travel) carbon emissions reporting is beneficial to NTU. This requires NTU to understand the various travel mode emissions, the carbon intensity factors, quantification and amalgamating these factors meaningfully into a strategic environmental plan that can comply with stakeholder demands for substantive meaningful carbon reporting.

(g) Adopting the Greenhouse Gas Reporting Protocol for Scope 3 (Travel) and Global Reporting Initiative 4 for carbon emission reporting and applying these format as an International Standard. Adopting these standards presents credibility and transparencies that offers support for environmental governance, carbon accountability and environmental sustainability.

5.5.2 RECOMMENDATIONS TO THE HIGHER EDUCATION SECTOR

The following recommendation are made for HEIs to consider when developing Scope 3 (Travel) carbon emissions abatement policies, reporting compliances to HEFCE, legal, stakeholder demands and environmental governance strategies that would offer HEIs to report effectively on their carbon footprint.

(a) Annual carbon footprint reporting should be made mandatory for all HEIs as part of its corporate sustainability reporting. Reporting should include current Scope 3 (Travel) carbon emissions shown separately with other Scope 3 and Scope 1 and 2 emissions categories. These should explain the metrics used together with other internationally accepted environmental indicators. A description attributable to the effects of climate change affecting the HE Sector and a statement concerning carbon emissions reductions concerning the near, medium and long term impacts and ways how to improving the Sector's carbon emissions performance relative to other sectors.

(b) EMS should be implemented that would ensure that the HE Sector has an environmental and carbon emissions governance mechanisms for Scope 3 (Travel) emissions management and accountability. Empirical measurements concerning the effectiveness of an EMS would offer more credibility concerning carbon data integrity and accountability. Adopting the recommendations of ISO 14001 and certification would show commitment to environmental management and indicative to Stakeholders that the HE Sector's is meeting the challenges of regulatory and competitive pressures in managing carbon emission.

(c) Presenting the mechanisms and procedures for the quantification tool for the quantification of Scope 3 (Travel) carbon emissions as a best practice model. Using this tool for benchmarking, carbon emissions abatement planning and reporting would be transparent, credible and defensible against misinterpretation by stakeholders and policy makers.

(d) Presenting the mechanisms for the development of the UniCarbon Index as a summative empirical measurement attributable to Scope 3 (Travel) carbon performance that would be a model for a key performance indicator for legal and stakeholder reporting matrix. HESA could establish a listing of HEIs who are tracking their carbon emissions performance and a comparison league table.

(e) Specific guidelines for reporting non-financial reporting concerning environmental sustainability, abatement policies and carbon foot print targets should be established by HESA are to be specifically applied to HEIs. These reporting standards should be complying with International Standards towards integrated reporting formats offering more transparencies and pertinent information concerning climate change and carbon emissions.

(f) HEFCE should incentivise HEIs to incur capital expenditure with soft loans that would lower the HEI’s carbon emissions in the future. HEIs should be encouraged to recruit professional environmental personnel and train existing personnel in environmental sustainability by claiming a bursary award.

5.6 CONTRIBUTION TO MANAGEMENT PRACTICE

The management research questions 3 and 4 (Chapter 1, p.32) are based on using NTU as a collaborative case study which focuses on identifying, managing, quantifying, and reporting carbon emissions for legal compliance purposes and management decision making processes. The research questions relate to determining NTU's environmental management practice efficiencies, carbon emissions data collections processes and reporting systems. These questions aims to determining empirically the effectiveness of NTU's environmental management identifying NTU's core environmental attributes, identifying their strength and weakness, communicating carbon performances and mechanisms for taking responsive action. The research questions would seek to evaluate the development of the UniCarbon index as a 'Key Performance Index' which would be determining NTU's Scope 3 (Travel) carbon emissions performance.

The focus of the case study was to understand NTU's involvement with some key environmental management practices that are targeted for adoption concerning Scope 3 (Travel) carbon emissions and to identifying how efficient this adoption has been across the campus activities

The following are the key contributions to management practices:

(a) Managing Scope 3 (Travel) carbon emissions requires NTU to integrate their campus environmental management practices into a coherent framework by adopting ISO 14001 management systems attributes and specific carbon emissions systems applicable to the HE Sector. This hybrid environmental management system would offer NTU with an effective environmental management system for Scope 3 (Travel) carbon accountability management practices. NTU established and implemented environmental quality assurances and rendered campus focussed Scope 3 (Travel) carbon emissions abatement management practices to achieve managed carbon performance. For better diffusion of environmental management practices, there are expectations that a well-structured environmental management system is able to efficiently collate and share information with a clear focus.

(b) Scope 3 (Travel) carbon emissions targets abatement planning can have been considered an important management function with different levels of involvement within NTU. Management structures within NTU estates management have been formalised with areas of environmental responsibility with the estate manager having the executive role. Environmental management practices are complex and inter-dependent by involving all personnel in decision making in implementing new strategic carbon reductions plans. This management practices, facilitated achievement of managed collaborations, partnering, carbon reduction and problem solving. This being possible and successful involving senior managers continuously repositioning the campus as a stakeholder with continuous change, external demand and resources evolve.

(c) Scope 3 (Travel) carbon emissions performance management is achieved by calculating the Scope 3 transport emissions index (UniCarbon index) by NTU for carbon reduction objectives and carbon mitigation tasks. Scope 3 (Travel) performance management offers NTU with empirical measurement from monitoring carbon reduction progress and developing performance targets that is responsive to internal and external pressures. This management process conducts specific carbon emissions appraisals that are interactive for management to present a strategic carbon reduction planning vested in carbon data quality and cost reduction of management services at all levels of NTU's Estates.

(d) NTU's adaptation of the Scope 3 (Travel) quantification tool management procedures enables carbon benchmarking and the setting of carbon emissions targets. Targets provide the impetus for the development of environmental management practices as well as efficiencies and improving environmental management benefits by effectively measuring, evaluating and reporting the impact of the different carbon reduction policies and regulations in the future. These management practices have considerable enhanced carbon reporting procedures that would be seeking to incorporate a focus on carbon governance, now recognised to provide the means for environmental sustainability

5.7 LIMITATIONS OF THIS COLLABORATIVE CASE STUDY RESEARCH

Chapter 1.12 (p.53) presented the most likely limitations to this case study research that may have had some impact on the outcomes on NTU and the HE Sector. These are limited to those frameworks, models and tools that have been considered to be most appropriate for NTU for undertaking this research. These included all various frameworks described in Chapter 3 with regard to Scope 3 (Travel) carbon emissions reporting that are available for use and recognised by the higher education sector.

The following limitations to this collaborative case study research are to be noted:

(a) Using NTU as a case study impedes the reliability and validity of research questionnaires and objectivity. This collaborative case study research is problem driven concerning the effectiveness of NTU's environmental management system, carbon quantification and reporting. NTU is a single case study that offers generalisability and information biases. Case study research localised and influenced by boundary factors particular to NTU, are based on context dependant environmental knowledge and prone to risk of over generalising of Scope 3 (Travel) environmental issues. The subjectivity of NTU's EMS, SWOT and mRating qualitative values are factors for consideration for research validation. There are validity limitations for case study research as there were few multiple sources of evidence to allow any triangulation of the research data of the different sources available at NTU.

(b) The scoring system applied to the SWOT and mRating values has limitations that has a profound effect on this case study research. Qualitative questionnaires were converted to quantitative empirical numbers allocated from 1 to 10 (with 10 being the best). The scoring was guided on the ARC's knowledge base, environmental policies, reporting standards and legal compliances. The limitation had arisen as there were no discussions or explanations for the allocation of empirical values and the basis of the weighting attached. This can be argued that such a scoring system requires a lesser degree of qualitative judgement. As such, both qualitative and quantitative data could be bias and inaccurate.

(c) The case study research developed a best practice Scope 3 (Travel) carbon emissions sustainability index using the recommendations of STARS when determining the Scope 3 (Travel) environmental attributes. The empirical

UniCarbon Index should be considered with reference to the STARS inherent methodological limitations of the sustainability characteristics of Scope 3 transport modes emissions. This research acknowledges the limitations that the UniCarbon Index has a real possibility to over/under empirically stating the specific transport sustainability attributes and perspectives.

(d) The target sample consisting of NTU Staff and Students for undertaking the Scope 3 internet travel data survey involved a small number of respondents within a limited one-week time period are not representative of the travel survey, travel mode and commute distances travelled. There are risks of data integrity and risks involved in generalising this travel data obtained. The travel survey semi structured questionnaires were open ended resulting that responses of travel data difficult for interpretation for the quantification of Scope 3 (Travel) carbon emissions. The practical limitations concerned the enticement of Staff and Students to participate and complete the online travel survey that would offer a large representative sample of the focus group.

(e) The choice of environmental data collection procedures is guided by the research design and questions. The NTU EMS attributes(SWOT) and efficiencies(mRating) questionnaire replies were qualitative interpretations by the ARC and quantitatively transposed by the researcher. These primary qualitative data collections could be highly subjective to different interpretations, thus not offering a clear and concise interpretations of the correct position. Transposition by the researcher could be associated concerning its reliability by any absolute measurement.

(f) The ARC composition consisted of a small number of members. Their environmental knowledge base, uncertainties of any applicability towards NTU and a lack of diversity amongst members of this committee could be a limitation. ARC meetings and time considerations associated with collection of qualitative data were limited. This reduces the level of Scope 3 (Travel) environmental management information and abstraction possible in relation to carbon emissions within NTU.

(g) Carbon footprint accountability consists of Scopes 1, 2 and Scope 3 consisting of Fifteen emissions categories (Diagram 1)(p.22). This research contribution is to two out of the fifteen categories (i.e. business travel and staff and students commuting). Additionally, specifically for HEIs, overseas student travel had been included as an indirect Scope 3 emissions specifically attributable to HEIs. This research had not discussed the carbon footprint policy considerations because (1) There is no research concerning the accountability of the remaining other thirteen constituent categories of Scope 3(direct and indirect) emissions at NTU or from published literature (2) there is no empirical quantum available for carbon footprints within NTU for analysis or discussions (3) only Scope 1 and 2 reporting is required by the CA2013

5.8 OPPORTUNITIES FOR FURTHER RESEARCH

This case study research widens the scope of Scope 3 (Travel) carbon emissions environmental accountability, management, quantification and reporting by focusing on the higher education sector. This research opens new research concerning environmental management practices by attempting to investigate Scope 3 (Travel) carbon emissions accountability, governance disclosures and carbon footprint reporting. There are further opportunities to test these constructs identified in this research and present as HEI models that could be adopted within the Higher Education Sector and replicated to other industry Sectors that could benefit.

The following are some examples which can be considered for further research that had been derived from this collaborative case study research:

(a) This research had investigated the nature of environmental management practices related to NTU's Scope 3 (Travel) carbon emissions accountability. However, there are still difficulties to understanding the environmental management practices involving efficient carbon emissions management procedures. This is an interdisciplinary field and the scope of management practices are extensive, covering from carbon emissions quantification diffused to carbon abatement management activities. Further research could be involved by designing a suitable EMS that can be efficiently accountable and adaptable to implementing the numerous environmental compliances according to the HEFCE and other stakeholders.

(b) In line with Scope 3 (Travel) carbon emissions performance assessment and measurement of KPIs are some of the most environmental management practices adopted. Different environmental practices have been taken into account. There are strong requirements for further research to assessing, if environmental practices affect the overall carbon footprint of HEIs with clearly defined KPI definitions and environmental management system to collate, analyse and distribute reliable carbon emissions data.

(c) This research investigated NTU's carbon reporting disclosure practices for compliance and legal reporting purposes. The HE Sector has not been able to implement carbon emissions reporting procedures at the moment since none of the available reporting tools and carbon abatement performance indicators have not been explicitly designed for the sector. Further research would be recommended by developing case studies to evaluate whether the reporting guidelines (e.g. global reporting initiative 4) 'amended' could be an effective Sector specific reporting framework specific for the HE Sector. Such focused studies could have a direct impact on Scope 3 (Travel) environmental policy setting, transnational standard setting for HEIs that could also impact on corporate governance. Further research can be described as 'exploring representational generalisation' that would be assisting to extend the robustness and applicability of 'best practice' carbon emissions reporting for the HE Sector.

(d) Scope 3 (Travel) online travel survey questionnaires in this research were generated to investigate NTU's Staff and Students commuting distances and the travel modes used. These questionnaires were limited in scope and had omitted a range of factors that could be further researched. Factors such as engine capacity, type of fuels used (diesel, lpg or hybrid) and distance travelled (using post codes). With this in mind, this research would encourage further research to investigate a better understanding of a HEI's Scope 3 (Travel) carbon emissions leading to a more accurate quantification concerning carbon emissions, carbon footprint and complying to HEFCE emissions targets.

(e) The research provides a platform for further research that can be developed in relation to HEIs climate change accountability with respect to the Climate Change Act 2008, and financial instruments concerning carbon certificates and carbon derivative trading. The HE Sector carbon financial instruments trading market is confronted with challenges, one such challenge has been the absence of a robust quantification tool Scope 3 (Travel) carbon emissions. Carbon derivative trading is a market mechanism and key financial instrument that has the potential to mitigate climate change. Further research can be explored to refining this research's Scope 3 (Travel) quantification tool to examining the factors driving carbon trading markets in the EU and what barriers are hampering the development of this trading market development.

5.9 CONCLUSION

This final chapter presented the summary of the reasons for this research, the research questions developed that the research sought to answer and the conclusions drawn from the data analysis and findings. This chapter also explained the limitations of this research, the contribution to management practice and recommendations for further research in field of Scope 3 (Travel) carbon emissions quantification tool development. Implementing and environmental management systems for carbon accountability were the core management systems research findings for implementing carbon footprint reporting for complying with legal and stakeholder compliances.

This thesis in now concluded.

APPENDIX 1

NOTTINGHAM TRENT UNIVERSITY TRAVEL SURVEY 2013

About your work / study

1. Are you staff or a student?

☐ Staff ☐ Student ☐ Both

2. Is your work / study

☐ Full time ☐ Part time

3. Where do you predominantly work / study?

☐ Brackenhurst campus ☐ Clifton campus ☐ City site ☐ Off-site e.g. distance learner

Your journey to NTU

4. Have you travelled to NTU to work / study in the last 7 days?

☐ Yes ☐ No (please go to question 10)

5. Please provide information on the journeys you made to and from NTU in the last 7 days
Select all modes that apply, including multi-mode journeys (e.g. park and ride)
If you did not travel on a particular day, please leave that column blank

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Car as driver	☐	☐	☐	☐	☐	☐	☐
Car as passenger	☐	☐	☐	☐	☐	☐	☐
Van as driver	☐	☐	☐	☐	☐	☐	☐
Van as passenger	☐	☐	☐	☐	☐	☐	☐
Bus or coach	☐	☐	☐	☐	☐	☐	☐
Rail	☐	☐	☐	☐	☐	☐	☐
Tram	☐	☐	☐	☐	☐	☐	☐
Motorcycle	☐	☐	☐	☐	☐	☐	☐
Moped	☐	☐	☐	☐	☐	☐	☐
Taxi	☐	☐	☐	☐	☐	☐	☐

Bicycle	☐	☐	☐	☐	☐	☐	☐
By foot	☐	☐	☐	☐	☐	☐	☐

6. **Please provide information on how far your round trip commute is in miles on a typical day for each mode of transport you use. Mileage is the miles travelled that day per mode (to and from NTU)**

Car as driver

Car as passenger

Van as driver

Van as passenger

Bus or coach

Rail

Tram

Motorcycle

Moped

Taxi

Bicycle

By foot

7. **If you travelled in a car or van as a driver or passenger, how many vehicle occupants were there in total?**

☐ 1 ☐ 2 ☐ 3 ☐ 4

Other, please specify

8. **Why do you travel to and from NTU the way you do? (Select up to three)**

☐ Convenience

☐ Time savings

☐ Cost

☐ To satisfy work needs/commitments

☐ Environmental reasons

☐ Health - disability reasons

☐ Health - fitness

Other, please specify

9. If you <u>drive or car share</u> to NTU where do you usually park?

- ☐ Not applicable, I am dropped off
- ☐ Public car park (with parking charges)
- ☐ On-site parking (no parking charges)
- ☐ On-street (no parking charges)
- ☐ On-site parking (with parking charges)
- ☐ On-street (with parking charges)
- ☐ Public car park (no parking charges)

Other, please specify

10. Do you use / have you used the <u>Unilink</u> bus to Clifton or <u>Service 100</u> to Brackenhurst in this academic year?

- ☐ Never
- ☐ Occasionally (e.g. once or twice a month)
- ☐ Infrequently (e.g. once or twice a term)
- ☐ Frequently (e.g. more than once a week)

11. Do you use / have you used the <u>Forest Recreation Ground</u> car park?

- ☐ Never
- ☐ Occasionally (e.g. once or twice a month)
- ☐ Infrequently (e.g. once or twice a term)
- ☐ Frequently (e.g. more than once a week)

12. What would encourage you to <u>walk or continue walking</u> to NTU? (Select up to three)

- ☐ Nothing would encourage me
- ☐ More lockers or storage facilities
- ☐ Free pedometers
- ☐ Improved showers and changing facilities
- ☐ Safer crossing facilities on route
- ☐ Personalised travel planning advice
- ☐ Improved lighting / security on route
- ☐ Walking buddies

Other, please specify

13. What would encourage you to <u>cycle or continue cycling</u> to NTU? (Select up to three)

- ☐ Nothing would encourage me
- ☐ Improved showers and changing facilities
- ☐ Better cycle parking
- ☐ Personalised travel planning advice
- ☐ Improved cycling routes / paths
- ☐ Free cycle training
- ☐ Option of trialling a bike
- ☐ Cycle hire
- ☐ Discounts at local bike stores

Other, please specify

14. What would encourage you to take <u>public transport or continue using public transport</u> to NTU?
(Select up to three)

- ☐ Nothing would encourage me
- ☐ More frequent / reliable services
- ☐ Improved ticket and timetabling information
- ☐ Less crowded services
- ☐ More secure / better quality waiting facilities
- ☐ Interest free loan or season ticket
- ☐ Improved security on public transport

Other, please specify

15. What would encourage you to <u>car share or continue to car share</u> to NTU?
(Select up to three)

- ☐ Nothing would encourage me
- ☐ Incentives for car sharers e.g. priority parking
- ☐ Finding car share partners with similar work / travel patterns
- ☐ Free online car sharing services
- ☐ Free transport if let down by car share partner

Other, please specify

About You

16. Are you...

☐ Male ☐ Female

17. What is your age?

☐ 21 or under ☐ 22-30 ☐ 31-40 ☐ 41-50 ☐ 51-60 ☐ 61 +

18. Please enter the <u>start postcode</u> of your commute to NTU

19. If you wish to make any additional comments about travel and transport management at NTU, please do so here:

20. Please enter your contact details if you would like to be entered into the prize draw for £100 Amazon vouchers

Thank you very much for completing our survey.

The information you provide will be stored and used in conjunction with the Data Protection Act 1998. It will be treated as entirely confidential and will be used to inform our work.

APPENDIX 2 (A): ASSUMPTIONS USED IN THE STARS METHODOLOGY

[Excerpts from the STARS Technical Manual 2.0, p.9]

(**http://www.aashe.org/files/documents/STARS/2.0/stars_2.0_technical_manual.pdf)**

<u>STARS – Sustainability, Tracking, Assessment and Rating System</u>

This is a voluntary self-reporting framework assisting HEIs to track and measure their sustainability progress. The procedures are as follows:

- Providing a framework for HEIs to account for their sustainability and carbon emissions
- Providing a standardised framework for measurements for benchmarking and comparison with other HEIs
- Motivating HEIs for continuous improvement towards sustainability and carbon emissions
- Enable information sharing about HEIs' sustainability practices and performances
- Building a campus sustainability community

APPENDIX 2 (B): ASSUMPTIONS OF THE STARS CREDITS

METHODOLGY USED [excerpts from the STARS Technical Manual 2.0]

http://www.aashe.org/files/documents/STARS/2.0/stars_2.0_technical_manual.pdf

<u>How Credits Are Developed and Weighted (pp.9-10)</u>

stars technical manual
version 2.0 | august 2013

"STARS credits are developed from Campus Sustainability Assessments and Sustainability Reports and other Ranking Systems.
Credits depend on the points that have been allocated by a Panel of STARS Steering Committee members and AASHE staff using the following considerations:

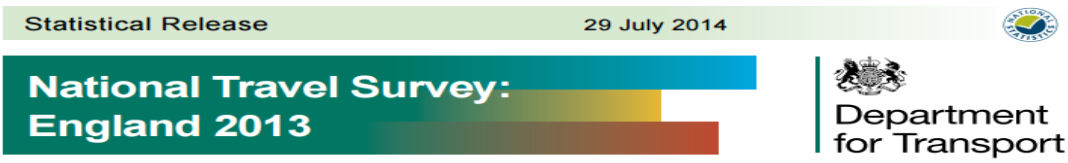
1. To what extent does achievement of the credit ensure that people (students, employees and/or local community members) acquire the knowledge, skills, and dispositions to meet sustainability challenges?
2. To what extent does achievement of the credit contribute to positive environmental, economic and social impacts?
   a. To what extent does achievement of the credit contribute to human and ecological, health and mitigate negative environmental impacts?
   b. To what extent does achievement of the credit contribute to securing a livelihood for a sustainable economy and other positive financial impacts?
   c. To what extent does achievement of the credit contribute to social justice, equity, diversity, cooperation, and other positive social impacts?

3. To what extent are the positive impacts associated with achievement of the credit not captured in other STARS credits?”

The researcher considered the above questions presented by STARS for allocation points or earning the credits taking into consideration that some sustainability initiatives may be very difficult to implement but yield negative impacts. STARS are flexible and credits include an applications criteria and specific to NTU and offer the full spectrum of sustainability achievements. For NTU the researcher used STARS that give a positive recognition.

APPENDIX 2 (C) : ASSUMPTIONS OF PERCENTAGE USED
(i.e., Scope 3 Travel Performance Index)

The researcher based the percentage assumptions concerning OP18(p.206), OP19(p.206), OP20(p.208), OP21(A)(p.209) and OP21(B)(210)[Computed Under STAR Credit Scoring] The researcher had computed the percentages from best estimates from the information received from the ARC, literature review (Green Gown Awards), NTU’s marketing and sustainability information. The researcher had consulted the National Travel Survey England (published 29 July 2014) and analysed and synthesised the travel behaviour and travel modes in England. *[https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/342160/nts2013-01.pdf]* for guidance to developing the Research’s percentage assumptions used in this research.



The researcher knows of no known alternative measurements that the researcher could rely on as being valid. The researcher reflected and reviewed these assumptions for determining the percentages and is of the opinion as good estimates for the purposes of this research study. The researcher had relied on substantive data published by the department for transport as reliable and valid data for the purposes of this research.

This Appendix 2 (C) should be read together with Appendix 10 (p.413) for referencing the STARS recommendations for the calculations of percentages and credit system used as a methodology for this research.

Overseas student population is estimated at 12% (provided by NTU Administration) of the total student population come for overseas. It is estimated that during convocation 3% of the total student families come from overseas.

APPENDIX 3

(A) SWOT and mRating Value (Strength) Summary Data Analysis

Question	SWOT Questionnaire	EMS Evaluation Methodology	SWOT Values					mRatings Value				
Action Reseaarch Committee Member Reference			A	B	C	D	Av	A	B	C	D	Av
Questions Key Nomenclature Reference are:	What are the strengths of NTU when											
SWOT STRENGTH = QS	(QS1) Adopting best environmental management practices?	(QSm1) Examination of the internal strengths of NTU in implementing (or maintaining from a pre-existing) environmental management system	4	3	2	4	2.5	7	6	7	8	7.00
mRATING STRENGTH = QSm	(QS2) Scope 3 (Travel) emissions data management efficiencies?	(QSm2) By evaluating NTU's management practices such as the accounting for environmental impacts.	2	3	3	3	2.8	7	5	6	5	5.75
	(QS3) How does NTU operate its data recording procedures?	(QSm3) EMS meeting targets of NTU's carbon policy and meeting HEFCE's compliances.	4	4	3	5	4.00	8	7	7	7	7.25
	(QS4) How is NTU perceived externally?	(QSm4) Ensuring the EMS meet the shared value base in order to operate effectively to reduce Scope 3 (T) carbon	6	7	8	7	7.00	8	7	8	7	7.50
	(QS5) How effectively has NTU managed its environmental strategic objectives?	(Qsm5) EMS meeting the long term objectives	5	4	5	4	4.50	8	7	7	8	7.50
	(QS6) How effective has NTU managed its Scope 3 (Travel) strategic aim?	(QSm6) NTU EMS using the best resources available of scope 3 (T) reduction efficiencies.	4	4	3	4	3.75	6	7	6	6	6.25
	(QS7) NTU's organisational mission for Scope 3(Travel) reduction strategies	(QSm7) EMS Operational objectives in place for reducing Scope 3 (T) carbon emissions	5	6	6	5	5.50	8	7	8	7	7.50
	(QS8) How is Scope 3 (Travel) carbon emissions reductions managed	(Qsm8) EMS core systems for NTU manage Scope 3 (T) carbon emissions.	6	5	6	6	5.75	7	6	6	6	6.25
	(QS9) How does the overall vision of Scope 3 (Travel) carbon mitigation?	(QSm9) NTU's EMS overall purpose for managing carbon emissions.	7	6	5	7	6.25	8	7	7	7	7.25
	(QS10) How does NTU's objectives relate to the overall purpose and mission for the next 3-5	(QSm10) EMS meeting the demands from stakeholders from carbon accountability	7	4	7	7	6.25	7	6	7	6	6.50
	Average Value						4.90					6.88

Actual Data (Qualitative to Quantitative transposed by the Researcher) using a rubric 1 to 10 with 10 being the best

(B) SWOT – Strengths Factor Analysis (Summary Statistics) [from p.334]

XLSTAT 2014.5.01 - Factor analysis - on 11/11/2014 at 17:09:48
Observations/variables table: Workbook = SWOT(04Nov)(1)A.xlsx / Sheet = Strength WB / Range = 'Strength WB'!$B$1:$E$11 / 10 rows and 4 columns
Observation labels: Workbook = SWOT(04Nov)(1)A.xlsx / Sheet = Strength WB / Range = 'Strength WB'!$A:$A / 10 rows and 1 column
Correlation: Pearson (n)
Extraction method: Principal factor analysis
Number of factors: Automatic
Initial communalities: Squared multiple correlations
Stop conditions: Convergence = 0.0001 / Iterations = 50
Rotation: Varimax (Kaiser normalization) / Number of factors = 2

Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
A	10	0	10	2.000	7.000	5.000	1.563
B	10	0	10	3.000	7.000	4.600	1.350
C	10	0	10	2.000	8.000	4.800	1.989
D	10	0	10	3.000	7.000	5.200	1.476

Kaiser-Meyer-Olkin measure of sampling adequacy:

A	0.713
B	0.803
C	0.856
D	0.719
KMO	0.764

Cronbach's alpha: 0.925

Factor analysis:

Maximum change in communality at each iteration:

Iteration	Maximum change
1	0.0273
2	0.0128
3	0.0069
4	0.0037
5	0.0020
6	0.0011
7	0.0006
8	0.0003
9	0.0002
10	0.0001

Reproduced correlation matrix:

	A	B	C	D
A	0.796	0.690	0.771	0.848
B	0.690	0.599	0.669	0.736
C	0.771	0.669	0.747	0.822
D	0.848	0.736	0.822	0.904

Residual correlation matrix:

	A	B	C	D
A	0.204	-0.059	-0.021	0.067
B	-0.059	0.401	0.085	-0.022
C	-0.021	0.085	0.253	-0.049
D	0.067	-0.022	-0.049	0.096

Eigenvalues:

	F1	F2
Eigenvalue	3.046	0.151
Variability (%)	76.142	3.787
Cumulative %	76.142	79.929

(C) mRating Value – Strengths Factor Analysis (Summary Statistics)

XLSTAT 2014.5.01 - Factor analysis - on 23/11/2014 at 18:34:37
Observations/variables table: Workbook = SWOT(12Nov)(1)C.xlsm / Sheet = Strentgh mV / Range = 'Strentgh mV'!$B:$E / 10 rows and 4 columns
Observation labels: Workbook = SWOT(12Nov)(1)C.xlsm / Sheet = Strentgh mV / Range = 'Strentgh mV'!$A:$A / 10 rows and 1 column
Correlation: Pearson (n)
Extraction method: Principal factor analysis
Number of factors: Automatic
Initial communalities: Squared multiple correlations
Stop conditions: Convergence = 0.0001 / Iterations = 50
Rotation: Varimax (Kaiser normalization) / Number of factors = 2
Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
A	10	0	10	6.000	8.000	7.400	0.699
B	10	0	10	5.000	7.000	6.500	0.707
C	10	0	10	6.000	8.000	6.900	0.738
D	10	0	10	5.000	8.000	6.700	0.949

Kaiser-Meyer-Olkin measure of sampling adequacy:

A	0.732
B	0.811
C	0.724
D	0.814
KMO	0.763

Cronbach's alpha: 0.841

Factor analysis:

Maximum change in communality at each iteration:

Iteration	Maximum change
3	0.0126
4	0.0065
5	0.0036
6	0.0020
7	0.0012
8	0.0007
9	0.0004
10	0.0002
11	0.0001
12	0.0001

Reproduced correlation matrix:

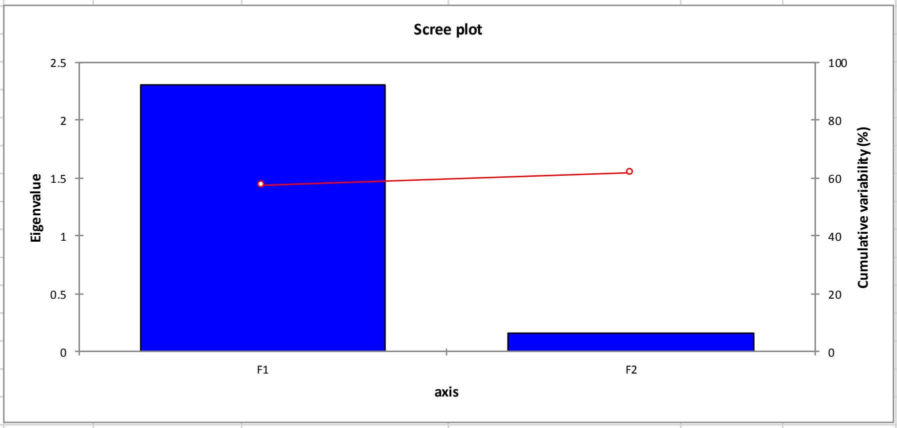
	A	B	C	D
A	0.594	0.506	0.662	0.568
B	0.506	0.431	0.564	0.484
C	0.662	0.564	0.738	0.633
D	0.568	0.484	0.633	0.542

Residual correlation matrix:

	A	B	C	D
A	0.406	-0.057	0.070	-0.032
B	-0.057	0.569	-0.032	0.096
C	0.070	-0.032	0.262	-0.045
D	-0.032	0.096	-0.045	0.458

Eigenvalues:

	F1	F2
Eigenvalu	2.305	0.167
Variability	57.631	4.172
Cumulativ	57.631	61.803



Eigenvectors:

	F1	F2
A	0.508	0.473
B	0.432	-0.548
C	0.566	0.446
D	0.485	-0.526

Factor pattern:

	F1	Initial communality	Final communality	ecific variance
A	**0.771**	0.554	0.594	0.406
B	**0.657**	0.393	0.431	0.569
C	**0.859**	0.609	0.738	0.262
D	**0.736**	0.460	0.542	0.458

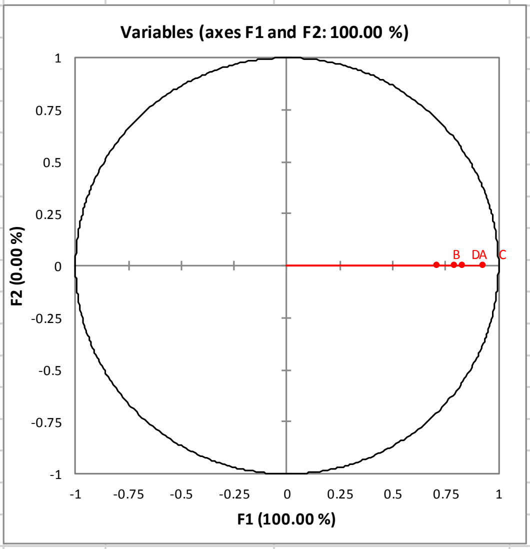
Values in bold correspond for each variable to the factor for which the squared cosine is the largest

Cronbach's alpha:

	Cronbach's alpha
F1	0.841

Correlations between variables and factors:

	F1
A	0.831
B	0.708
C	0.926
D	0.794



Factor pattern coefficients:

	F1
A	0.227
B	0.166
C	0.458
D	0.250

Factor scores:

Observatio	F1
1	**0.165**
2	**-1.568**
3	**0.478**
4	**1.132**
5	**0.755**
6	**-1.138**
7	**1.132**
8	**-1.043**
9	**0.478**
10	**-0.390**

Values in bold correspond for each observation to the factor for which the squared cosine is the largest

APPENDIX 4

(A) SWOT and mRating Value (Weakness) Summary Data Analysis

Question	SWOT Questionnaire	EMS Evaluation Methodology	SWOT Values					mRatings Value				
Action Reseaarch Committee Member Reference			A	B	C	D	Av	A	B	C	D	Av
Questions Key Nomenclature Reference are:	What are the weakness of NTU when											
SWOT WEAKNESS = QW	**(QW1)** adopting environmental practices	**(QWm1)** Examination of NTU's weaknesses and the HE Sector in general when adopting environmental management practices.	3	3	4	4	3.50	4	4	3	4	3.75
mRATING WEAKNESS = QWm	**(QW2)** HEFCE compliances	**(QWm2)** Examining if an effective EMS is dependent on IT Infrastructure	3	2	3	2	2.50	3	3	3	4	3.25
	(QW3) Difficulty in understanding and recording carbon emissions	**(QWm3)** Ensuring that the staffing levels is able to manage the EMS.	4	5	5	5	4.75	4	5	6	5	5.00
	(QW4) Evaluating if NTU has limited access to capital funding.	**(QWm4)** Evaluating NTU's strategic mission can be active for Scope 3 (Travel) reductions.	8	8	7	7	7.50	5	4	3	4	4.00
	(QW5) stringent bureaucratic requirements	**(QWm5)** Evaluating NTU's day to day EMS operations are efficient.	6	5	6	5	5.50	4	5	6	6	5.25
	(QW6) Lack of appropriate management.	**(QWm6)** Ensuring that the EMS operational objectives are achievable.	7	5	7	8	6.75	6	5	6	6	5.75
	(QW7) How does the collective mission of NTU's vision of meeting its Carbon Reduction Targets?	**(QWm7)** NTU EMS are complex and difficult to prepare detailed instructions that will feed into work plans.	7	6	7	7	6.75	6	5	6	6	5.75
	(QW8) How does the long term changes that NTU is able to implement?	**(QWm8)** Long term EMS challenges that can effect efficiencies.	3	2	3	3	2.75	7	6	7	5	6.25
	(QW9) How does NTU maintain appropriate carbon emissions record keeping?	**(QWm9)** Keeping appropriate records for carbon audit is cumbersome and difficult to implement.	4	4	3	5	4.00	5	4	6	6	5.25
	(QW10) How does NTU ensure performance measures are adequate?	**(QWm10)** EMS performance measures are difficult to measure	2	2	3	3	2.50	3	3	2	4	3.00
	Average Value						4.65					4.73

Actual Data (Qualitative to Quantitative transposed by the Researcher) using a rubric 1 to 10 with 10 being the best

(B) SWOT (Weakness) Summary Data Analysis

XLSTAT 2014.5.01 - Factor analysis - on 12/11/2014 at 16:06:46
Observations/variables table: Workbook = SWOT(11Nov)(1)B.xlsm / Sheet = Weakness WB / Range = 'Weakness WB'!$B:$E / 10 rows and 4 columns
Observation labels: Workbook = SWOT(11Nov)(1)B.xlsm / Sheet = Weakness WB / Range = 'Weakness WB'!$A:$A / 10 rows and 1 column
Correlation: Pearson (n)
Extraction method: Principal factor analysis
Number of factors: Automatic
Initial communalities: Squared multiple correlations
Stop conditions: Convergence = 0.0001 / Iterations = 50
Rotation: Varimax (Kaiser normalization) / Number of factors = 2

Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	bs. without missing dat	Minimum	Maximum	Mean	d. deviation
A	10	0	10	2.000	8.000	4.700	2.111
B	10	0	10	2.000	8.000	4.200	1.989
C	10	0	10	3.000	7.000	4.800	1.814
D	10	0	10	2.000	8.000	4.900	1.969

Kaiser-Meyer-Olkin measure of sampling adequacy:

A	0.797
B	0.894
C	0.849
D	0.925
KMO	0.862

Cronbach's alpha: 0.972

Factor analysis:

Maximum change in communality at each iteration:

Iteration	Maximum change
1	0.0237
2	0.0082
3	0.0032
4	0.0014
5	0.0007
6	0.0003
7	0.0002
8	0.0001
9	0.0000

Reproduced correlation matrix:

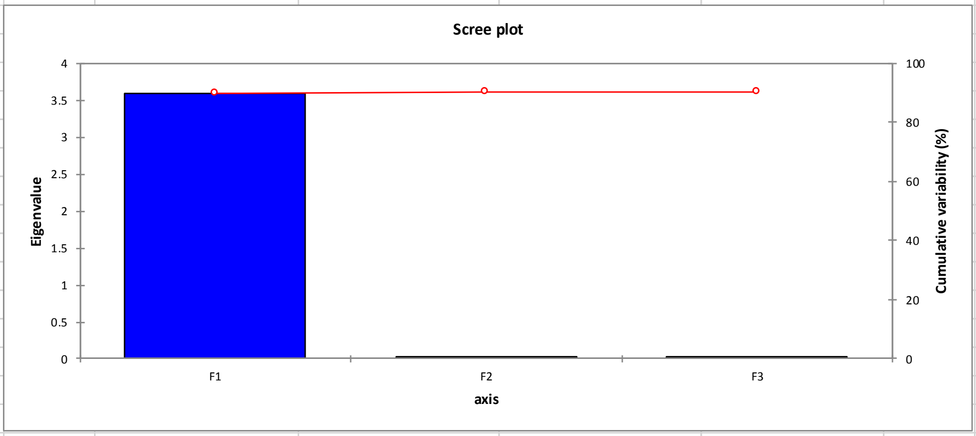
	A	B	C	D
A	0.964	0.907	0.940	0.910
B	0.907	0.853	0.884	0.856
C	0.940	0.884	0.916	0.887
D	0.910	0.856	0.887	0.859

Residual correlation matrix:

	A	B	C	D
A	0.036	0.009	0.001	-0.009
B	0.009	0.147	-0.009	0.001
C	0.001	-0.009	0.084	0.009
D	-0.009	0.001	0.009	0.141

Eigenvalues:

	F1	F2	F3
Eigenvalu	3.593	0.018	0.001
Variability	89.821	0.438	0.027
Cumulativ	89.821	90.259	90.287



Eigenvectors:

	F1	F2	F3
A	0.518	-0.492	0.495
B	0.487	-0.503	-0.508
C	0.505	0.508	0.481
D	0.489	0.498	-0.515

Factor pattern:

	F1	Initial communality	Final communality	Specific variance
A	**0.982**	0.926	0.964	0.036
B	**0.924**	0.844	0.853	0.147
C	**0.957**	0.897	0.916	0.084
D	**0.927**	0.836	0.859	0.141

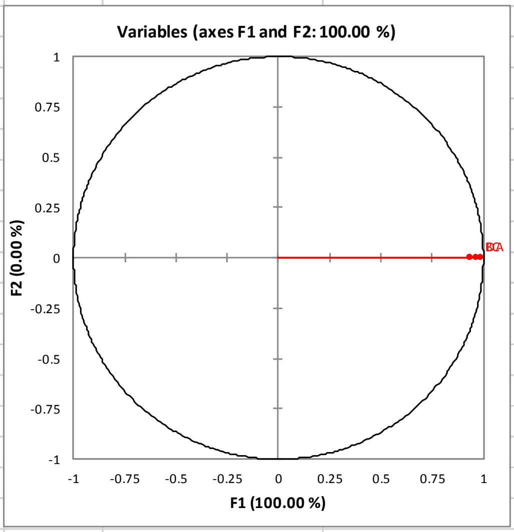
Values in bold correspond for each variable to the factor for which the squared cosine is the largest

Cronbach's alpha:

	Cronbach's alpha
F1	0.972

Correlations between variables and factors:

	F1
A	0.992
B	0.933
C	0.967
D	0.936



Factor pattern coefficients:

	F1
A	0.546
B	0.105
C	0.217
D	0.151

Factor scores:

Observatio	F1
1	**-0.704**
2	**-1.047**
3	**-0.113**
4	**1.558**
5	**0.558**
6	**1.199**
7	**1.174**
8	**-0.966**
9	**-0.421**
10	**-1.239**

Values in bold correspond for each observation to the factor for which the squared cosine is the largest

(C) mRating Value – Weakness Factor Analysis (Summary Statistics)

XLSTAT 2014.5.01 - Factor analysis - on 12/11/2014 at 17:11:51
Observations/variables table: Workbook = SWOT(11Nov)(1)B.xlsm / Sheet = Weakness WB(mV) / Range = 'Weakness WB(mV)'!$B:$E / 10 rows and 4 columns
Observation labels: Workbook = SWOT(11Nov)(1)B.xlsm / Sheet = Weakness WB(mV) / Range = 'Weakness WB(mV)'!$A:$A / 10 rows and 1 column
Correlation: Pearson (n)
Extraction method: Principal factor analysis
Number of factors: Automatic
Initial communalities: Squared multiple correlations
Stop conditions: Convergence = 0.0001 / Iterations = 50
Rotation: Varimax (Kaiser normalization) / Number of factors = 2

Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
A	10	0	10	3.000	7.000	4.700	1.337
B	10	0	10	3.000	6.000	4.400	0.966
C	10	0	10	2.000	7.000	4.800	1.814
D	10	0	10	4.000	6.000	5.000	0.943

Kaiser-Meyer-Olkin measure of sampling adequacy:

A	0.847
B	0.624
C	0.613
D	0.602
KMO	0.653

Cronbach's alpha: 0.914

Factor analysis:

Maximum change in communality at each iteration:

Iteration	Maximum change
2	0.0513
3	0.0188
4	0.0100
5	0.0061
6	0.0037
7	0.0023
8	0.0014
9	0.0004
10	0.0002
11	0.0001

Reproduced correlation matrix:

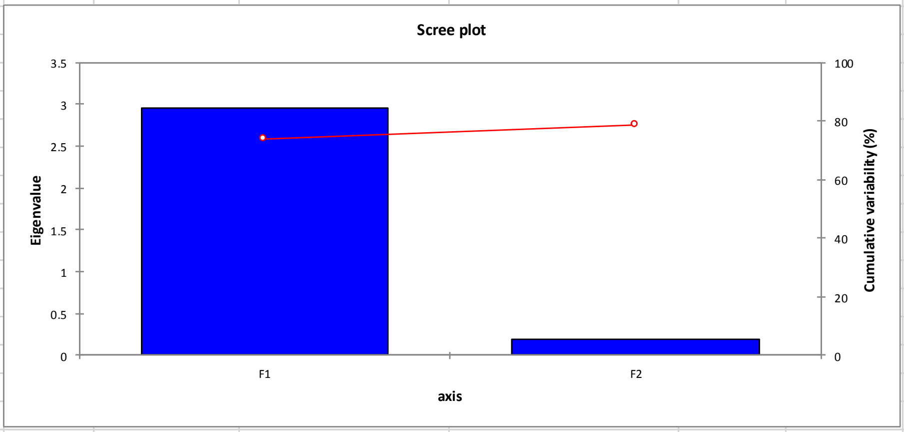
	A	B	C	D
A	0.583	0.689	0.764	0.573
B	0.689	0.814	0.902	0.677
C	0.764	0.902	1.000	0.750
D	0.573	0.677	0.750	0.563

Residual correlation matrix:

	A	B	C	D
A	0.417	0.102	-0.058	-0.044
B	0.102	0.186	-0.027	-0.067
C	-0.058	-0.027	0.000	0.095
D	-0.044	-0.067	0.095	0.437

Eigenvalues:

	F1	F2
Eigenvalu	2.961	0.197
Variability	74.033	4.926
Cumulativ	74.033	78.959



Eigenvectors:

	F1	F2
A	0.444	-0.515
B	0.524	-0.506
C	0.581	0.466
D	0.436	0.511

Factor pattern:

	F1	Initial communality	Final communality	ecific variance
A	**0.764**	0.630	0.583	0.417
B	**0.902**	0.867	0.814	0.186
C	**1.000**	0.920	**1.000**	**0.000**
D	**0.750**	0.787	0.563	0.437

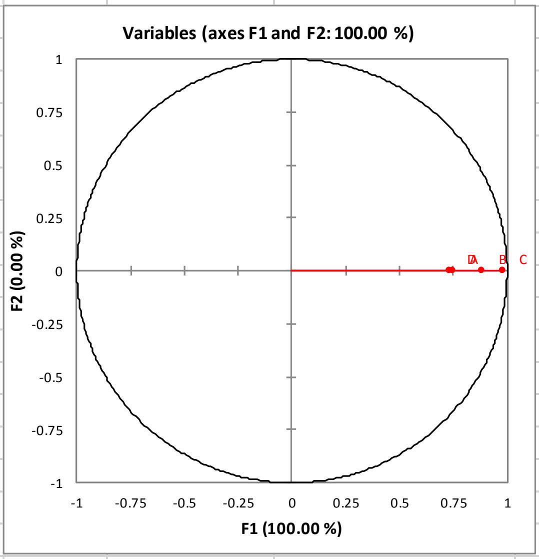
Values in bold correspond for each variable to the factor for which the squared cosine is the largest

Cronbach's alpha:

	Cronbach's alpha
F1	0.914

Correlations between variables and factors:

	F1
A	0.749
B	0.885
C	0.981
D	0.736



Factor pattern coefficients:

	F1
A	0.132
B	-0.197
C	1.407
D	-0.388

Factor scores:

Observatio	F1
1	**-1.025**
2	**-0.915**
3	**0.780**
4	**-0.921**
5	**0.346**
6	**0.554**
7	**0.554**
8	**1.695**
9	**0.664**
10	**-1.732**

Values in bold correspond for each observation to the factor for which the squared cosine is the largest

APPENDIX 5

(A) SWOT and mRating Value (Opportunities) Summary Data Analysis

Question	SWOT Questionnaire	EMS Evaluation Methodology	SWOT Values					mRatings Value				
Action Reseaarch Committee Member Reference			A	B	C	D	Av	A	B	C	D	Av
Questions Key Nomenclature Reference are:	What are the opportunities of NTU when											
SWOT OPPORTUNITIES = QO	**(QO1)** adopting new environmental management practices?	**(QOm1)** Examines the opportunities NTU may face externally when adopting such environmental practices.	6	7	7	6	6.50	6	6	5	5	5.50
mRATING OPPORTUNITIES = QOm	**(QO2)** Scope 3 (T) pollution control measures	**(QOm2)** Evaluating information, systems, processes and challenges such as 'green campus' and new financial challenges.	7	8	7	7	7.3	7	7	6	7	6.75
	(QO3) carbon emission pollution auditing expertise to other HEI	**(QOm3)** Investigating the potential benefits of an efficient EMS for carbon accountability	5	6	5	5	5.3	7	7	8	7	7.25
	(QO4) Scope 3 (Travel) consultation opportunities to other HEIs.	**(QOm4)** Investigating the potential of EMS improvement for Scope 3 (T) carbon reductions.	6	6	5	4	5.3	7	6	7	6	6+50
	(QO5) Influencing HEFCE carbon policies on Travel management.	**(QOm5)** Increased implementation of carbon reduction with less complexities and supportive policies	8	7	8	8	7.8	7	6	7	5	6.50
	(QO6) Developing best practices of Scope 3 (Travel) carbon accountability for HEIs	**(QOm6)** Implementing EMS systems that are applicable to Scope 3 (Travel) carbon management.	8	8	7	7	7.50	7	8	7	7	6.75
	(QO7) Availability of more funding support for developing specific EMS for HEIs	**(QOm7)** EMS delivering pollution control management that can be transposed to waste, energy, economy and sustainability	5	5	4	6	5.00	8	7	8	7	7.50
	(QO8) Establishing carbon accountability for calculating carbon credits	**(QOm8)** EMS systems that offer Scope 3 (Travel) carbon monitoring and carbon audits for management purposes.	8	8	7	7	7.50	7	7	6	6	6+50
	(QO9) Developing EMS standards for HEIs	**(QOm9)** EMS that can provide evidence for eco labelling of campus	8	7	7	6	7.00	7	7	6	6	6.50
	(QO10) Generating innovative EMS	**(QOm10)** EMS for integrating sustainability and environmental management systems.	8	7	7	7	7.3	8	7	7	7	7.25
	Average Vale						6.6					6.70

Actual Data (Qualitative to Quantitative transposed by the Researcher) using a rubric 1 to 10 with 10 being the best

(B) SWOT (Opportunities) Summary Data Analysis

XLSTAT 2014.5.01 - Factor analysis - on 14/01/2015 at 13:22:21
Observations/variables table: Workbook = SWOT(12Nov)(1)C.xlsm / Sheet = Opp WB(A) / Range = 'Opp WB(A) '!$A:$E / 10 rows and 5 columns
Observation labels: Workbook = SWOT(12Nov)(1)C.xlsm / Sheet = Opp WB(A) / Range = 'Opp WB(A) '!$A:$A / 10 rows and 1 column
Correlation: Pearson (n)
Extraction method: Principal factor analysis
Number of factors: Automatic
Initial communalities: Squared multiple correlations
Stop conditions: Convergence = 0.0001 / Iterations = 50
Rotation: Varimax (Kaiser normalization) / Number of factors = 2
Summary statistics

Summary statistics:

Variable	bservatior	/ith missin	thout miss	Minimum	Maximum	Mean	d. deviation
Questions	10	0	10	1.000	10.000	5.500	3.028
A	10	0	10	5.000	8.000	6.900	1.287
B	10	0	10	5.000	8.000	6.900	0.994
C	10	0	10	4.000	8.000	6.400	1.265
D	10	0	10	4.000	8.000	6.300	1.160

Correlation matrix (Pearson (n)):

Variables	Questions	A	B	C	D
Questions	**1**	0.528	0.018	0.087	0.269
A	0.528	**1**	0.773	0.847	0.693
B	0.018	0.773	**1**	0.830	0.607
C	0.087	0.847	0.830	**1**	0.742
D	0.269	0.693	0.607	0.742	**1**

Kaiser-Meyer-Olkin measure of sampling adequacy:

Questions	0.163
A	0.520
B	0.671
C	0.574
D	0.785
KMO	0.539

Cronbach's alpha: 0.854

Factor analysis:

Maximum change in communality at each iteration:

Iteration	imum change
17	0.0061
18	0.0060
19	0.0059
20	0.0058
21	0.0057
22	0.0013
23	0.0006
24	0.0003
25	0.0002
26	0.0001

Reproduced correlation matrix:

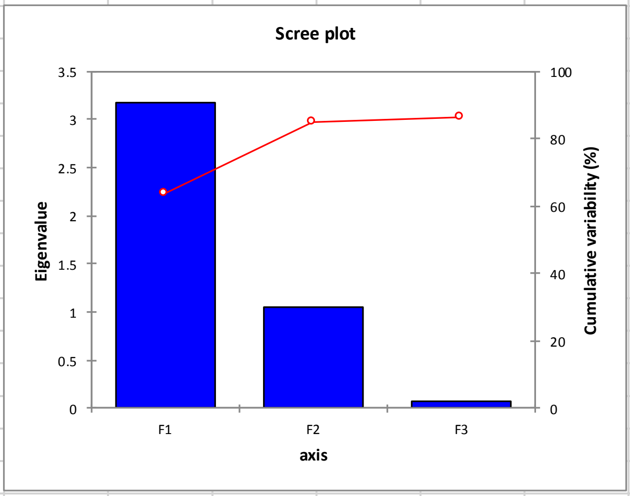
	Questions	A	B	C	D
Questions	1.000	0.519	0.030	0.090	0.257
A	0.519	0.963	0.740	0.856	0.720
B	0.030	0.740	0.758	0.849	0.620
C	0.090	0.856	0.849	0.954	0.708
D	0.257	0.720	0.620	0.708	0.562

Residual correlation matrix:

	Questions	A	B	C	D
Questions	0.000	0.008	-0.012	-0.003	0.012
A	0.008	0.037	0.033	-0.010	-0.027
B	-0.012	0.033	0.242	-0.019	-0.013
C	-0.003	-0.010	-0.019	0.046	0.035
D	0.012	-0.027	-0.013	0.035	0.438

Eigenvalues:

	F1	F2	F3
Eigenvalu	3.180	1.062	0.069
Variability	63.609	21.231	1.377
Cumulativ	63.609	84.841	86.218



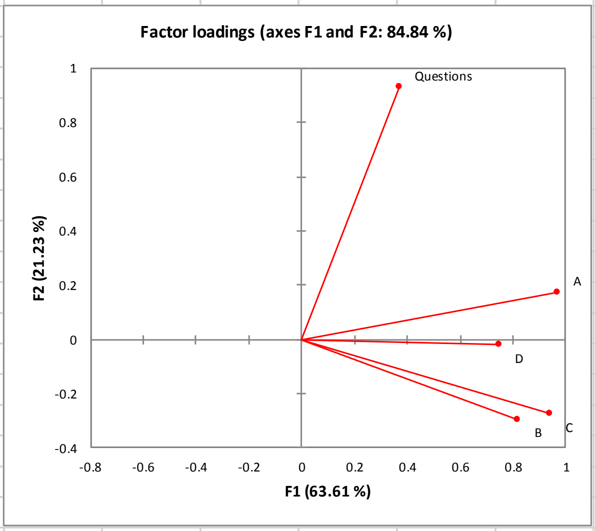
Eigenvectors:

	F1	F2	F3
Questions	0.208	0.905	-0.093
A	0.541	0.170	0.499
B	0.460	-0.285	0.483
C	0.525	-0.267	-0.469
D	0.420	-0.020	-0.538

Factor pattern:

	F1	F2	al communl	l commun	cific variance
Questions	0.369	**0.929**	0.846	**1.000**	**0.000**
A	**0.966**	0.175	0.956	0.963	0.037
B	**0.820**	-0.293	0.814	0.758	0.242
C	**0.937**	-0.276	0.921	0.954	0.046
D	**0.749**	-0.021	0.612	0.562	0.438

Values in bold correspond for each variable to the factor for which the squared cosine is the largest

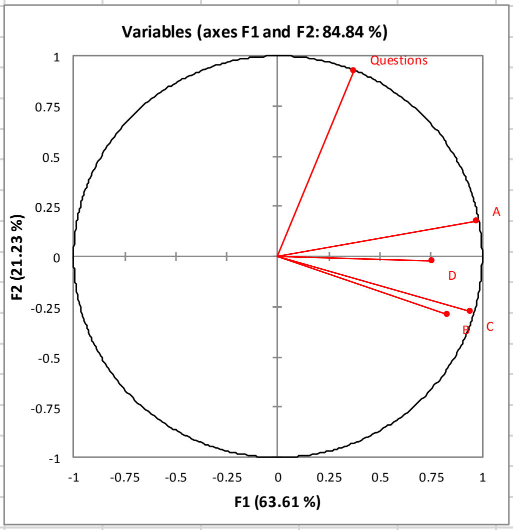


Cronbach's alpha:

	Cronbach's alpha
F1	0.923
F2	

Correlations between variables and factors:

	F1	F2
Questions	0.372	0.926
A	0.973	0.175
B	0.826	-0.292
C	0.945	-0.275
D	0.755	-0.021



Factor pattern coefficients:

	F1	F2
Questions	0.055	1.236
A	0.507	-0.554
B	0.030	0.130
C	0.462	0.032
D	0.022	-0.072

Factor scores:

Observatio	F1	F2
1	-0.232	**-1.478**
2	0.254	**-1.430**
3	**-1.431**	-0.289
4	**-1.016**	-0.247
5	**1.100**	-0.770
6	**0.747**	-0.163
7	**-1.751**	1.203
8	**0.785**	0.698
9	0.752	**1.056**
10	0.791	**1.421**

Values in bold correspond for each observation to the factor for which the squared cosine is the largest

(C) mRating Value – Opportunities Factor Analysis (Summary Statistics)

XLSTAT 2014.5.01 - Factor analysis - on 12/11/2014 at 18:43:11
Observations/variables table: Workbook = SWOT(11Nov)(1)B.xlsm / Sheet = Opp WB (mV) / Range = 'Opp WB (mV)'!$B:$E / 10 rows and 4 columns
Observation labels: Workbook = SWOT(11Nov)(1)B.xlsm / Sheet = Opp WB (mV) / Range = 'Opp WB (mV)'!$A:$A / 10 rows and 1 column
Correlation: Pearson (n)
Extraction method: Principal factor analysis
Number of factors: Automatic
Initial communalities: Squared multiple correlations
Stop conditions: Convergence = 0.0001 / Iterations = 50
Rotation: Varimax (Kaiser normalization) / Number of factors = 2
Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
A	10	0	10	6.000	8.000	7.100	0.568
B	10	0	10	6.000	7.000	6.600	0.516
C	10	0	10	5.000	8.000	6.700	0.949
D	10	0	10	5.000	7.000	6.400	0.699

Kaiser-Meyer-Olkin measure of sampling adequacy:

A	0.737
B	0.545
C	0.614
D	0.745
KMO	0.674

Cronbach's alpha: 0.832

Factor analysis:

Maximum change in communality at each iteration:

Iteration	laximum change
3	0.0187
4	0.0092
5	0.0046
6	0.0023
7	0.0012
8	0.0006
9	0.0003
10	0.0002
11	0.0001
12	0.0001

Reproduced correlation matrix:

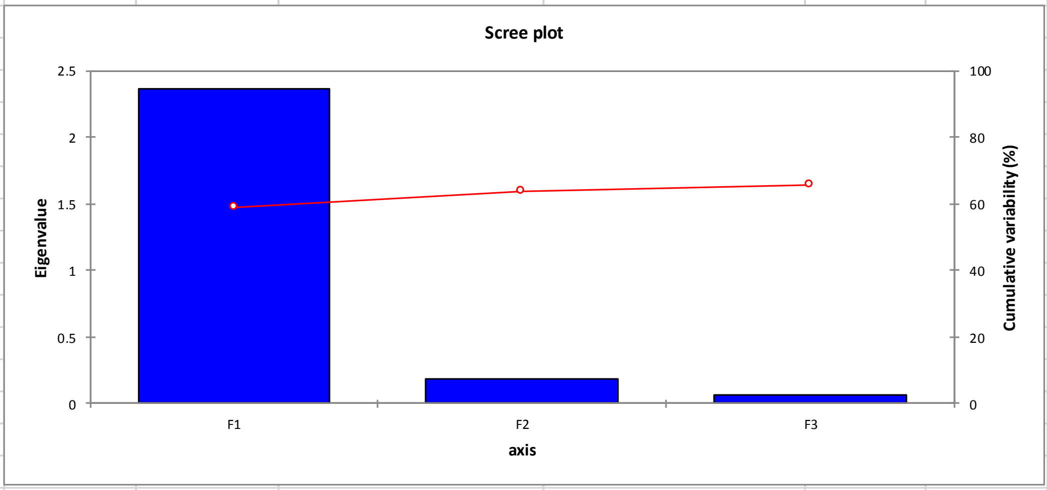
	A	B	C	D
A	0.808	0.443	0.646	0.804
B	0.443	0.243	0.354	0.441
C	0.646	0.354	0.517	0.643
D	0.804	0.441	0.643	0.801

Residual correlation matrix:

	A	B	C	D
A	0.192	0.088	0.035	-0.076
B	0.088	0.757	-0.173	0.051
C	0.035	-0.173	0.483	0.060
D	-0.076	0.051	0.060	0.199

Eigenvalues:

	F1	F2	F3
Eigenvalue	2.368	0.184	0.067
Variability (%	59.204	4.603	1.687
Cumulative %	59.204	63.807	65.494



Eigenvectors:

	F1	F2	F3
A	0.584	0.263	0.652
B	0.320	0.701	-0.191
C	0.467	-0.651	0.196
D	0.581	-0.127	-0.707

Factor pattern:

	F1	Initial communality	Final communality	ecific variance
A	**0.899**	0.660	0.808	0.192
B	**0.493**	0.421	0.243	0.757
C	**0.719**	0.630	0.517	0.483
D	**0.895**	0.657	0.801	0.199

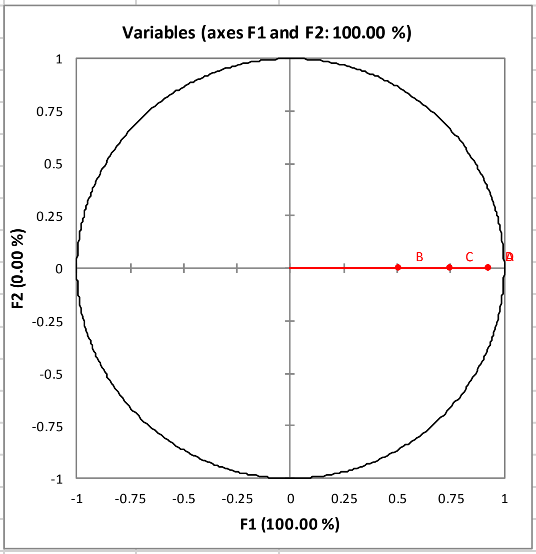
Values in bold correspond for each variable to the factor for which the squared cosine is the largest

Cronbach's alpha:

	Cronbach's alpha
F1	0.832

Correlations between variables and factors:

	F1
A	0.930
B	0.510
C	0.744
D	0.926



Factor pattern coefficients:

	F1
A	0.561
B	-0.065
C	-0.032
D	0.541

Factor scores:

Observation	F1
1	**-2.148**
2	**0.357**
3	**0.285**
4	**-0.361**
5	**-0.361**
6	**0.454**
7	**1.328**
8	**-0.459**
9	**-0.459**
10	**1.364**

Values in bold correspond for each observation to the factor for which the squared cosine is the largest

APPENDIX 6

(A) SWOT and mRating Value (Threats) Summary Data Analysis

Question	SWOT Questionnaire	EMS Evaluation Methodology	SWOT Values					mRatings Value				
Action Reseaarch Committee Member Reference			A	B	C	D	Av	A	B	C	D	Av
Questions Key Nomenclature Reference are:	What are the threats of NTU when											
SWOT THREATS = QT	**(QT1)** adopting environmental management practices?	**(QTm1)** Investigating the threats to NTU adopting such environmental practices.	6	6	5	6	5.8	5	5	4	4	4.50
mRATING THREATS = QTm	**(QT2)** lack of HEFCE support and skills shortages	**(QTm2)** Evaluating future environmental regulations and additional capital expenditure capping.	7	8	7	6	7.00	7	6	7	6	6.50
	(QT3) impact of funding opportunities for capital projects to reduce carbon emissions	**(QTm3)** Evaluating the communication demands of all stakeholders	8	8	8	7	7.75	8	7	7	6	7.00
	(QT4) How the barriers for carbon reduction polices (transport technology)	**(QTm4)** Evaluating the lack of long term planning tools for NTU's EMS for implementation of policies.	8	7	7	6	7.00	6	7	7	6	6.50
	(QT5) what the competition from other universities in the UK for a greener university	**(QTm5)** Investigating the availability of computing systems to be able to cope with carbon accounting.	7	6	6	5	6.00	7	7	6	6	6.50
	(QT6) Carbon reduction operational standards are difficult to implement and costly.	**(QTm6)** In view of the overwhelming production of carbon data, how secure is this data to external threats.	8	8	7	7	7.50	7	7	6	6	6.50
	(QT7) Future insecure factors of hydrocarbons for travel.	**(QTm7)** Analysis of EMS failure in implementation of systems and accountability of Scope 3 (Travel) carbon reductions.	8	7	8	7	7.50	5	6	5	5	5.25
	(QT8) Adverse political mandatory legislations for accountability	**(QTm8)** Analysing lack of skilled management and manpower for delivering an efficient EMS.	8	8	7	7	7.50	8	8	7	7	7.50
	(QT9) Severe change in Climate Change	**(QTm9)** Analysing the lack of sustainability attitudes of Staff and Students by NTU	7	7	6	6	6.50	6	7	6	6	6.25
	(QT10) future legislation to implement EMS	**(QTm10)** Evaluating the lack of Top Management for support of NTU's EMS	8	8	8	8	8.00	7	7	6	6	6.50
	Average Value						7.05					6.30

Actual Data (Qualitative to Quantitative transposed by the Researcher) using a rubric 1 to 10 with 10 being the best

(B) SWOT Data Analysis Summary – Threats

XLSTAT 2014.5.01 - Factor analysis - on 24/11/2014 at 16:56:16
Observations/variables table: Workbook = SWOT(12Nov)(1)C.xlsm / Sheet = Th WB (mV) / Range = 'Th WB (mV)'!$B:$E / 10 rows and 4 columns
Observation labels: Workbook = SWOT(12Nov)(1)C.xlsm / Sheet = Th WB (mV) / Range = 'Th WB (mV)'!$A:$A / 10 rows and 1 column
Correlation: Pearson (n)
Extraction method: Principal factor analysis
Number of factors: Automatic
Initial communalities: Squared multiple correlations
Stop conditions: Convergence = 0.0001 / Iterations = 50
Rotation: Varimax (Kaiser normalization) / Number of factors = 2

Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
A	10	0	10	5.000	8.000	6.600	1.075
B	10	0	10	5.000	8.000	6.700	0.823
C	10	0	10	4.000	7.000	6.100	0.994
D	10	0	10	4.000	7.000	5.800	0.789

Kaiser-Meyer-Olkin measure of sampling adequacy:

A	0.955
B	0.660
C	0.699
D	0.634
KMO	0.711

Cronbach's alpha: 0.943

Factor analysis:

Maximum change in communality at each iteration:

Iteration	Maximum change
1	0.0697
2	0.0297
3	0.0134
4	0.0056
5	0.0023
6	0.0010
7	0.0004
8	0.0002
9	0.0001
10	0.0000

Reproduced correlation matrix:

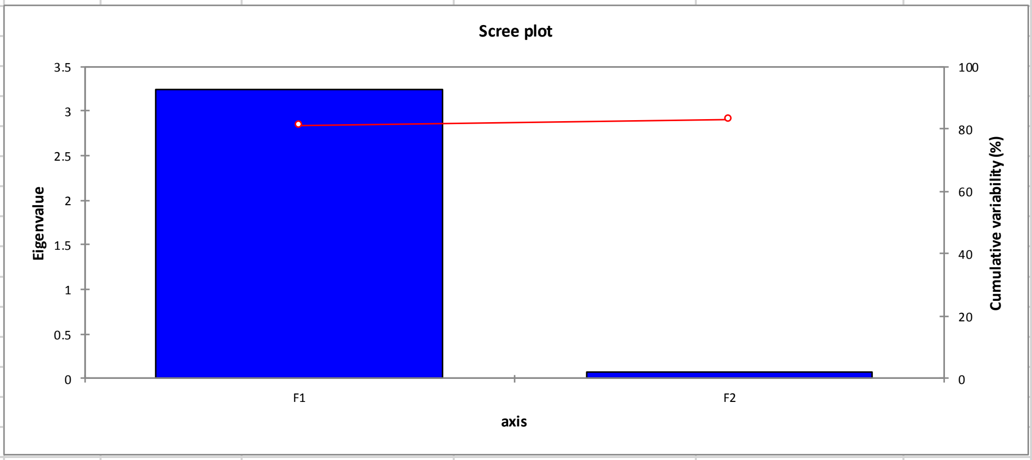
	A	B	C	D
A	0.701	0.734	0.728	0.837
B	0.734	0.768	0.762	0.876
C	0.728	0.762	0.756	0.869
D	0.837	0.876	0.869	1.000

Residual correlation matrix:

	A	B	C	D
A	0.299	-0.006	0.041	-0.025
B	-0.006	0.232	-0.043	0.047
C	0.041	-0.043	0.244	0.009
D	-0.025	0.047	0.009	0.000

Eigenvalues:

	F1	F2
Eigenvalu	3.239	0.078
Variability	80.967	1.938
Cumulativ	80.967	82.905



Eigenvectors:

	F1	F2
A	0.465	-0.488
B	0.487	0.551
C	0.483	-0.547
D	0.559	0.398

Factor pattern:

	F1	Initial communality	Final communality	Specific variance
A	**0.837**	0.674	0.701	0.299
B	**0.876**	0.891	0.768	0.232
C	**0.869**	0.834	0.756	0.244
D	**1.000**	0.951	**1.000**	**0.000**

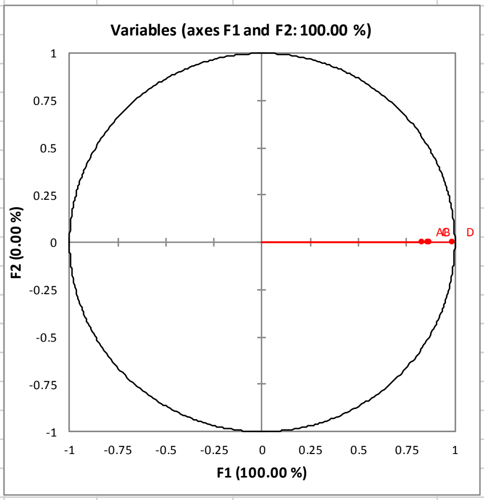
Values in bold correspond for each variable to the factor for which the squared cosine is the largest

Cronbach's alpha:

	Cronbach's alpha
F1	0.943

Correlations between variables and factors:

	F1
A	0.827
B	0.865
C	0.858
D	0.987



Factor pattern coefficients:

	F1
A	0.083
B	-0.467
C	-0.246
D	1.580

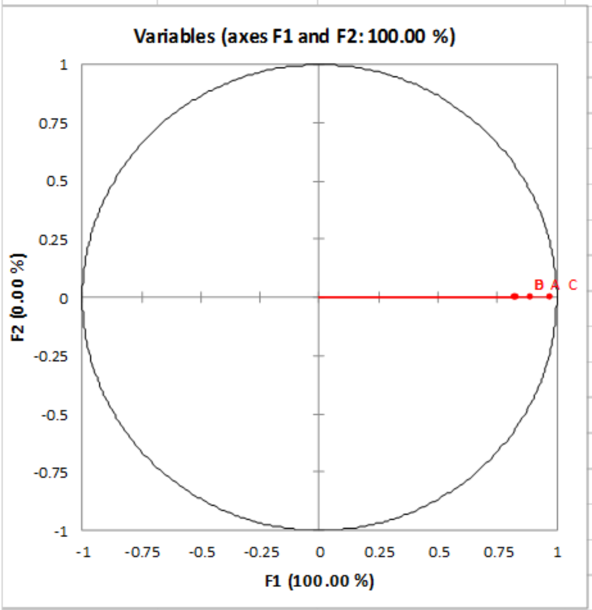
Factor scores:

Observatio	F1
1	**-2.367**
2	**0.638**
3	**0.122**
4	**-0.041**
5	**0.302**
6	**0.302**
7	**-1.114**
8	**1.636**
9	**0.220**
10	**0.302**

Values in bold correspond for each observation to the factor for which the squared cosine is the largest

Correlations between variables and factors:

	F1
A	0.894
B	0.834
C	0.973
D	0.825



Factor pattern coefficients:

	F1
A	0.147
B	0.189
C	0.558
D	0.163

Factor scores:

Observation	F1
1	**-1.868**
2	**0.018**
3	**1.031**
4	**-0.005**
5	**-1.260**
6	**0.439**
7	**0.788**
8	**0.439**
9	**-0.815**
10	**1.233**

Values in bold correspond for each observation to the factor for which the squared cosine is the largest

(C) mRating Value – Threats Data Analysis Summary

XLSTAT 2014.5.01 - Factor analysis - on 12/11/2014 at 20:07:35
Observations/variables table: Workbook = SWOT(11Nov)(1)B.xlsm / Sheet = Th WB (A) / Range = 'Th WB (A)'!$B:$E / 10 rows and 4 columns
Observation labels: Workbook = SWOT(11Nov)(1)B.xlsm / Sheet = Th WB (A) / Range = 'Th WB (A)'!$A:$A / 10 rows and 1 column
Correlation: Pearson (n)
Extraction method: Principal factor analysis
Number of factors: Automatic
Initial communalities: Squared multiple correlations
Stop conditions: Convergence = 0.0001 / Iterations = 50
Rotation: Varimax (Kaiser normalization) / Number of factors = 2

Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
A	10	0	10	6.000	8.000	7.500	0.707
B	10	0	10	6.000	8.000	7.300	0.823
C	10	0	10	5.000	8.000	6.900	0.994
D	10	0	10	5.000	8.000	6.500	0.850

Kaiser-Meyer-Olkin measure of sampling adequacy:

A	0.755
B	0.871
C	0.736
D	0.853
KMO	0.795

Cronbach's alpha: 0.913

Factor analysis:

Maximum change in communality at each iteration:

Iteration	Maximum change
2	0.0163
3	0.0076
4	0.0039
5	0.0021
6	0.0012
7	0.0007
8	0.0004
9	0.0002
10	0.0001
11	0.0001

Reproduced correlation matrix:

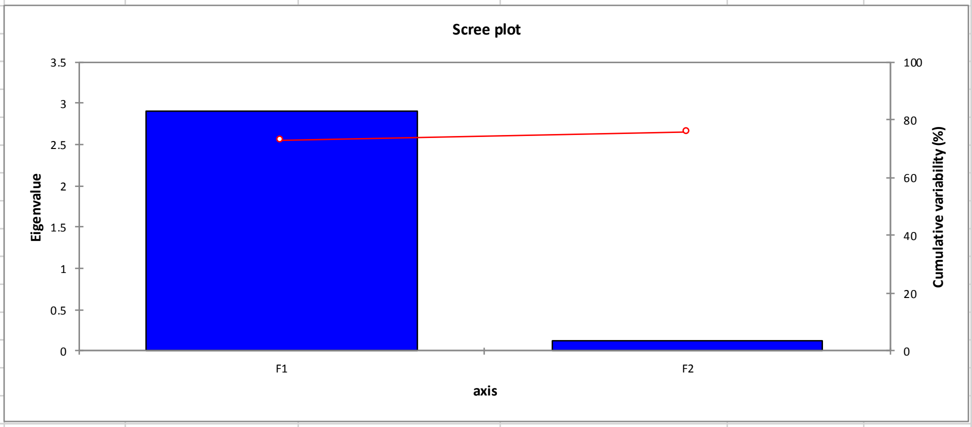
	A	B	C	D
A	0.746	0.695	0.811	0.688
B	0.695	0.648	0.756	0.641
C	0.811	0.756	0.882	0.748
D	0.688	0.641	0.748	0.635

Residual correlation matrix:

	A	B	C	D
A	0.254	-0.027	0.058	-0.041
B	-0.027	0.352	-0.037	0.073
C	0.058	-0.037	0.118	-0.025
D	-0.041	0.073	-0.025	0.365

Eigenvalues:

	F1	F2
Eigenvalue	2.911	0.131
Variability (%	72.777	3.280
Cumulative %	72.777	76.057



Eigenvectors:

	F1	F2
A	0.506	0.478
B	0.472	-0.526
C	0.551	0.462
D	0.467	-0.531

Factor pattern:

	F1	Initial communality	Final communality	Specific variance
A	**0.864**	0.759	0.746	0.254
B	**0.805**	0.602	0.648	0.352
C	**0.939**	0.809	0.882	0.118
D	**0.797**	0.601	0.635	0.365

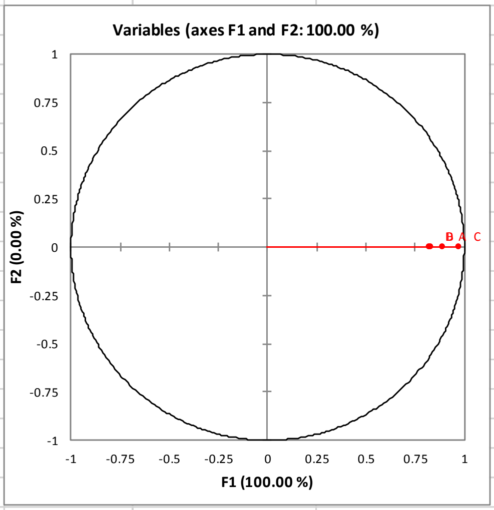
Values in bold correspond for each variable to the factor for which the squared cosine is the largest

Cronbach's alpha:

	Cronbach's alpha
F1	0.913

Correlations between variables and factors:

	F1
A	0.894
B	0.834
C	0.973
D	0.825



Factor pattern coefficients:

	F1
A	0.147
B	0.189
C	0.558
D	0.163

Factor scores:

Observation	F1
1	**-1.868**
2	**0.018**
3	**1.031**
4	**-0.005**
5	**-1.260**
6	**0.439**
7	**0.788**
8	**0.439**
9	**-0.815**
10	**1.233**

Values in bold correspond for each observation to the factor for which the squared cosine is the largest

APPENDIX 7 (A)

(A) Staff Travel Survey Analysis

STAFF JOURNEYS PER 7 DAYS FROM 22 FEBRUARY 2013

Number of Staff Repiles 1,079 (Sample size 22.05%) (Total Staff 4,893)(From Web Survey)

[Data Analysed from Data Reports provided by NTU Computing Centre in collaboration with the Researcher]

		Journey Statistics	Miles	< 5	> 5 < 9	> 10 < 19	> 20 < 29	> 30 < 39	> 40 < 49	> 50	Total Miles	*Emission Factor	Scope 3 Total GHG Emissions kg CO2e per Unit	4*Vehicle Size Provided by NTU Transport Manager
Brackenhurst														
	% Allocation for Cars			0.43	0.04	0.31	0.12	0.04	0.02	0.04				
Monday to	Car Journeys	168		72.24	6.72	52.08	20.16	6.72	3.36	6.72				
Sunday	**Total Miles by Car			361.2	60.48	989.52	584.64	262.08	164.64	336	2758.56	0.31913	704.27	80% Small Car
												0.40116	165.99	15% Medium Car
												0.34265	10.56	5% Diesel Cars
	*** Bus Journey(5 miles)	38									190	0.13552	41.44	from miles to vKm
	Trams (4 miles)	0									0	0.07659	0.00	from miles to vKm
	Rail(6 miles)	1									6	0.06715	0.65	from miles to vKm
	Taxi (4 miles)	0									0	0.23327	0.00	from miles to vKm
TOTAL KgCO2e													922.92	
City														
Monday to Sunday	Car Journeys	971		417.53	38.84	301.01	116.52	38.84	19.42	38.84				
	Total Miles by Car			2087.7	349.56	5719.19	3379.08	1514.76	951.58	1942	15943.82	0.31913	4,070.52	80% Small Car
												0.40116	959.40	15% Medium Car
												0.34265	273.16	5% Diesel Cars
	*** Bus Journey (5 miles)	1451									7255	0.13552	1,582.30	from miles to vKm
	Trams (4 miles)	434									1736	0.07659	213.98	from miles to vKm
	Rail (6 miles)	210									1260	0.06715	136.16	from miles to vKm
	Taxi (4 miles)	10									40	0.23327	15.02	from miles to vKm
TOTAL KgCO2e													7,250.54	
Clifton														
Moday to	Car Journeys	559		240.37	22.36	173.29	67.08	22.36	11.18	22.36				
Sunday	Total Miles for Car			1201.9	201.24	3292.51	1945.32	872.04	547.82	1118	9178.78	0.31913	2,343.38	80% Small Car
												0.40116	552.32	15% Medium Car
												0.34265	157.26	5% Diesel Cars
	*** Bus Journey (5 miles)	325									1625	0.13552	354.41	from miles to vKm
	Trams (4 miles)	27									108	0.07659	13.31	from miles to vKm
	Rail	42									252	0.06715	27.23	from miles to vKm
	Taxi	3									12	0.23327	4.50	from miles to vKm
TOTAL KgCO2e													3,452.42	

*https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69554/pb13773-ghg-conversion-factors-2012.pdf (Factors include All Scope Grand Total)

** Journey miles calculated at the maximum value in the particular band (ie.>5<9 use 9)

*** Assumption on Journey Miles in P.184)

4* Vehicle Size Provided by NTU Transport Manager. The Researcher had reviewed the reliability from a visual visit to the Clifton Campus and accepts the assumptions

vkm (vehicle-km) is a measure of vehicle activity, representing the movement of a vehicle over a distance

1 mile - 1.609mm

APPENDIX 7 (B)

(B) Student Travel Survey Analysis

STUDENT JOURNEYS PER 7 DAYS FROM 22 FEBRUARY 2013														
Number of Student Repiles 1,336 (Sample Size 5.44% (Student Population 24,534 in 2012/13)(from Web Survey)														
[Data Analysed from Data Reports provided by NTU Computing Centre in collaboration with the Researcher]													Scope 3 Total GHG Emissioins	
Brackenhurst		**Journey Statistics**	**Miles Traveled**	**< 5**	**> 5 < 9**	**> 10 < 19**	**> 20 < 29**	**> 30 < 39**	**> 40 < 49**	**> 50**	**Total Miles**	**Emission Factor per mile**	**kgCO2e per Unit**	4*Vehicle Size Provided by NTU Transport Manager
	% Allocation for Cars			43%	4%	31%	12%	4%	2%	4%				
Monday to	Number of Car Journeys	199		85.57	7.96	61.69	23.88	7.96	3.98	7.96				
Sunday	Total Miles by Car			427.85	71.64	1172.11	692.52	310.44	195.02	398	3267.58	0.31913	834.23	80% Small Car
												0.40116	196.62	15% Medium Car
												0.34265	55.98	5% Diesel Cars
	Bus Journey (5 miles)	150									750	0.13552	163.57	*from miles to vKm*
	Trams (4 miles)	5									20	0.07659	2.47	*from miles to vKm*
	Rail (6 miles)	5									30	0.06715	3.62	*from miles to vKm*
	Taxi (4 miles)	1									4	0.23327	1.50	*from miles to vKm*
TOTAL KgCO2e													**1258.00**	
City														
Monday to														
Sunday	Car Journeys	266		114.38	10.64	82.46	31.92	10.64	5.32	10.64				
	Total Miles by Car			571.9	95.76	1566.74	925.68	414.96	260.68	532	4367.72	0.31913	1115.10	80% Small Car
												0.40116	262.82	15% Medium Car
												0.34265	74.83	5% Diesel Cars
	Bus Journey (5 miles)	791									3955	0.13552	862.58	*from miles to vKm*
	Trams (4 miles)	356									1424	0.07659	175.52	*from miles to vKm*
	Rail (6 miles)	123									738	0.06715	79.75	*from miles to vKm*
	Taxi (4 miles)	23									92	0.23327	34.54	*from miles to vKm*
TOTAL KgCO2e													**2605.14**	
Clifton														
Moday to	Car Journeys	322		138.46	12.88	99.82	38.64	12.88	6.44	12.88				
Sunday	Total Miles for Car			692.3	115.92	1896.58	1120.56	502.32	315.56	644	5287.24	0.31913	1349.85	80% Small Car
												0.40116	318.15	15% Medium Car
												0.34265	90.58	5% Diesel Cars
	Bus Journey (5 miles)	915									4575	0.13552	997.80	*from miles to vKm*
	Trams (4 miles)	36									144	0.07659	17.75	*from miles to vKm*
	Rail (6 miles)	55									330	0.06715	35.66	*from miles to vKm*
	Taxi (4 miles)	8									32	0.23327	12.01	*from miles to vKm*
TOTAL KgCO2e													**2821.81**	

*https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69554/pb13773-ghg-conversion-factors-2012.pdf (Factors include All Scope Grand Total)
** Journey miles calculated at the maximum value in the particular band (ie.>5<9 use 9)
*** Assumption on Journey Miles in P.184)
4* Vehicle Size Provided by NTU Transport Manager. The Researcher had reviewed the reliability from a visual visit to the Clifton Campus and accepts the assumptions
vkm (vehicle-km) is a measure of vehicle activity, representing the movement of a vehicle over a distance
1 mile - 1.609mm

Appendix 8 A – Students Participation Ethical Information

Part 1

RESEARCH INFORMATION SHEET

NTU Ethical Reference Approval Obtained on	04 February 2013
Researcher's Name	Jaya Chelliah (jaychelliah@yahoo.com)
Course Code	DBA Research

Research Title – Quantifying and Managing Scope 3 (Travel) Carbon Emissions in a UK University. A case study with Nottingham Business School

This research is the fifth document for the partial fulfilment for the award of the Doctor of Business Administration, from Nottingham Trent University. I request your participation of this research project by completing the attached questionnaires. Please ensure that you have carefully read Part B below and email to me confidentially if you seek more information or explanations.

What is the research about?

This case study collaborative research investigation is based on the travelling modalities of staff and students of Nottingham Trent University in a week in February 2014. This research would serve as a preliminary indicator to evaluating the Scope 3 (Travel) carbon emissions of commuting travel by staff and students. My research interest concerns the development of a Scope 3 (Travel) quantification tool and a travel sustainability index. This quantification tool will be part of the quantification methodology for benchmarking Nottingham Trent University's carbon footprint.

What will be your contribution to this research?

The research would be providing valuable information to Universities to benchmark their Scope3 (Travel) carbon emissions as part of the UK's management and control of Green House Gases and Climate Change

Answering the questionnaires

Please ensure that you answer ALL questions to the best of your abilities.

Only completed scripts will be analysed

Storage and transportation of data

All data will be subjected to secure encryption during submission and data will be securely stored within NTU secure IT site ensuring absolute anonymity and security.

APPENDIX 8A (Continued)

25 February 2013

Research Title – Quantifying and Managing Scope 3 (Travel) Carbon Emissions in a UK University. This research programme was carried out in collaboration with Nottingham Trent University

NTU Ethical Reference Approval Letter (Appendix 8B)	Amanda Lomax (p.405)
Researcher's Name	Jaya Chelliah
Course Code	DBA Document 5

Thank you for considering taking part in this research. The researcher (Jaya Chelliah organising the research must explain the project to you before you agree to take part. Any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you decide whether to participate. You must request for a copy of this Consent Form to keep and refer to at any time (if required)

- I understand that if I decide at any time during the research that I no longer wish to participate in this project, I can notify the researchers involved and withdraw from it immediately without giving any reason. Furthermore, I understand that I will be able to withdraw my data up to two weeks following the date of the interview with the researcher [10 March 2014}. I consent to the processing of my personal information for the purposes explained to me. I understand that such information will be treated in accordance with the terms of the Data Protection Act 1998.

The information you have submitted will be published as without disclosing personal information and treated with anonymity Please note that, as far as possible within the scope of the research, confidentiality and anonymity will be maintained as outlined in the Information Sheet.

- I agree that the researcher may use my data for future research and analysis:
    - yes [ ] no [ ]
    - only with my future permission yes [ ] no [ ]

Participant's Statement:

I ____

agree [ ] {please put X} that the research project named above has been explained to me to my satisfaction and I agree to take part in the study. I have read both the notes written above and the Information Sheet about the project, and understand what the research study involves.

Date:______________

APPENDIX 8 B

COPY OF ETHICAL APPROVAL CONFIRMATION FROM NTU ETHICS COMMITTEE

Lomax, Amanda-Jane

To:	Chelliah, Jaya 2008 (PGR)
Cc:	Molthan-Hill, Petra; Howarth, Richard
Subject:	DBA Document 5 - Ethical Approval Confirmation Jaya Raj Chelliah

Dear Jaya,

Thank you for submitting an ethical approval application for DBA Document 5.

I am pleased to confirm that your ethics application has been approved.

Kind regards

Angela

c.c. to supervisors

Regards

Mandi

Amanda-Jane Lomax
Research Administrator
Nottingham Trent University Graduate School
Burton Street, Nottingham, UK, NG1 4BU

Location: 4711 Chaucer
Tel: +(0)115 848 8088
Fax: +(0)115 848 8700
Email: amanda-jane.lomax@ntu.ac.uk
Web: www.ntu.ac.uk

APPENDIX 8 C

COPY OF RESEARCHER'S ETHICAL APPROVAL CONSENT FORM SUBMITTED TO NTU'S ETHICS COMMITTEE

The Business, Law and Social Sciences (BLSS) Graduate School
Doctor in Business Administration (DBA) Programme

Ethical Approval Checklist – Form B

Form B must signed off by the research student, one member of the supervisory team, and a programme leader, to signify that the proposed research conforms with good ethical principles and standards, before commencing any research in preparation for **Documents 5** within any of the professional doctorate programmes.

Assurance that all research fieldwork will conform with good ethical standards is provided by the student when signing this form. Please complete this document following the BLSS Graduate School & the DBA Programme Guidelines.

Award title	Doctor in Business Administration (DBA)
Cohort	10
Research Student's Name	JAYA RAJ CHELLIAH
Document title	DOCUMENT 5
Supervisors	1. MRS PETRA MOLTHAN-HILL 2. MR RICHARD HOWARTH
Date	04/02/2013
Identify any question indicating that approval from PDREC is required.	NONE

At the end of each section it will be indicated if ethical approval must be sought from the Professional Doctorates Research Ethics Committee (PDREC).

1. Research Student

Section OA I: Familiarisation with policy

Please confirm if you are fully acquainted with policy guiding ethical research:

• BLSS Graduate School research ethics policy, and the procedures for ethical approval in the DBA Programme.	Yes	No
• The guidelines for ethical research promulgated by your own professional association, as appropriate	Yes	No
• The Regulations for the Use of Computers (*see* NTU website)	Yes	No
• Guidelines for Risk Assessment in Research (Appendix 3)	Yes	No

If you answered **NO** to any of these questions, please note that you must study these guidelines and regulations before proceeding to complete the remainder of this form.

Section OA II: External Ethical Review

OB.1 Has a favourable ethical opinion been given for this project by an NHS or social care research ethics committee, or by any other external research ethics committee?	Yes	No
OB.2 Will this project be submitted for ethical approval to an NHS or social care committee or to any other external research ethics committee?	Yes	No

If you answered **YES** to either of these two questions, please sign the declaration at the end of the form and submit it (together with the letter confirming ethical approval) before starting any primary research.

If you answered **NO** to both questions, please proceed to Section A

Section A: Investigators

A.1. Have you attended the professional doctorate workshops on research methods (modules 1 and 2) or attended other award-bearing or training programmes on research methods?	YES	NO
A.2. Are you in regular contact with your supervisory team?	YES	NO
A.3. Can you confirm that you are **NOT** expected to undertake physically invasive procedures (not covered by a generic protocol) during the course of the research?	YES	NO
A.4 Can you confirm that you will **NOT** be in a position of authority that may compromise the integrity of participants (e.g. academic staff using his/her students, or managers using subordinates as participants)?	YES	NO

If you answered NO to any of questions A1-A.4, an application for ethical approval needs to be made to the PDREC.

Section B: Participants & Methodology/Procedures

B.1 Does the research involve vulnerable participants? If **not**, go to Section C

B.2 If the research does involve vulnerable participants: will participants knowingly be recruited from one or more of the following vulnerable groups?

• Children under 18 years of age	Yes	No
• People over 65 years of age	Yes	No
• Pregnant women	Yes	No
• People with mental illness	Yes	No
• Prisoners/Detained persons	Yes	No
• Other vulnerable group	Yes	No

  ▪ please specify: ____________________

B.3 Have you been asked to obtain a Criminal Records Bureau (CRB) check as a condition of access to any source of data for this document in the UK?	Yes	No

B.4 To the best of your knowledge, please indicate whether the proposed study:

• Involves procedures likely to cause physical, psychological, social or emotional distress to participants	Yes	No
• Is designed to be challenging physically or psychologically in any way (includes any study involving physical exercise)	Yes	No
• Exposes participants to risks or distress greater than those encountered in their normal lifestyle	Yes	No
• Involves the use of hazardous materials	Yes	No

If you have answered **YES** to any of questions B1-B4, an application for ethical approval needs to be made to the PDREC.

Section C: Observation/Recording

C.1 Does the study involve data collection, or the observation or recording of participants?	Yes	No
C.2 Will those contributing to the data collected (being observed or being recorded), or those of the appropriate authority, be informed that the observation and/or recording will take place?	Yes	No

If you have answered **NO** to question C.2, an application for ethical approval needs to be made to the PDREC.

Section D: Consent and Deception

Informed Consent & Data Withdrawal

D.1 Will participants, or those of the appropriate authority, be fully informed of the objectives, and of all other particulars of the investigation (preferably at the start of the study, but where this would interfere with the study, at the end)?	Yes	No
D.2 Will participants, or those of the appropriate authority, be fully informed of the use of the data collected (including, where applicable, any intellectual property arising from the research)?	Yes	No
D.3 For detained persons, members of the armed forces, employees, students and other persons judged to be under duress, will care be taken over the gaining of freely informed consent?	Yes	No
D.4 Will participants, or those of the appropriate authority, be informed of their right to withdraw from the investigation at any time (or before a specific deadline) and to require their own data to be destroyed?	Yes	No

If you have answered **NO** to any of questions D.1-D.4, an application for ethical approval needs to be made to the PDREC.

D.5 Does the study involve deception of participants (i.e., withholding of information and/or misleading participants) which could potentially harm and/or exploit participants?	Yes / No

If you answer **NO** to question D.5, please proceed to section E.

Deception

D.6 Is deception an unavoidable part of the study?	Yes	No
D.7 Will participants, or those of the appropriate authority, be de-briefed and the true object of the research revealed at the earliest stage upon completion of the study?	Yes	No
D.8 Has consideration been given on the way that participants, or those of the appropriate authority, will react to the withholding of information or deliberate deception?	Yes	No

If you have answered **NO** to questions D6-D.8 an application for ethical approval needs to be made to the PDREC.

Section E: Storage of Data and Confidentiality

Please see University guidance on https://www.ntu.ac.uk/intranet/policies/legal_services/data_protection/16231gp.html. You will need your user name and password to gain access to this page on the Staff Intranet.

E.1 Will all information on participants be treated as confidential and not identifiable unless agreed otherwise in advance, and subject to the requirements of law?	Yes	No
E.2 Will storage of data comply with the Data Protection Act 1998?	Yes	No
E.3 Will any video/audio recording of participants be kept in a secure place and not released for use by third parties?	Yes	No
E.4 Will video/audio recordings be destroyed within six years of the completion of the investigation?	Yes	No

If you have answered **NO** to questions E1-E4, an application for ethical approval needs to be made to the PDREC.

Section F: Incentives

F.1. Have incentives (other than those contractually agreed, salaries or basic expenses) been offered to the investigator to conduct the investigation?	Yes / No
F.2. Will incentives (other than basic expenses) be offered to potential participants, or those of the appropriate authority, as an inducement to participate in the investigation?	Yes / No

If you have answered **YES** to questions F1-F2, an application for ethical approval needs to be made to the PDREC.

The design of the participant information sheet/consent form, and of any research instrument (including questionnaires, sampling and interview schedules) that will be used have been discussed with my supervisor(s).	Yes / No

Compliance with Ethical Principles

Please sign the declaration below, to confirm that this form has been completed to the best of your knowledge and after discussing the answers provided with your supervisor(s). If at any stage you have been asked to submit an application for ethical approval to the PDREC please also complete and submit the appropriate form.

Signature of Research Student ....JRChelliah........

Signature of Supervisor ....

Signature of Programme Leader ....Neil Vale........

Date ....04/02/2013....

APPENDIX 9 – LINKS BETWEEN ACTUAL DATA AND THE THESIS

The Appendix reports on the information and data gathering and how the data was used within the thesis. The methodology used in this study is rooted in two methodological approaches.

1. Collaborative Research Design and Qualitative Enquiry

The Researcher worked collaboratively with NTU. The Researcher designed the Research Design Frameworks and Detailed the Methodologies the the Research. The Researcher obtained the primary qualitative data from the SWOT and mRating Value questionnaires. The Researcher converted the qualitative replies to quantitative empirical data based on a rubric of 1 to 10, with 10 being the best. Actual Data are found in Appendixes 3 to 6 (pp.338 -365)

2. Data Obtained from Travel Survey by the Researcher in Collaboration with NTU

The Travel Data Survey was undertaken by NTU using their webserver as the data processing facility. Data was reported according to the Travel Survey Questionnaire in a spreadsheet format and MS Excel File. Data was analysed from this information and presented in the Thesis. Other UK Travel Data provided were (i) UK Travel Information (ii) Overseas Student Population and Origins (assumptions). These are assumptions are located in pp.197 to 198 above.

3. Data Obtained from NTU's Approved Travel Agents Travel Data

NTU provided the data reports for Staff UK and Overseas Travel by Continents and Mode of Travel. NTU's Appointed Travel Agent is Ian Allen Travel presenting UK and overseas travel data based on distance travelled and Geographical Zones.

The Data from the above sources formed the primary data sets for the quantification of Scope 3 (Travel) carbon emissions for 2013 by NTU and reported in this Thesis.

APPENDIX 10 – STARS CREDIT SYSTEM REFERENCE

(A) **OP19 – STUDENT COMMUTE CREDIT** (p.209)

[http://www.aashe.org/files/documents/STARS/2.0/stars_2.0.2_credit_op_19.pdf]

OP 19: Student Commute Modal Split

2 points available

A. Credit Rationale

This credit recognizes institutions where students use preferable modes of transportation to travel to and from the institution. Commute modal split is a common measure used to evaluate the sustainability performance of a transportation system. Using alternative modes of transportation helps reduce local air pollution and GHG emissions. Walking and biking offer health benefits as well.

B. Criteria

Institution's students commute to and from campus using more sustainable commuting options such as walking, bicycling, vanpooling or carpooling, taking public transportation, riding motorcycles or scooters, riding a campus shuttle, or a combination of these options.

Students who live on campus should be included in the calculation based on how they get to and from their classes.

C. Applicability

This credit applies to all institutions where students attend the physical campus.

D. Scoring

Institutions earn the maximum of 2 points available for this credit by having all students use alternative modes of transportation for getting to and from campus. Incremental points are awarded based on the percentage of students that use alternative modes. For example, an institution for which 50 percent of students use alternative modes and the other 50 percent drive alone would earn 1 point (half of the available points for this credit). Points earned are calculated according to the following table:

Scoring Example: Student Commute Modal Split

Example University students have the following commuting composition:

- 30 percent live on campus (and, therefore, do not drive alone to commute)
- 15 percent walk, bike, or use non-motorized transportation
- 20 percent take campus shuttles or public transportation
- 5 percent carpool

Total percentage using alternatives to single-occupancy vehicle commuting = 30 + 15 + 20 + 5 = **70**

Factor	*Multiply*	Total Percentage of Students Using More Sustainable Commuting Options (0-100)	*Equals*	Total Points
0.02	×	70	=	**1.4**

E. Reporting Fields

Required

- Total percentage of students (graduate and undergraduate) that use more sustainable commuting options (0-100)
- An affirmation that the submitted information is accurate to the best of a responsible party's knowledge and contact information for the responsible party. The responsible party should be a staff member, faculty member, or administrator who can respond to questions regarding the data once submitted and available to the public.

Optional

- The percentage of the institution's students that:
  - Commute with only the driver in the vehicle (excluding motorcycles and scooters) as their primary method of transportation (0-100)
  - Walk, bicycle, or use other non-motorized means as their primary method of transportation (please note that this may include on-campus residents) (0-100)
  - Vanpool or carpool as their primary method of transportation (0-100)
  - Take a campus shuttle or public transportation as their primary method of transportation (0-100)

Scoring Example: Student Commute Modal Split

Example University students have the following commuting composition:

- 30 percent live on campus (and, therefore, do not drive alone to commute)
- 15 percent walk, bike, or use non-motorized transportation
- 20 percent take campus shuttles or public transportation
- 5 percent carpool

Total percentage using alternatives to single-occupancy vehicle commuting = 30 + 15 + 20 + 5 = 70

Factor	Multiply	Total Percentage of Students Using More Sustainable Commuting Options (0-100)	Equals	Total Points
0.02	×	70	=	1.4

E. Reporting Fields

Required

- Total percentage of students (graduate and undergraduate) that use more sustainable commuting options (0-100)
- An affirmation that the submitted information is accurate to the best of a responsible party's knowledge and contact information for the responsible party. The responsible party should be a staff member, faculty member, or administrator who can respond to questions regarding the data once submitted and available to the public.

Optional

- The percentage of the institution's students that:
  - Commute with only the driver in the vehicle (excluding motorcycles and scooters) as their primary method of transportation (0-100)
  - Walk, bicycle, or use other non-motorized means as their primary method of transportation (please note that this may include on-campus residents) (0-100)
  - Vanpool or carpool as their primary method of transportation (0-100)
  - Take a campus shuttle or public transportation as their primary method of transportation (0-100)

STARS 2.0 Technical Manual 207 OP | Waste

  - Use a motorcycle, scooter or moped as their primary method of transportation (0-100)
- A brief description of the method(s) used to gather data about student commuting
- The website URL where information about sustainable transportation is available
- Notes about the submission

F. Measurement

Timeframe
Report the most recent data available during the three years prior to the anticipated date of submission.

Sampling and Data Standards
Institutions may use a representative sample to gather data about student commuting behavior. The South Coast Air Quality Management District in California provides guidelines on how to measure commuting behavior (pdf).

This credit is scored based on the percentage of students (graduate and undergraduate) using alternatives to single-occupancy vehicle commuting (i.e. more sustainable commuting options). Students who do not regularly attend the physical campus (i.e. distance education students) may be excluded. It is not required that the various transportation modes reported in the optional reporting fields total 100.

SCORING [https://stars.aashe.org/pages/participate/recognition-scoring.html] and [http://www.aashe.org/files/documents/STARS/2.0/stars_2.0.2_introductory_materials.pdf]

Points were allocated by a panel of STARS Steering Committee members and AASHE staff using the following considerations: To what extent does achievement of the credit contribute to (a) human and ecological health and mitigate negative environmental impacts; (b) secure livelihoods, a sustainable economy and other positive financial impacts; and (c) social justice, equity, diversity, cooperation, democracy and other positive social impacts? To what extent are the positive impacts associated with achievement of the credit not captured in other STARS credits?

(B) OP 20 – STAFF COMMUTE CREDIT (p. 208)

[p209 - http://www.aashe.org/files/documents/STARS/2.0/stars_2.0_technical_manual.pdf]

OP 20: Employee Commute Modal Split

2 points available

A. Credit Rationale

This credit recognizes institutions where employees use preferable modes of transportation to travel to and from the institution. Commute modal split is a common measure used to evaluate the sustainability performance of a transportation system. Using alternative modes of transportation reduces local air pollution and GHG emissions. Walking and biking offer health benefits as well.

B. Criteria

Institution's employees (faculty, staff, and administrators) get to and from campus using more sustainable commuting options such as walking, bicycling, vanpooling or carpooling, taking public transportation, riding motorcycles or scooters, riding a campus shuttle, telecommuting, or a combination of these options.

Employees who live on campus should be included in the calculation based on how they get to and from their workplace.

C. Applicability

This credit applies to all institutions.

D. Scoring

Institutions earn the maximum of 2 points for this credit by having all employees use alternative modes of transportation for getting to and from campus. Incremental points are awarded based on the percentage of employees that use alternative modes. For example, an institution for which 50 percent of employees use alternative modes and the other 50 percent drive alone would earn 1 point (half of the available points for this credit). Points earned are calculated according to the following table:

Enter values as indicated below to calculate points earned for this credit
Points will be calculated automatically when data are entered in the STARS online Reporting Tool

Factor	*Multiply*	Total Percentage of the Institution's Employees Using More Sustainable Commuting Options (0-100)	*Equals*	Total Points Earned
0.02	×	_____	=	

Scoring Example: Employee Commute Modal Split

Example University employees have the following commuting composition:

- 10 percent walk, bike, or use non-motorized transportation
- 30 percent take campus shuttles or public transportation
- 15 percent carpool

Total percentage using alternatives to single-occupancy vehicle commuting = 10 + 30 + 15 = **55**

Factor	Multiply	Total Percentage of the Institution's Employees Using More Sustainable Commuting Options (0-100)	Equals	Total Points
0.02	×	55	=	1.1

E. Reporting Fields

Required

- Total percentage of the institution's employees that use more sustainable commuting options (0-100)
- An affirmation that the submitted information is accurate to the best of a responsible party's knowledge and contact information for the responsible party. The responsible party should be a staff member, faculty member, or administrator who can respond to questions regarding the data once submitted and available to the public.

Optional

- The percentage of the institution's employees that:
  - Commute with only the driver in the vehicle (excluding motorcycles and scooters) as their primary method of transportation (0-100)
  - Walk, bicycle, or use other non-motorized means as their primary method of transportation (please note that this may include on-campus residents) (0-100)
  - Vanpool or carpool as their primary method of transportation (0-100)
  - Take a campus shuttle or public transportation as their primary method of transportation (0-100)

  - Use a motorcycle, scooter or moped as their primary method of transportation (0-100)
  - Telecommute for 50 percent or more of their regular work hours (0-100)
- A brief description of the method(s) used to gather data about employee commuting
- The website URL where information about sustainable transportation is available
- Notes about the submission

F. Measurement

Timeframe

Report the most recent data available within the three years prior to the anticipated date of submission.

Sampling and Data Standards

Institutions may use a representative sample to gather data about employee commuting behavior. The South Coast Air Quality Management District provides guidelines on how to measure commuting behavior (pdf).

This credit is scored based on the percentage of employees using alternatives to single-occupancy vehicle commuting (i.e. more sustainable commuting options). It is not required that the various transportation modes reported in the optional reporting fields total 100.

(C) OP21 – SUPPORT FOR SUSTAINABLE TRANSPORT
[http://www.aashe.org/files/documents/STARS/2.0/stars_2.0.2_credit_op_21.pdf]

OP 21: Support for Sustainable Transportation

2 points available

A. Credit Rationale

This credit recognizes institutions that support active transportation and commuting alternatives for its students and employees. Encouraging more sustainable modes of transportation and offering programs to reduce commuting helps decrease local air pollution and greenhouse gas emissions.

B. Criteria

Part 1

The institution demonstrates its support for active (i.e. non-motorized) transportation on campus in one or more of the following ways:

Option A: Institution:

- Provides secure bicycle storage (not including office space), shower facilities, and lockers for bicycle commuters. The storage, shower facilities and lockers are co-located in at least one building/location that is accessible to all commuters.
- Provides short-term bicycle parking (e.g. racks) within 50 ft (15 m) of all occupied, non-residential buildings and makes long-term bicycle storage available within 330 ft (100 m) of all residence halls (if applicable).
- Has a "complete streets" or bicycle accommodation policy (or adheres to a local community policy) and/or has a continuous network of dedicated bicycle and pedestrian paths and lanes that connects all occupied buildings and at least one inter-modal transportation node (i.e. transit stop or station). And/or
- Has a bicycle-sharing program or participates in a local bicycle-sharing program

Option B: Institution is certified as a Bicycle Friendly University (at any level) by the League of American Bicyclists (U.S.) or under a similar third party certification for non-motorized transportation.

Part 2

Institution has implemented one or more of the following strategies to encourage more sustainable modes of transportation and reduce the impact of student and employee commuting. The institution:

- Offers free or reduced price transit passes and/or operates a free campus shuttle for commuters. The transit passes may be offered by the institution itself, through the larger university system of which the institution is a part, or through a regional program provided by a government agency.
- Offers a guaranteed return trip (GRT) program to regular users of alternative modes of transportation
- Participates in a car/vanpool or ride sharing program and/or offers reduced parking fees or preferential parking for car/vanpoolers
- Participates in a car sharing program, such as a commercial car-sharing program, one administered by the institution, or one administered by a regional organization
- Has one or more Level 2 or Level 3 electric vehicle recharging stations that are accessible to student and employee commuters
- Offers a telecommuting program for employees, either as a matter of policy or as standard practice
- Offers a condensed work week option for employees, either as a matter of policy or as standard practice
- Has incentives or programs to encourage employees to live close to campus
- Other strategies

C. Applicability

This credit applies to all institutions.

D. Scoring

Each part is scored independently.

Part 1

Institutions earn the maximum of 0.5 points for meeting all four of the criteria listed in Option A or for meeting the criteria in Option B. Partial points are available for uncertified institutions based on number of criteria met in Option A. For example, an institution that meets 2 of the criteria would earn 0.25 points (half of the points available for Part 1).

Part 2

Institutions earn 0.25 points for each initiative described above. Institutions with six or more of the initiatives listed earn the maximum of 1.5 points available for Part 2.

E. Reporting Fields

Required

- An indication of whether the institution encourages more sustainable modes of transportation and reduces the impact of commuting in the following ways:
  - Provides secure bicycle storage (not including office space), shower facilities, and lockers for bicycle commuters
  - Provides short-term bicycle parking within 50 ft (15 m) of all occupied, non-residential buildings and makes long-term bicycle storage available within 330 ft (100 m) of all residence halls (if applicable)
  - Has a "complete streets" or bicycle accommodation policy (or adheres to a local community policy) and/or has a continuous network of dedicated bicycle and pedestrian paths and lanes that connects all occupied buildings and at least one inter-modal transportation node (i.e. transit stop or station)
  - Has a bicycle-sharing program or participates in a local bicycle-sharing program
  - Is certified as a Bicycle Friendly University by the League of American Bicyclists (U.S.) or under a similar third party certification covering non-motorized transportation
  - Offers free or reduced price transit passes and/or operates a free campus shuttle for commuters
  - Offers a guaranteed return trip program to regular users of alternative modes of transportation
  - Participates in a car/vanpool or ride sharing program and/or offers reduced parking fees or preferential parking for car/vanpoolers
  - Participates in a car sharing program, such as a commercial car-sharing program, one administered by the institution, or one administered by a regional organization
  - Has one or more Level 2 or Level 3 electric vehicle recharging stations that are accessible to student and employee commuters
  - Offers a telecommuting program for employees as a matter of policy or as standard practice
  - Offers a condensed work week option for employees as a matter of policy or as standard practice
  - Has incentives or programs to encourage employees to live close to campus
  - Other strategies (please specify)
- An affirmation that the submitted information is accurate to the best of a responsible party's knowledge and contact information for the responsible party. The responsible party should be a staff member, faculty member, or administrator who can respond to questions regarding the data once it is submitted and available to the public.

Conditional

Required for each type of program or initiative that the institution is reporting:

- A brief description of the program or initiative

Required if the institution is certified as a Bicycle Friendly University or under a similar third party certification covering non-motorized transportation:

- A brief description of the certification, including date certified and level

Optional

- The website URL where information about the institution's sustainable transportation program(s) is available
- Notes about the submission

F. Measurement

Timeframe

Report on current programs, practices and plans.

Sampling and Data Standards

Not applicable

BIBLIOGRAPHY

Aamaas, B., Borken-Kleefeld, J., and Peters, G.P. (2013), 'The climate impact of travel behaviour: A German case study with illustrative mitigation options', *Environmental Science & Policy*, Volume 33, pp.173-282, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.envsci.2013.06.009 (Accessed on 14 August 2013)

Aashe (2012), '*STARS – a program of aashe – technical manual'*, *Version 1.2.* [Online], Available at www.aashe.org (Accessed on 30 November 2013)

Aashe (2013a), '*Association for the Advancement of Sustainability in Higher Education (AASHE)'*, [Online], Available at www.aashe.org (Accessed on 30 November 2013)

Aashe (2013), '*STARS – a program of aashe – technical manual'*, *Version 2.0*. [Online], Available at www.aashe.org (Accessed on 07 January 2014)

Aashe (2014), *'STARS 2.0 Technical Manual'*, [Online], Available at http://www.aashe.org/files/documents/STARS/2.0/stars_2.0_technical_manual_-_administrative_update_two.pdf (Accessed 01 March 2014)

Abolarin, S.M., Gbadegesin, A.O., Shitta, M.B., Yussuff, A., Eguma, C.A., Ehwerhemuepha, L., and Adegbenno, O. (2013), 'A collective approach to reducing carbon dioxide emission: A case study of four University of Lagos Halls of residence', *Energy and Buildings*, Volume 61, pp. 318-322, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.enbuild.2013.02.041 (Accessed on 20 December 2014)

Acca (2010), '*Accounting for Carbon'*, p.18-20, [Online], Available at http://www.accaglobal.com/content/dam/acca/global/PDF-technical/environmental-publications/rr-122-001.pdf (Accessed on 14 March 2014)

Acca (2014), '*The new strategic report'*, [Online], Available at http://www.accaglobal.com/uk/en/technical-activities/technical-resources-search/2014/january/new-strategic-report.html (Accessed on 16 November 2015)

Agarwal, R., Grassi, W., and Pahl, J. (2012), 'Meta-SWOT: introducing a new strategic planning tool', *Journal of Business Planning*, Volume 33 (2), pp.12-21, *Emeraldinsigh*t, [Online], Available at doi: 10.1108/02756661211206708 (Accessed on 23 February 2016)

Altan, S.M., Gbadegesin, A.O., Shitta, M.B., Yussuff, A., Eguma, C.A., Ehwerhemuepha, L., and Adegbenro, O. (2013), 'A collective approach to reducing carbon dioxide: A case study of four University of Lagos Halls of residences;, *Energy and Building*, Volume 61, pp.318-322, *Sciencedireect* [Online], Available at http://dx.doi.org/10.1016/j.enbuild.2013.02.041(Accessed on 15 February 2014)

Ajjan, H., and Hartshorne, R. (2008), ‘Investigating faculty decisions to adopt Web 2.0 technologies: Theory and empirical tests’, *The internet and higher education*, Volume 11 (2), pp.71-80, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.iheduc.2008.05.002 (Accessed on 17 February 2014)

Alazzani, A., and Wan-Hussin, W.N. (2013), ‘Global Reporting Initiative’s environmental reporting: A study of oil and gas companies’, *Ecological Indicators*, Volume 32, pp.19-24, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.ecolind.2013.02.019 (Accessed on 21 February 2014)

Alonso-Almeida, M.del Mar., Marimon, F., Casani, F., and Rodriguez-Pomeda, J. (2015). ‘Diffusion of sustainability reporting in universities: current situation and future perspectives’, *Journal of Cleaner Production*, Volume 106, pp.144-154, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2014.02.008 (Accessed on 20 July 2015)

Alwaer, H., and Clements-Croome (2010), ‘Key performance indicators (KPIs) and priority setting in using the multi-attribute approach for assessing sustainable intelligent buildings:, *Building and Environment*, Volume 45, pp.799-807, *Sciencedirect* [Online], Available at doi:10.1016/j.buildenv.2009.08.019 (Accessed on 17 April 2014)

Alwin, D.F. (2010)[Eds. Wright, J.D. and Marsden, P.V.], ‘*Handbook of Survey Research’*, p.418, 2nd Edition, Emerald Group Publishing, UK.

Altan H. (2010), ‘Energy efficiency interventions in UK Higher Education Institutes’, *Energy Policy 38*, pp.7722-7731, *Sciencedirect* [Online] Available at http://ac.els-cdn.com/S0301421510006397/1-s2.0-S0301421510006397-main.pdf?_tid=bbd33688-d10b-11e2-b6e8-00000aacb35e&acdnat=1370786090_b07eb1467ee0a540cf2b769e35ed982d (Accessed 31 May 2013)

Altbach, P.G. (2007), ‘The Internationalisation of Higher Education: Motivations and Realities’, *Journal of Studies in International Education’*, Volume 11 (3-4), *Sagejournals* [Online], Available at doi: 10.1177/1028315307303542 (Accessed on 01 August 2013)

Alshuwaikhat, H.M. and Abubakar, I. (2008), ‘An integrated approach to achieving campus sustainability: assessment of the current campus environmental management practices’, *Journal of Cleaner Production 16*, pp.1777-1785. *Sciencedirect* [Online] Available at doi:10.1016/j.jclepro.2007.12.002 (Accessed on 31 May 2013)

Alwaer, H., and Clements-Croome (2010), ‘Key performance indicators (KPIs) and priority setting in using the multi-attribute approach for assessing sustainable intelligent buildings’, *Building and Environment*, Volume 45 (4), pp.799-807, *Sciencedirect* [Online], Available at doi:10.1016/j.buildenv.2009.08.019 (Accessed on 17 April 2014)

Alwan, Z. and Jones, P. (2014), 'The importance of embodied energy in carbon footprint assessment', *Structural Survey*, Volume 32, pp.49-60, *Emerldinsight* [Online], Available at doi: 10.1108/SS-01-2013-0012 (Accessed on 17 March 2014)

Ambila, Z. and Sohal, A, (2009), 'A study of the environmental management system (EMS) adoption process within Australasian organisations – 2. Role of stakeholders', *Technovation 24*, pp.371-386, *Sciencedirect* [Online]. Available at doi:10.1016/S0166-4972(02)00115-3 (Accessed on 05 August 2013)

Amores-Salvado, J., Martin-de Castro, G. and Navas-Lopez, J.E. (2015), 'The importance of the complementarity between environmental management systems and environmental innovation capabilities: A firm level approach to environmental and business performance benefits', *Technological Forecasting and Social Change 96,* pp.288-297, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.techfore.2015.04.004 (Accessed on 08 March 2016)

Andrew, J. and Cortese, C. L. (2011), 'Carbon Disclosures: Comparability, the Carbon Disclosure Project and the Greenhouse Gas Protocol, *Australasian Accounting, Business and Finance Journal,* 5(4), pp.5-18.[Online] Available at:http://ro.uow.edu.au/aabfj/vol5/iss4/3 (Accessed on 31 January 2016)

Andrew, J. and Cortese, C. (2011), 'Accounting for climate change and self-regulation of carbon disclosures', *Accounting Forum 35,* pp. 130-138, *Sciencedireect* [Online], Available at http://www.dx. doi.10.1016/j.accfor.2011.06.006 (Accessed on 02 July 2013)

Andrew, J and Cortese, C. (2013), 'Free market environmentalism and neoliberal project: The case of the Climate Disclose Standards Board', *Climate Perspectives on Accounting,* Volume 24, pp. 397-409, *Sciencedirect* [Online], Available on http://dx.doi.org/10.1016/j.cpa.2013.05.010 (Accessed on 09 August 2013)

Apergis, N., Eleftheriou, S., and Payne, J. E. (2013), 'The relationship between international financial reporting standards, carbon emissions and R&D expenditures: Evidence from European manufacturing firms', *Ecological Economics,* Volume 88, pp.57-66, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.ecolecon.2012.12.024 (Accessed on 09 August 2013)

Ascui, F and Lovell, H. (2012), 'Carbon accounting and the construction of competence', *Journal of Cleaner Production,* Volume 36, pp.48-59, *Sciencedirect* [Online], Available on doi:10.1016/j.jclepro.2011.12.015 (Accessed on 10 August 2013)

Atmos (2015), '*Atmosfair – offsetting your air travel',* [Online], Available at https://www.atmosfair.de/ (Accessed on 07 January 2015)

Bachmann. C. (2009), 'Sustainable performance increases and strategic turnaround management: current corporate restructuring experiences in the Romanian Market', *Business Strategy Series,* Volume 10 (6), pp.331-338, *Emeraldinsight* [Online], Available at http://dx.doi.org/10.1108/17515630911005600 (Accessed on 06 March 2016)

Badley, G. (2003), 'The crisis in Educational Research: a pragmatic approach', *European Educational Research Journal*, Volume 2 (2), pp.295-308, [Online], Available at http://www.wwwords.co.uk/rss/abstract.asp?j=eerj&aid=1722 (Accessed on 10 February 2014)

Bagal, D. (2006), 'Personal and intellectual influences leading to Lewin's paradigm of action research', *Action Research,* Volume 4 (4), pp. 367-388, *Sageonline* [Online], Available at doi: 10.1177/1476750306070101 (Accessed on 25 August 2013)

Balzarova, M.A. and Castka, P. (2008), 'Underlying mechanisms in the maintenance of ISO 14001 environmental management systems', *Journal of Cleaner Production*, Volume 16, pp. 1949-1957, *Sciencedirect* [Online], Available on doi:10.1016/j.jclepro.2008.01.007 (Accessed on 05 August 2013)

Bangay, C. and Blum, N (2010), 'Education responses to climate change and quality: Two parts of the same agenda?, *International Journal of Educational Development'*, Volume 30, pp.359-368. *Sciencedirect* [Online] Available at doi:10.1016/j.ijedudev.2009.11.011 (Accessed on 31 May 2013)

Bansal, P. and Bognar, W.C. (2002). 'Deciding on ISO14001 : Economics, Institutions and Contexts', *Long Range Planning*, Volume 35 (3), pp. 269-290, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/S0024-6301(02)00046-8 (Accessed on 06 August 2013)

Barako, D.G., Hancock, P., and Izan, Y. (2006), 'Factors influencing voluntary corporate disclosure by Kenyan Companies', *Corporate Governance: An International Review*, Volume 14 (2), pp.107-125, *Wiley* [Online], Available at doi: 10.1111/j.1467-8683.2006.00491.x (Accessed on 09 August 2013)

Barnes, P. and Jerman. P. (2012), 'Developing an environmental management system for a multiple university consortium'. *Journal of Cleaner Production*, Volume 10 (1), pp. 33-39, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/S0959-6526(01)00020-8 (Accessed on 05 August 2013)

Baumgartner, R.J. (2009), 'Organisational culture and leadership: Preconditions for the development of a sustainable corporation', *Sustainable Development,* Volume 17 (2), pp.102-113, *Wiley* [Online], Available on doi: 10.1002/sd.405 (Accessed on 09 August 2013)

Bebbington, J, and Gray, R. (2001), 'An account of sustainability: Failure, success and reconceptualization', *Critical Perspectives on Accounting*, Volume 12, pp.557-587, *Idealibrary* [Online], Available at doi:10.1006/cpac.2000.0450 (Accessed on 15 November 2015)

Bebbington, J., Gray, R., and Laughlin, R. (2012), '*Financial Accounting and Practice and Principles'*, p.411, 3rd Edition, Thompson, London

Bebbington, J., and Larrinaga-Gonzalez, C. (2008),'Carbon trading: accounting and reporting issues', *European Accounting Review*, Volume 42(3), pp.697-717 [Online] Available at http://www.gci.org.uk/Documents/Carbon_Trading.pdf (Accessed on 01 July 2013)

Bahl, S., and Milne, G.R. (2007) [Editor, Belk, R.W], '*Handbook of Qualitative Research in Marketing'*, p.198, Edward Elgar Publishing, Cheltenham, UK

Belkaoui, A.R (2004), '*Accounting Theory'*, pp.345-353, 5th Edition, Thomson, London

Bencze, O.C., Dasmohapatra, S., and Tilotta, D.C. (2012), 'A concept for a performance based rating system for home resilience; EsScU, *International Journal of Disaster Resilience in the Built Environment*, Volume 3 (2), pp.148-165, *EmeraldInsight* [Online], Available at doi: 10.1108/17595901211245242 (Accessed on 08 February 2014)

Bennell, P and Pearce, T. (2003), 'The internationalization of higher education: exporting education to developing and transition economies', *International Journal of Educational Development*, Volume 23, pp. 215–232, *Sciencedirect* [Online], Available at doi:10.1016/S0738-0593(02)00024-X (Accessed on 01 August 2013)

Benton, T (2013)[Eds, Archer, M., Bhaskar, R., Coller, A., Lawson, T., and Norrie, A.], '*Critical realism: Essential Readings*', p.298, Routledge Publications, UK

Berners-Lee, M., Howard, D.C., Moss, J., Kaivato, K., and Scott, W.A. (2011), 'Greenhouse gas footprinting for small business – the use of input-output data', *Science of the Total Environment*, Volume 409(5), pp.883-91, *Sciencedirect* [Online], Available at doi:10.1016/j.scitotenv.2010.11.023 (Accessed on 15 February 2014)

Berg, B.L. (2004), '*Qualitative Research Methods for Social Sciences'*, p. 28, Pearson, London

Beringer, A., Wright, T., Malone, L. (2008), 'Sustainability in higher education in Atlantic Canada', *International Journal of Sustainability*, Volume 9 (1), pp.48-67, *Emeraldinsight* [Online], Available at doi: 10.1108/14676370810842184 (Accessed on 03 August 2013)

Bero, B.N., Doerry, E, Middleton, R., and Meinhardt, C. (2012), 'Challenges in the development of environmental management systems on the modern university campus', *International Journal of Sustainability in Higher Education*, Volume 13 (2), pp. 133-149, *Emeraldinsight* [Online], Available at doi 10.1108/14676371211211827 (Accessed on 03 August 2013)

Berry, D.M. (2004), 'Internet Research: privacy, ethics and alienation: an open source approach', *Internet Research*, Volume 14 (4), pp.323-332, *Emeraldinsight* [Online], Available at 10.1108/10662240410555333 (Accessed on 02 December 2013)

Bilodeau, L., Podger, J., and Abd El-Aziz, A. (2014), 'Advancing campus and community sustainability: strategic alliances in action', *International Journal of Sustainability in Higher Education, Volume,* 15 (2), pp.157-168, *Emeraldinsight* [Online], Available at doi: 10.1108/IJSHE-06-2012-0051(Accessed on 17 February 2014)

Black, P.A. (1983), 'Participant Observation and Logical Positivism in the Social Sciences: A Note', *World Development,* Volume 11 (4), pp.389-390, *Sciencedirect* [Online], Available online (Accessed on 04 December 2013)

Blaikie, N. (2007), '*Approaches to Social Enquiry'*, p.13, 2nd Edition, Cambridge UK, Polity Press.

Boehm, M. and Thoman, O. (2013), ' Looking beyond the rim of one's teacup : a multidisciplinary literature review of Product-Service Systems in Information Systems, Business Management and Engineering & Design, *Journal of Cleaner Production 51*, pp.245-260, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2013.01.019 (Accessed on 06 July 2013)

Bohte, W. and Maat, K. (2009), 'Deriving and validating trip purposes and travel modes for multi-day GPS-based travel surveys: A large scale application in the Netherlands', *Transport Research Part C: Emerging Technologies,* Volume 17 (3), pp.286-297, *Sciencedirect* [Online], Available at doi:10.1016/j.trc.2008.11.004 (Accessed on 17 December 2014)

Boiral, O. (2001), 'Corporate Greening Through ISO 14001: A Rational Myth?', *Organization Science,* Volume 18 (1), pp.127-146, [Online], Available at doi: 10.1287/orsc.1060.0224 (Accessed on 05 August 2013)

Boiral, O. and Henri, J-F. (2012), 'Modelling the impact of ISO 14001 on environmental performance: A comparative approach', *Journal of Environmental Management*, Volume 99, pp.84-97, *Sciencedirect* [Online], Available at doi:10.1016/j.jenvman.2012.01.007 (Accessed on 02 January 2015)

Bottomley, P.A. and Doyle, J.R. (2013), 'Comparing the validity of numerical judgements elicited by direct rating and point allocation: Insights from objectively verifiable perceptual tasks', *European Journal of Operational Research,* Volume 228, pp.148-157, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.ejor.2013.01.005 (Accessed on 08 February 2014)

Boston, J. and Lempp, F. (2011),'Explaining and solving the mismatch between scientific urgency and political inertia', *Accounting, Auditing and Accountability Journal*, Volume 24(8), pp. 1000-1021, *Emeraldinsight* [Online] Available at doi: 10.1108/09513571111184733 (Accessed on 10 March 2014)

Bouten, L. and Hoozee, S. (2013), 'On the interplay between environmental reporting and management accounting change', *Management Accounting Research,* Volume 24 (2013), pp.333-348, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.mar.2013.06.005 (Accessed on 03 December 2013)

Bowen. F., and Wittneben, B. (2011), 'Carbon Accounting', Accounting, Auditing & Accountability Journal, Volume 24 (8), pp.1022-1036, *Emeraldinsight* [Online], Available at doi :10.1108/09513571111184742 (Accessed on 12 August 2013)

Bowers, T. (2010), 'From image to economic value: a genre analysis of sustainability reporting', *Corporate Communications An International Journal*, Volume 15 (3), pp.249-262, *Emeraldinsight* [Online] Available at doi:10.1108/13563281011068113 (Accessed on 04 July 2013)

Bracci, E. and Maran, L. (2013), 'Environmental management and regulation: pitfalls of environmental accounting?', *Management of Environmental Quality: An International Journal*, Volume 24 (4), pp.538-554, *Sciencedirect* [Online], Available at doi:10.1108/MEQ-04-2012-0027 (Accessed on 08 August 2013)

Bradfield, R., Wright, G., Burt. G., Cairns, G., Van Der Heijden, K. (2005), 'The origins and evolution of scenario techniques in long range business planning', *Futures*, Volume 37(8), pp.795-812, *Sciencedirect* [Online], Available at doi:10.1016/j.futures.2005.01.003 (Accessed on 17 August 2014)

Brandt, U.S., and Svendsen, G.T. (2013), 'Is local participation always optimal for sustainable action? The costs of consensus-building in Local Agenda 21', *Journal of Environmental Management*, Volume 129, pp.266-273, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jenvman.2013.07.020 (Accessed on 15 November 2015)

Brick, M., Dipko, S., Presser, S., Tucker, C., and Yuan,Y. (2006), 'Nonresponse Bias in a Dual Frame Sample of Cell and Landline Numbers', *Public Opinion Quarterly*, Volume 70 (5), pp.780-793, *Oxfordjournals* [Online], Available at http://poq.oxfordjournals.org/content/70/5/646.full.pdf+html (Accessed on 02 December 2013)

Bright (2015), '*Exploring the disadvantages of PDCA Methodologies'*, [Online], Available at http://www.brighthubpm.com/methods-strategies/75929-exploring-the-disadvantages-of-pdca-methodologies/ (Accessed on 23 November 2015)

Brinkhurst, M., Rose, P, Maurice, G., and Ackerman, J.D. (2011), 'Achieving campus sustainability: top-down, bottom-up or neither', *International Journal of Sustainability in Higher Education*, Volume 12(4), pp.338-354, *Emeraldinsight* [Online] Available at doi:10.1108/14676371111168269 (Accessed on 03 July 2013)

Bracci, E. and Maran, L. (2013), 'Environmental management and regulation; pitfalls of environmental accounting?', *Management of Environmental Quality: An International Journal*, Volume 24 (4), pp.538-554, *Emeraldinsight* [Online], Available at doi:10.1108/MEQ-04-2012-0027 (Accessed on 06 December 2014)

Brocken, N.M.P., and Allwood, J.M. (2012), 'Strategies to reduce the carbon footprint of consumer goods by influencing stakeholders', *Journal of Cleaner Production*, Volume 35, pp. 118-129. *Sciencedirect* [Online], Available at doi:10.1016/j.jclepro.2012.05.031 (Accessed on 02 October 2013)

Brown, J. and Fraser, M. (2006), 'Approaches and perspectives in social and environmental accounting: an overview of the conceptual landscape', *Business Strategy and the Environment*, Volume 15 (2), pp. 103-117, *Wiley* [Online], Available on doi: 10.1002/bse.452 (Accessed on 08 August 2013)

Brundtland (1992),'*Our common future: A Reader's Guide – The Brundtlamd Report Explained'*, Don Hinnchsen, Routledge, USA

Bryman, A. and Bell, E. (2007), '*Business Research Methods'*, pp. 75-84, Oxford University
Press. London

Bryman, A. (2004), 'Qualitative research on leadership: A critical but appreciative review', *The Leadership Quarterly*, Volume 15, pp.729-769, *Sciencedirect* [Online], Available at doi:10.1016/j.leaqua.2004.09.007 (Accessed on 04 December 2013)

Burandt, S., and Barth, M. (2010), 'Learning settings to face climate change', *Journal of Cleaner Production*, Volume 18 (7), pp.659-665, *Sciencedirect* [Online] Available at http://dx.doi.10.1016/j.jclepro.2009.09.010 (Accessed on 02 July 2013)

Busch, M., La Notte, A., Laporte, V., and Erhard, M. (2012), 'Potentials of quantitative and qualitative approaches to assessing ecosystem services', *Ecological Indicators 21*, pp.89-103, *Sciencedirect* [Online], Available at doi:10.1016/j.ecolind.2011.11.010 (Accessed on 24 September 2014)

Buys, L., Mengersen, K., Johnson, S., Van Bauuren, N., and Chauvin, A. (2014), Creating a Sustainability Scorecard as a predictive tool for measuring the complex social, economic and environmental impacts of industries, a case study : Assessing the viability and sustainability of the dairy industry', *Journal of Environmental Management*, Volume 133, pp.184-192, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jenvman.2013.12.013 (Accessed on 17 February 2014)

Callon, M. (2009), 'Civilizing markets : Carbon trading between in vitro and in vivo experiments', *Accounting, Organisations and Society*, Volume 34 (3-4), pp. 535-546, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.aos.2008.04.003 (Accessed on 10 February 2014)

Camara, M., Charmorro, E., and Moreno, A. (2009), 'Stakeholder Reporting: The Spanish Tobacco Monopoly (1887-1986)', *European Accounting Review*, Volume 18 (4), pp.697-717, *TaylorFrancisOnline* [Online], Available at doi:10.1080/09638180902863753 (Accessed on 10 February 2014)

Cambridge (2014), '*University of Cambridge Footprint and Analysis of Scope 3 Emissions: Element 1: Final Report'*, [Online], Available at http://www.environment.admin.cam.ac.uk/files/university_of_cambridge_scope_3_element_1_final.pdf (Accessed on 23 November 2015)

Carbon Trust (2014), '*Carbon Trust Helps GHG Protocol create pragmatic guidance for measurement of Scope 3 emissions'*, [Online], Available at http://www.carbontrust.com/about-us/press/2013/04/carbon-trust-ghg-protocol-pragmatic-guidance-scope-3-emissions-measurement (Accessed on 14 February 2014)

Cargan, L. (2007), '*Doing Social Research'*, p.116, Roman & Littlefiled Publishers, USA

Carroll, A.B., and Buchholtz. A. K. (2014), '*Business and Society: Ethics, Sustainability and Stakeholder Management'*, p.45, Cengage Learning, Stanford, USA

Caro, D., Bastianoni, S., Borghesi, S., Pulselli, F. M. (2014), 'on the feasibility of a consumer-based allocation method in national GHG inventories', *Ecological Indicators*, Volume 36, pp.640-643, *Scincedirect* [Online], Available at http://dx.doi.org/10.1016/j.ecolind.2013.09.021 (Accessed on 12 March 2014)

Cca (2008), '*Climate Change Act', Chapter 27,* [Online], Available at http://www.legislation.gov.uk/ukpga/2008/27/introduction (Accessed on 25 March 2013)

Cdsb (2013), '*Climate change reporting framework'*, [Online], Available at http://www.cdsb.net/climate-change-reporting-framework/why-we-need-framework (Accessed on 10 August 2013

Cdsb (2014), '*Proposals for boundary setting in mainstream reports'*, p.3 [Online], Available at http://www.cdsb.net/sites/cdsbnet/files/proposals_for_mainstream_report_boundary_setting.pdf (Accessed on 29 January 2016)

Cdp (2013), '*CDP : The Facts'*, [Online], Available at https://www.cdp.net/Documents/CDP-the-facts.pdf (Accessed on 31 Janaury 2016)

Cdp (2015), '*Carbon Disclosure Project'*, [Online], Available at https://www.cdp.net/en-US/OurNetwork/Pages/special-projects.aspx#cdsb (Accessed on 29 January 2016)

Cdp (2010), 'The Carbon Management Strategic Priority', *Carbon Disclosure Project*, [Online], Available at https://www.cdproject.net/en-US/WhatWeDo/Documents/cdp-carbon-management-strategic-priority-report.pdf (Accessed on 08 August 2013)

Ceres (2014), '*Value at Risk: Climate Change and the Future of Governance'*, pp.17-21, Boston, USA, [Online], Available at http://www.ceres.org/resources/reports/value-at-risk-climate-change-and-the-future-2002 (Accessed on 07 July 2013)

Chambers, N., Simmons, C., and Wackermagel, M. (2014), '*Sharing Nature's Interest: Ecological Footprints as an Indicator of Sustainability'*, p.16, Routledge, UK

Chelliah, J.R. (2015),'Quantifying and Managing Scope 3 (Travel) carbon emissions in a UK University'(unpublished thesis)[Online] (Turnitin) Accessed on 12 April 2016

Chivers, D. (2007), '*The Companies Act 2006: Directors' Duties Guidance'*, p.6 [Online], Available at http://corporate-responsibility.org/wp-content/uploads/2013/11/directors_guidance_final.pdf (Accessed on 16 November 2015)

Choudhury, M.A. and Korvin, G. (2001), 'Sustainability in knowledge-centred socio-scientific systems', *International Journal of Sustainability in Higher Education*, Volume 2 (3), pp. 257-266, *Emeraldinsight* [Online], Available at http://dx.doi.org/10.1108/14676370110397688 (Accessed on 21 October 2015)

Chung, J-E., Sterquist, B., and Chen, Z. (2008), 'Japanese retail buyer supplier relationships: does performance matter?, *Asia Pacific Journal of Marketing*, Volume 20 (1), pp.55-75, *Emeraldinsight* [Online], Available at Doi: 10.1108/13555850810844878 (Accessed on 08 February 2014)

City (2014), '*City University London – Sustainability Annual Report 2012/13'*, pp.19-23, [Online], Available at https://www.city.ac.uk/__data/assets/pdf_file/0011/207587/6916_SustainabilityReport_A4_WEB-Jan-2014.pdf (Accessed on 14 November 2015)

Clarke, A. and Kouri, R. (2009), 'Choosing an appropriate university or college environmental management system', *Journal of Cleaner Production 17*, pp. 971-984, *Sciencedirect* [Online] Available at doi:10.1016/j.jclepro.2009.02.019 (Assessed on 05 December 2014)

Clarke, A. (2006). 'The campus environmental management system cycle in practice', *Journal of Cleaner Production*, Volume 7 (4), pp.374-389, *Emeraldinsight* [Online], Available at doi: 10.1108/1467637061070218, (Accessed on 01 August 2013)

Cleary, J. (2009), 'Life cycle assessments of municipal solid waste management systems: A comparative analysis of selected peer reviewed literature', *Environmental International*, Volume 35 (8), pp.1256-1266, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.envint.2009.07.009 (Accessed on 15 November 2015)

Clift R (2007), 'Climate Change and Energy Policy: the importance of sustainability arguments', *Energy 32*, pp.262-268, *Sciencedirect* [Online], Available at doi:10.1016/j.energy.2006.07.031 (Assessed on 31 May 2013)

Costa, R., and Menichini, T. (2013), 'A Multidimensional approach for CSR assessment: The importance of stakeholder perception', *Expert Systems with Applications*, Volume 40, pp.150-161, *Scienedirect* [Online], Available at http://dx.doi.org/10.1016/j.eswa.2012.07.028 (Accessed on 10 February 2014)

Corporate (2013) [Corporate Citizenship], '*Getting Ready for Mandatory Carbon Reporting'*, [Online], Available at http://www.corporate-citizenship.com/getting-ready-for-mandatory-carbon-reporting/ (Accessed on 05 July 2013)

Chicco. G. and Stephenson, P.M. (2012), 'Effectiveness of setting cumulative carbon dioxide emissions reducing targets", *Energy*, pp.19-31, *Sciencedirect* [Online] Available at doi:10.1016/j.energy.2011.11.024 (Accessed on 10 February 2014)

Clarke, A. (2006), 'The Campus environmental management system cycle in practice', *International Journal of Sustainability in Higher Education*, Volume 7 (4), pp.374-389, *Emeraldinsight* [Online], Available at DOI 10.1108/14676370610702181 (Accessed on 20 November 2015)

Climate Change (2010), [Online], Available at http://www.climatechange.bham.ac.uk/documents/CMIP_2011_Final.pdf (Accessed on 01 December 2013)

Coghlan, D. (2007), 'Insider action research: opportunities and challenges', *Management Research News*, Volume 30 (5), pp.335-343, *Emeraldinsight* [Online], Available at doi: 10.1108/01409170710746337 (Accessed on 03 March 2016)

Cohen, L., Manion, L., and Morrison, K. (2011), '*Research Methods in Education'*, p.116, 7th Edition, Routledge, Oxon

Copernicus (2011), '*Copernicus-Alliance'*, [Online], Available at www.copernicus-alliance.org (Accessed on 04 August 2013)

Cotton, D.R.E. and Winter, J. (2010)[Eds Jones, P., Selby, D. and Sterling, S] 'It's not just Bits of Paper and Light Bulbs: A review of Sustainability Pedagogies and their Potential for use in Higher Education', *Sustainability Education: Perspectives and Practice Across Higher Education*, pp. 85, 102-112, Earthscan, London

Crc (2013), '*CRC Energy Efficiency Scheme'*. [Online] Available at https://www.gov.uk/crc-energy-efficiency-scheme (Accessed on 31 May 2013)

Crc (2013a), '*CRC Energy Efficiency Scheme'*, [Online], Available at https://www.gov.uk/government/policies/reducing-demand-for-energy-from-industry-businesses-and-the-public-sector--2/supporting-pages/crc-energy-efficiency-scheme (Accessed on 31 May 2013)

Creswell, J.W. (2012), '*Qualitative Inquiry and Research Design: Choosing Among Five Approaches',* pp.42-242. Sage Publications. UK

Cuevas, S.C. (2011), 'Climate change, vulnerability and risk linkages' *International Journal of Climate Change Strategies and Management*, Volume 3(1), pp.29-60, *Emeraldinsight* [Online] Available at http://www.emeraldinsight.com/journals.htm?issn=1756-8692&volume=3&issue=1&articleid=1906468 (Assessed on 31 May 2013)

D'Amour, D., Farrada-Videla, M., Rodriguez, L.S.M., and Beaulieu, M-D. (2005), 'The conceptual basis for interprofessional collaboration: Core concepts and theorectical frameworks', *Jouranl of Interprofessional Care*, Supplement 1, pp.116-131, [Online], Available at http://caipe.org.uk/silo/files/the-conceptual-basis-for-interprofessional-collaboration-core-concepts-and-theoretical-frameworks.pdf (Accessed on 21 Janaury 2016)

Damian, I.P.M., Segundo, S.J.E., and Merlo, E.M. (2014), 'SWOT analysis of the services provided by e-government sites in Brazil', *Procedia Computer Science*, Volume 33, pp.130-135, *Sciencedirect* [Online], Available at doi: 10.1016/j.procs.2014.06.021 (Accessed on 07 July 2014)

Darnall, N., Gallagher, D.R., and Andrews, R.N.L.[Ed. Sarkis.., J] (2007), 'ISO 14001 : Greening Management Systems', *Greener Manufacturing and Operations, Greenleaf Publishing*, [Online], Available at http://ssrn.com/abstract=1009966 (Accessed on 06 August 2013)

Davidson, L., Littleford, C., and Ryley, T. (2014), 'Air Attitudes and behaviours: the development of environmental – based segments, *Journal of Air Transport*, Volume 36, pp.13-22, *Sciencedirec*t [Online], Available at doi: 10.1016/j.jairtraman.2013.12.007 (Accessed on 17 July 2013)

Deegan, C. (2009), '*Financial Accounting Theory'*, pp.128-129, McGraw-Hill Book Company, 3rd Edition, Sydney

Defra (2009), '*Guidance on how to measure and report your greenhouse gas emissions'*, [Online], Available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69282/pb13309-ghg-guidance-0909011.pdf (Accessed on 08 August 2013)

Defra (2010), '*The contribution that reporting of GHG emissions makes to the UK meeting its Climate Change Objectives: A review of the current evidence'*,[Online], Available at www.archive.defra.gov.uk/environment/business/reporting/pdf/corporate-reporting101130.pdf (Accessed on 28 February 2014)

Defra (2011), '*Implementing the Climate Change Act 2008'*, [Online], Available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48081/1683-4th-carbon-budget-policy-statement.pdf (Accessed on 16 November 2015)

Defra (2012). '*Reporting Guidance for Business on Environmental Key Performance Indicators: a consultation on Guidance for UK Business'*, [Online], Available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/82551/consult-kpi-document.pdf (Accessed on 17 February 2014)

Defra (2012a), '*Summary of the key findings from the UK Climate Change Risk Assessment 2012'*, p.5 [Online], Available at http://www.defra.gov.uk/sac/files/SAC1215-CCRA-Paper-Annex-1-Key-Findings.pdf (Assessed on 01 July 2012)

Defra (2012b), '2012 *Guidelines to Defra/DECC's GHG Conversion Factors for Company reporting'*, [Online], Available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69554/pb13773-ghg-conversion-factors-2012.pdf (Accessed on 08 December 2014)

Defra3 (2013), '*Environmental reporting guidelines: Including mandatory greenhouse gas emissions reporting guidance'*, [Online], Available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/206392/pb13944-env-reporting-guidance.pdf (Accessed on 10 August 2013)

Defra (2015), '*Greenhouse Gas Conversion Factor Repository', Defra*, [Online], Available at http://www.ukconversionfactorscarbonsmart.co.uk/ (Accessed on 22 October 2015)

Defra4 (2015), (Vedrenne, M., Cooke, S., Stedman, J.R., and Kent, A.J.), '*Streamlined PCM Technical Report', Version 2.1*,[Online], Available at http://uk-air.defra.gov.uk/assets/documents/reports/cat09/1511260938_AQ0959_Streamlined_PCM_Technical_Report_(Nov_2015).pdf

Deloitte (2015), 'IFRS – *Fair value measurement'*, [Online], Available at http://www.iasplus.com/en-gb/standards/ifrs-en-gb/ifrs13 (Accessed on 27 Janaury 2016)

De Montfort (2011), '*De Montfort University Carbon Management Plan'*, p.15 [Online], Available at http://www.dmu.ac.uk/documents/about-dmu-documents/dmu-estate/environmental/dmu-carbon-management-plan.pdf (Accessed on 06 February 2016)

Dessai, S. and Slujis, J, (2007), '*Uncertainty and Climate Change Adaptation – A Scoping Study'*, [Online], pp.3-6, Available at http://research.fit.edu/sealevelriselibrary/documents/doc_mgr/946/Dessai_et_al._2007._CC_Adaptation_Scoping_Study.pdf (Accessed on 23 October 2015)

Devereux, P. and Fan, W. (2011), 'Earnings returns to the British education expansion', *Economics of Education Review*, Volume 30, pp,1153-1166, *Sciencedirect* [Online], Available at doi:10.1016/j.econedurev.2011.03.004 (Accessed on 17 February 2014)

Dick, B. (2002), 'Postgraduate programs using action research', *The Learning Organisation.* Volume 9 (4), pp.159-170, *Emeraldinsight* [Online], Available at doi: 10.1108/09696470210428886 (Accessed on 30 June 2014)

Disterheft, A., Caeiro, S.S.F.S., Ramos, M.R. and Azeiteiro, U.M.M. (2012), 'Environmental Management Systems (EMS) implementation process and practices in European higher education institutions – Top down versus participatory approaches', *Journal of Cleaner Production,* Volume 31, pp.80-90, *Sciencedirect* [Online], Available at doi:10.1016/j.jclepro.2012.02.034 (Accessed on 05 January 2015)

Dmu (2012), '*De Montfort University Environmental Report – 2012/13 – Report of the Sustainable Development Task Force March 2014'*, pp.7-8 [Online], Available at http://www.dmu.ac.uk/documents/dmu-staff/environmental/environmental-report-2012-13.pdf (Accessed on 11 November 2015)

Doha (2012), '*Unfccc – Doha Conference'*, [Online], Available at http://unfccc.int/meetings/doha_nov_2012/meeting/6815.php (Accessed on 17 May 2013)

Downie, J. and Stubbs, W. (2013), 'Evaluation of Australian Companies Scope 3 Green House Emissions Assessments', *Journal of Cleaner Production* (Inpress), pp.1-8, *Sciencedirect* [Online] Available at doi:10.1016/j.clepro.2011.09.010 (Assessed on 02 June 2013)

Dyson, R.G. (2004), 'Strategic development and SWOT analysis at the University of Warwick', *European Journal of Operational Research,* pp. 631-640, *Sciencedirec*t [Online], Available at doi:10.1016/S0377-2217(03)00062-6 (Accessed on 03 March 2016)

Ec (2015). *Environmental Association of Universities and Colleges (EUAC) – HEFCE Survey Measuring Scope 3 Emissions from Higher Education Institutions'*. [Online], Available at http://www.eauc.org.uk/hefce_survey_for_work_on_measuring_scope_3_emis (Accessed on 20 November 2015)

Ec1 (2015). '*Environmental Association of Universities and Colleges (EUAC): Enviromental Management Systems',* [Online], Available at http://www.eauc.org.uk/environmental_management_systems (Acccessed on 02 March 2016)

Eco (2013), '*EcoCampus'* [Online], Available at www.ecocampus.co.uk, (Accessed on 14 April 2014)

Ecoamerica (2015), '*American College & Universities Presidents Climate Commitment',* [Online], Available at http://ecoamerica.org/programs/american-college-university-presidents-climate-commitment/ (Accessed on 10 February 2016)

Ecometrica (2013), '*Mandatory carbon reporting requirements are firmed up'*, [Online], Available at http://ecometrica.com/blog/mandatory-carbon-reporting-requirements-are-firmed-up/ (Accessed on 08 August 2013)

Economist (2012), '*What Doha did', The Economist,* [Online], Available at http://www.economist.com/news/international/21568355-no-progress-today-slightly-better-chance-progress-tomorrow-what-doha-did (Accessed on 19 November 2015)

Eccles, R.G., and Krzuz, M.P. (2010), '*One Report: Integrating Reporting for a Sustainable Strategy'*, pp. 35-40, Wiley, UK

Eccles, R.G., Krzus, M.P., Rogers, J., and Serafeim, G. (2012), 'The Need for Sector-Specific Materialty and Sustainability Reporting Standards', *Journal for Applied Corporate Finance*, Volume 24 (2), *Wileyonline* [Online], Available at http://onlinelibrary.wiley.com/doi/10.1111/j.1745-6622.2012.00380.x/epdf (Accessed on 02 March 2016)

Egenhofer, C (2007), 'The Making of the EU Emissions Trading Scheme: Status, Prospects and Implications for Business', *European Management Journal*, Volume 25 (6), pp. 453-463, *Sciencedirect* [Online], Accessed on 08 August 2013

Eiadat, Y., Kelly, A., Roche, F., and Eyadat, H. (2008), 'Green and competitive? An empirical test of the mediating role of environmental innovation strategy', *Journal of World Business*, Volume 43, pp. 131-145, *Sciencedirect* [Online], Available at doi:10.1016/j.jwb.2007.11.012 (Accessed on 19 December 2014)

Ellis, J., Winkle, H., Corfee-Morlot, J., and Gargon-Lebrun, F. (2007), 'CDM : Taking Stock and looking forward', *Energy Policy*, Volume 35 (1), pp.15-28, *Sciencedirect* [Online], Available at doi:10.1016/j.enpol.2005.09.018 (Accessed on 08 August 2013)

Elliott, R. and Timulak, L. (2005), '*Descriptive and interpretive approaches to qualitative research'*, Chapter 11, pp. 147-157, [Online] Available at http://nideffer.net/classes/GCT_RPI_S14/readings/interpretive.pdf (Accessed on 22 October 2015)

Elms, H., Johnson-Cramer, M.E., and Berman, S.L. [Eds, Philips, R.A.], '*Stakeholder Theory – Impacts and Prospects'*, p.5, Edward Elgar Publishing, UK/USA

Endowment (2015), '*Sustainable Endowments Institute'*, [Online], Available at http://www.endowmentinstitute.org/ (Accessed on 12 February 2016)

Erdas, C., Fokaides, P.A., Charalambous, C. (2015), 'Ecological footprint analysis based awareness creation for energy efficiency and climate change mitigation measures enhancing the environmental management system of Limasol Port', *Journal of Cleaner Production*, Volume 108, pp.716-724, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2015.07.087 (Accessed on 23 October 2015)

Ets (2015), '*Aviation Cap 2010-2020'*, [Online], Available at http://ec.europa.eu/clima/policies/ets/cap/index_en.htm (Accessed on 18 April 2015)

Eu (2014), '*Non Financial Reporting'*, [Online], Available at http://ec.europa.eu/internal_market/accounting/non-financial_reporting/index_en.htm (Accessed on 23 April 2014)

Evans. J.R. and Mathur, A. (2005), 'The value of online surveys', *Internet Research,* Volume 15 (2), pp.195-219, *Sciencedirect* [Online], Available at doi 10.1108/10662240510590360, (Accessed on 10 February 2014)

Evangelinos, K.L., Jones, N., and Panoriou, E.M. (2009), 'Challenges and opportunities for sustainability in regional universities: a case study in Mytilene, Greece', *Journal of Cleaner Production*, Volume 17, pp.1154-1161, *Sciencedirect* [Online], Available at doi:10.1016/j.jclepro.2009.02.020 (Accessed on 14 April 2015)

Fadzil, Z.F., Hashim, H.S., Che-Ani, A.I., and Aziz, S. (2012), 'Developing a Campus Sustainability Assessment Framework for the National University of Malaysia'. *World Academy of Science, Engineering and Technology 66,* pp.751-755, [Online] Available at http://www.waset.org/publications/9122 (Assessed on 04 July 2013)

Fassin, Y. (2009), 'The Stakeholder Model Refined', *Journal of Business Ethics,* Volume 84(1), pp.113-135, *SpringerLink*[Online] Available at 10.1007/s10551-008-9677-4 (Accessed on 15 February 2013)

Faux, J. (2012), 'Environmental event materiality and decision making', *Managerial Auditing Journal*, Volume 27(3) pp.284-298, *Emeraldinsight* [Online], Available at doi 10.1108/02686901211207500 (Accessed on 04 February 2014)

Fein, J. (2012), 'Advancing sustainability in higher education: Issues and opportunities for research', *Higher Education Policy*, Volume 15, pp.143-152, *Palgrave Macmillian* [Online], Available at doi:10.1016/S0952-8733(02)00005-3 (Accessed on 05 December 2013)

Ferras-Balas D., Buecland, H. and De Mirera, M (2008), 'Exploration of the University's role in society for sustainable development through a systems transition approach: case study of the technical university of Catalonia', *Journal of Cleaner Production 17(22), Sciencedirect* [Online], Available at doi:10.1016/j.jelepro.2008.11.006 (Accessed on 17 May 2014)

Ferreira, A.J.D., Lopes, M.A.R. and Morais, J.P.F (2006), 'Environmental management and audit schemes implementation as an educational tool for sustainability, *Journal of Cleaner Production 14*, pp.973-982, *Sciencedirect* [Online] Available at doi:10.1016/j.jclepro.2006.01.003 (Assessed on 03 July 2013)

Fillimonau, V., Dickinson, J., and Robbins, D. (2014), 'The carbon impact of short haul tourism: a case study of UK travel to Southern France using life cycle analysis', *Journal of Cleaner Production,* Volume 64,pp.628-638, *Scienedirect* [Online] Available at http://dx.doi.org/10.1016/j.jclepro.2013.07.052 (Accessed on 14 February 2014)

Finlay, J. and Massey, J. (2011), 'Eco-Campus: applying the ecocity model to develop green university and college campuses, *International Journal of Sustainability in Higher Education*, Volume 13 (2), pp.150-165, *Emeraldinsight* [Online], Available at doi 10.1108/14676371211211836 (Accessed on 02 August 2013)

Florini, A. and Saleem, S. (2011), 'Information Disclosure in Global Energy Governance', *Global Policy 2*, pp.144-154, *Wiley* [Online], Available at doi: 10.1111/j.1758-5899.2011.00135.x (Accessed on 07 July 2013)

Fisher (2003), 'Applying ISO 14001 as a business tool for campus sustainability', *International Journal of Sustainability in Higher Education'*, Volume 4 (2), pp.138-150, *Emeraldinsight* [Online], Available at DOI 10.1108/14676370310467159 (Accessed on 21 November 2015)

Flick, U. [Eds, Flick, U., Von Kardorff, E., and Steinke, I] (2004), '*A Companion to Qualitative Research*', p.178, Sage Publications, UK

Flyvbjerg, B.[Eds.Denzin, N.K. and Lincoln, Y.S.] (2011), '*The Sage Handbook of Qualitative Research'*, pp.301-315, Sage Publications, UK

Fonseca, A., McAllister, M.L. and Fitzpatrick, P. (2014), 'Sustainability reporting among mining corporation: a constructive critique of the GRI approach', *Journal of Cleaner Production*, pp.1-14, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2012.11.050 (Accessed on 10 February 2014)

Foo, K.Y. (2013), 'A vision on the role of environmental higher education contributing to the sustainable development in Malaysia', *Journal of Cleaner Production*, Volume 61, pp.6-12, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2013.05.014 (Accessed on 05 December 2014)

Frame, B. and O'Connor, M. (2011), 'Integrating valuation and deliberation: the purpose of sustainability assessment'. *Environmental Science and Policy*, Volume 14, pp.1-10, *Sciencedirect* [Online], Available at doi:10.1016/j.envsci.2010.10.009 (Accessed on 10 February 2014)

Franco, L.A., Meadows, M. and Armstrong, S. (2013), 'Exploring individual differences in scenario planning workshops: A cognitive style framework', *Technological Forecasting and Social Change*, Volume 80. pp.723-734, *Sciencedirect* [Online], Available at doi:10.1016/j.techfore.2012.02.008, (Accessed on 04 December 2013)

Frankel, J.A. (2010). '*The Natural Resource Curse: A Survey'*, [Online], Available at http://www.nber.org/papers/w15836.pdf, (Accessed on 17 July 2014)

Frc (2012), '*The UK Stewardship Code'*, [Online], Available at https://www.frc.org.uk/Our-Work/Publications/Corporate-Governance/UK-Stewardship-Code-September-2012.pdf (Accessed on 20 June 2014)

Frc (2014), '*Financial Reporting Council* ', [Online], Available at http://www.frc.org.uk/Home.aspx (Accessed on 11 August 2013)

Freeman, R.E. (2010), '*Strategic Management: A Stakeholder Approach'*, p. 233, Cambridge University Press, UK

French, S. (2009), 'Action Research for practising managers', *Journal of Management Development*, Volume 28 (3), pp.187-204, *Emeraldinsight* [Online], Available at doi: 10.1108/02621710910939596 (Accessed on 30 June 2014)

Friesner, T (2013), '*SWOT Analysis'*, [Online], Available at http://www.marketingteacher.com/history-of-swot-analysis/ (Accessed on 15 November 2013)

Gandhi, N.M.D., Selladurai, V., Santhi, P. (2006), 'Green Productivity Indexing', *International Journal of Productivity and Performance Management'*, Volume 55 (7), pp.594-606, *Emeraldinsight* [Online], Available at doi: 10.1108/17410400610702179 (Accessed on 14 February 2016)

Garcia, R., and Freire, F. (2014), 'Carbon footprint of particleboard: a comparison between ISO.TS 14067, GHG Protocol, PAS 2050 and Climate Declaration', *Journal of Cleaner Production*, Volume 66, pp.199-209, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2013.11.073 (Accessed on 17 February 2014)

German (2011), '*German Sustainability Code'*, pp.11-12 [Online], Available at http://www.nachhaltigkeitsrat.de/uploads/media/RNE_The_German_Sustainability_Code_GSC_text_No_41_January_2012.pdf (Accessed 17 July 2013)

Geng, Y., Lui, K., Xue, B., and Fujita, T. (2013), 'Creating a green university in China: a case of Shenyang University, *Journal of Cleaner Production*, Volume, 61, pp.13-19, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2012.07.013 (Accessed on 17 August 2013)

Granly, B.M., and Welo, T. (2014), 'EMS and Sustainability : experiences with ISO 14001 and Eco-Lighthouse and Norwegian metal processing SMEs', *Journal of Cleaner Production*, Volume 64,pp.194-204, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2013.08.007, (Accessed on 17 February 2014)

Greene, J.C. (2007), 'Employing Mixed Methods in Evaluation', *Centres for Disease Control – American Evaluation Association Summer Evaluation Institute*, [Online], Available at http://betterevaluation.org/sites/default/files/si07.greeneF.pdf (Accessed on 15 January 2016)

Greene, J.C. and Caracelli, V.J. [Eds] (1997), 'Advances in mixed-method evaluation: The challenges and benefits of integrating diverse paradigms', *New Directions from Program Evaluation* [Online], Available at http://www.hfrp.org/evaluation/the-evaluation-exchange/issue-archive/methodology/advancing-mixed-method-evaluation (Accessed on 12 January 2016)

Grubb, M. (2000), 'Economic dimensions of technological and global responses to the Kyoto Protocol', *Journal of Economic Studies*, Volume 27 (1/2), pp.111-125, *Emeraldinshight* [Online], Available at http://dx.doi.org/10.1108/EUM0000000005313 (Accessed on 18 November 2015)

Ghg (2012), '*Greenhouse Gas Protocol Project Accounting'*, [Online], Available at http://ghgprotocol.org/files/ghgp/ghg_project_accounting.pdf (Accessed on 18 November 2015)

Ghg (2012a), 'Corporate Standard', *Greenhouse Protocol*, [Online], Available at http://www.ghgprotocol.org/standards/corporate-standard (Accessed on 03 December 2013)

Ghg (2012b), '*A Corporate Accounting and Reporting Standard', Greenhouse Gas Protocol,* p.4-5, [Online], Available at http://www.ghgprotocol.org/files/ghgp/public/ghg-protocol-revised.pdf (Accessed on 03 December 2013)

Ghg (2013), '*Greenhouse Gas Protocol'*, [Online], Available at http://www.ghgprotocol.org/files/ghgp/public/ghg-protocol-revised.pdf (Accessed on 09 August 2013)

Ghg (2013b), 'Required Greenhouse Gases in Inventories – Accounting and reporting Standard Amendments, February 2013, *Greenhouse Gas Protocol,* [Online]. Available at http://www.ghgprotocol.org/files/ghgp/NF3-Amendment_052213.pdf (Accessed on 03 December 2013)

Ghg (2013c) '*Guidance for Calculating Scope 3 Emissions'*, [Online], Available at http://www.ghgprotocol.org/files/ghgp/tools/GHG%20Protocol%20Guidance%20for%20Calculating%20Scope%203%20Emissions%20-%20DRAFT%20August%202011.pdf (Accessed on 03 December 2013)

Ghg (2013d), '*Greenhouse Gas Protocol'*, [online], Available at http://www.ghgprotocol.org/files/ghgp/Chapter6.pdf (Accessed on 02 December 2013)

Ghgprotocol (2013)[Ed. Sotos, M], '*Global Protocol for Community-Scale Greenhouse Gas Emissions (GPC)*', [Online], Available at http://www.ghgprotocol.org/files/ghgp/MSotos_GHGP_WRI_23May2013.pdf (Accessed on 27 January 2016)

Ghgreporting (2011), '*Guidance for calculating Scope 3 Emissions'*. [Online], Available at http://www.ghgprotocol.org/files/ghgp/tools/GHG%20Protocol%20Guidance%20for%20Calculating%20Scope%203%20Emissions%20-%20DRAFT%20August%202011.pdf (Accessed on 17 June 2014)

Gilbert, N. (2007), ‘Research Theory and Method’, *Researching Social Life,* p.25 [Online], Available at http://www.corwin.com/upm-data/18483_03_Gilbert(Researching)_Ch_02_WATERMARKED.pdf (Accessed on 30 November 2015)

Girod, B., Van Vuuren, D.P. and Hertwich, E.G. (2014), ‘Climate policy through changing consumption choices: Options and obstacles for reducing greenhouse gas emissions’, *Global Environmental Change,* Volume 25, pp.5-15, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.gloenvcha.2014.01.004 (Accessed on 12 March 2014)

Goulden, M., Ryley, T., and Dingwall, R. (2014), ‘Beyond ‘predict and provide’: UK transport, the growth paradigm and climate change’, *Transport Policy*, Volume 32, pp. 139-147, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.tranpol.2014.01.006 (Accessed on 10 March 2014)

Granly, B.M., and Welo, T. (2014), ‘EMS and sustainability: experiences with ISO 14001 and Eco-Lighthouse in Norwegian metal processing SMEs’, *Journal of Cleaner Production*, Volume 64, pp.194-204, *Sciencedirect* [Online]. Available at http://dx.doi.org/10.1016/j.jclepro.2013.08.007 (Accessed on 10 April 2014)

Gray, D.E. (2013), ‘*Doing Research in the Real World – The Theoretical Perspectives and Research Methodologies’*, [Online],pp.16-38, Available at http://uk.sagepub.com/sites/default/files/upm-binaries/58626_Gray__Doing_Research_in_the_Real_World.pdf (Accessed on 01 December 2015)

Globalreporting (2013), ‘*Global Reporting Initiative – G4 Sector Disclosures’*, [Online], Available at https://www.globalreporting.org/reporting/sectorguidance/sectorguidanceG4/Pages/default.aspx (Accessed on 11 August 2013)

Goldman, A. W. and Kane, M. (2014), ‘Concept of mapping and network analysis: Am analytic approach to measure ties among constructs’, *Evaluation and Program Planning,* Volume 47, pp.9-17, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.evalprogplan.2014.06.005 (Accessed on 17 November 2015)

Gomez, F. U., Saez-Navarrete, C., Lioi, S. R., and Marzuca, V. I. (2014), ‘Adaptable model for assessing sustainability in higher education’, *Journal of Cleaner Production – In press, Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2014.07.047 (Accessed on 12 January 2015)

Gonzalez-Benito, J., Lannelongue, G., and Queiruga, D. (2011), ‘Stakeholders and environmental management systems: a synergistic influence on environmental imbalance’, *Journal of Cleaner Production,* Volume 19, pp.1622-1630, *Sciencedirect* [Online], Available at doi:10.1016/j.jclepro.2011.05.013 (Accessed on 07 December 2014)

Gov (1990), '*Environmental Protection Act 1990, Chapter 43, Part 1*,' [Online], Available at http://www.legislation.gov.uk/ukpga/1990/43/contents (Accessed on 26 June 2014)

Gov (2006), '*Companies Act 2006, Section 385'*, [Online], Available at http://www.legislation.gov.uk/ukpga/2006/46/section/385 (Accessed 01 June 2013)

Gov (2008). '*Climate Change Act – Chapter 27'*, [Online], Available at http://www.legislation.gov.uk/ukpga/2008/27 (Accessed on 16 June 2014)

Gov (2013), '*Climate Change Bill – Adapting to Climate Change',* [Online], Available at https://www.gov.uk/government/policies/adapting-to-climate-change (Accessed on 10 August 2013)

Gov (2013a), '*The Companies Act 2006 (Strategic Report and Directors' Report) Regulation 2013',* [Online], Available at http://www.legislation.gov.uk/uksi/2013/1970/pdfs/uksi_20131970_en.pdf (Accessed on February 2014)

Gov (2013b), '*Greenhouse gas conversion factors for company reporting 2013 : methodology paper for emissions factors'*, [Online], Available from https://www.gov.uk/government/publications/green-house-gas-conversion-factors-for-company-reporting-2013-methodology-paper-for-emission-factors (Accessed on 15 February 2014)

Gove (2013c) '*Overseas Student Increases'* [Online], Available at http://www.gov.uk/government/uploads/system/uplaods/attachment_data/file/340601/bis-13-1082-international-education-accompanying-analytical-narrative-revised.pdf (Accessed on 07 January 2016)

Gov (2014), '*CRC Energy Efficiency Scheme: qualification and registration'*, [Online], Available at https://www.gov.uk/guidance/crc-energy-efficiency-scheme-qualification-and-registration (Accessed on 19 November 2015)

Gov (2014a), '*EU ETS: Charges'*, [Online], Available at https://www.gov.uk/guidance/eu-ets-charges (Accessed on 20 November 2015)

Gov (2015), '*Participating in EU ETS'*, [Online], Avaliable at https://www.gov.uk/guidance/participating-in-the-eu-ets (Accessed on 15 March 2016)

Governance (2009*), 'The Walker Report', International Corporate Governance'*, [Online], Available at www.governance.co.uk (Accessed on 11 August 2013)

Granly,B.M. and Welo, T. (2014), 'EMS and sustainability : experiences with ISO 14001 and Eco-Lighthouse in Norwegian Metal Processing SMEs', *Journal of Cleaner Production*, Volume 64, pp.194-204, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2013.08.007 (Accessed on 17 February 20147)

Gray, D.E. (2009), '*Doing Research in the Real World'*, p.17, 2^{nd} Edition, Sage, London

Greenbiz (2012)[Ed. Baier, P]. '*What you need to know about Scope 3 Emission'*. [Online] Available at http://www.greenbiz.com/blog/2012/02/28/scope-3-emissions-reporting-grows (Accessed 04 July 2013)

Groves, R.M. (2006), 'Nonresponse Rates and Nonresponse Bias in Household Surveys', *Public Opinion Quarterly*, Volume 70 (5), pp.646-675, *Oxford Journals* [Online], Available at doi: 10.1093/poq/nfl033 (Accessed on 02 December 2013)
Gri (2011), 'Sustainability Reporting Guidelines', *Global Reporting Initiative*, p.5, [Online], Available at https://www.globalreporting.org/resourcelibrary/G3.1-Guidelines-Incl-Technical-Protocol.pdf (Accessed on 04 December 2013)

Gri (2014a), 'G4 Sustainability Reporting Guidelines', *Global Reporting Initiative*, [Online], Available at https://www.globalreporting.org/resourcelibrary/GRIG4-Part1-Reporting-Principles-and-Standard-Disclosures.pdf (Accessed on 21 February 2014)

Gri (2015), '*Global Reporting Initiative'*, [Online], Available at https://www.globalreporting.org/Pages/default.aspx (Accessed on 15 April 2014)

Gruber, T. R. (1993), '*A Translation Approach to Portable Ontology Specifications'* [Online], Available at http://tomgruber.org/writing/ontolingua-kaj-1993.pdf (Accessed on 12 December 2015)

Guardian (2011), '*What are the maim man made greenhouse gasses*?', [Online], Available at http://www.theguardian.com/environment/2011/feb/04/man-made-greenhouse-gases (Accessed on 24 Janaury 2016)

Guba, E.G. and Lincoln, Y.S. (1994), '*Competing Paradigms in Qualitative Research'*, [Online], Handbook of Qualitative Research – Gdufs.biz, Available at http://www.gdufs.biz/10-guba_lincoln_94.pdf (Accessed on 12 February 2014)

Guereca, L.P., Torres, N., and Noyola, A. (2013), 'Carbon footprint as a basis for a cleaner research institute in Mexico', *Journal of Cleaner Production 47,* pp.396-403, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2013.01.030, (Accessed on 09 February 2014)

Guerrero-Baena, M.D., Gomex-Limon, J.A., and Fruet, J.V. (2014), 'A multi criteria method for environmental management system selection: an intellectual capital approach', *Journal of Cleaner Production*, Volume 105 (15), pp.428-437, *Sciencedirect* [Online], Available doi:10.1016/j.jclepro.2014.07.079, (Accessed on 01 December 2014)

Guest R. (2010), 'The economics of sustainability in the context of climate change: An overview'. *Journal of World Business 45,* pp.326-335, *Sciencedirect* [Online] Available at http://ac.els-cdn.com/S1090951609000418/1-s2.0-S1090951609000418-main.pdf?_tid=3574cb16-d042-11e2-9175-00000aab0f6b&acdnat=1370699535_ec6d853145a443059b17f5ba5e7315c4 (Accessed on 31 May 2013)

Guide (2015), '*Nottingham Trent University and league tables'*, [Online], Available at http://www.thecompleteuniversityguide.co.uk/nottingham-trent (Accessed on 23 October 2015)

Guardian (2015) '*A guide to the government's new rules for international students*' [Online], Available at http://www.theguardian.com/education/2015/jul/29/a-guide-to-the-governments-new-rules-for-international-students (Accessed on 07 January 2016)

Habermas, J. (1996), '*Between Facts and Norms: Contribution to a Discourse Theory of Law and Democracy*', p.45-48, Massachusetts Institute of Technology, USA [Online], Available at http://blogs.unpad.ac.id/teddykw/files/2012/07/J%C3%BCrgen-Habermas-Between-Facts-and-Norms.pdf (Accessed on 17 September 2013)

Hancock, J. and Nuttman, S. (2014), 'Engaging higher education institutions in the challenge of sustainability: sustainable transport as a catalyst of action', *Journal of Cleaner Production*, Volume 62 (1), pp.62-71, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2013.07.062 (Accessed on 23 October 2015)

Hahn, R., and Kuhnen, M. (2013), 'Determinants of sustainability reporting: a review of results, trends, theory and opportunities in an expanding filed of research', *Journal of Cleaner Production*, Volume 59, pp.5-21, *Sciencedirect* [Online], Available at doi:10.1016/j.jclepro.2013.07.005 (Accessed on 12 January 2015)

Haigh. M., and Shapiro, M.A. (2012), 'Carbon reporting: does it matter?, *Accounting, Auditing & Accountability Journal*, Volume 25 (1), pp.105-125, *Emeraldinsight* [Online], Available at doi: 10.1108/09513571211191761(Accessed on 12 August 2013)

Halila, F., and Tell, J. (2013), 'Creating synergies between SMEs and Universities for ISO 14001 certification, *Journal of Cleaner Production*, Volume 48, pp.85-92, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2012.11.014 (Accessed on 17 February 2014)

Hallegatte, S. (2009), 'Strategies to adapt to an uncertain climate change, *Global EnvironmentalChange,* Volume19, pp. 240-7, *Sciencedirect* [Online], Available at doi:10.1016/j.gloenvcha.2008.12.003 (Accessed on 02 July 2013)

Harris, S. and Bahmed, L. (2013), 'Assessment of environmental management system performance in the Algerian companies certified ISO 14001', *Management of Environmental Quality: An International Journal*, Volume 24 (2), pp.228-243, *Emeraldinsight* [Online], Available at doi: 10.1108/14777831311303100 (Accessed on 07 December 2013)

Haque, S and Deegan, C. (2010), 'Corporate Change – Related Governance Practices and Related Disclosures : Evidence from Australia', *Australian Accounting Review*, Volume 20 (4), pp.317-333, *Wiley* [Online], Available from doi: 10.1111/j.1835-2561.2010.00107.x (Accessed on 07 August 2013)

Haque, S, Deegan, C and Inglis, R [Eds, Moroney, R and De Lange, P] (2010), *'Towards the development of a best practice guide for the disclosure of organisation climate change-related corporate governance practices'*, pp. 1-35. [Online], Available on http://researchbank.rmit.edu.au/view/rmit:13184 (Accessed on 07 August 2013)

Haslan, C., Butlin, J., Anderson, T., and Malamatenios, J. (2014), 'Accounting for carbon and reframing disclosure: A business model approach', *Accouting Forum*, pp. 200-211, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.accfor.2014.04.002 (Accessed on 27 January 2016)

Hawkins, D., Hong, S.M., Raslan, R., Mumovic, D., and Hanna, S. (2012), 'Determinants of energy use in Higher Education Buildings using statistical and artificial neural network methods', *International Journal of Sustainable Built Environment'*, Volume 1, pp.50-63, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.ijsbe.2012.05.002 (Accessed on 09 August 2013)

Hse (2015), '*Health and Safety Executive: A Brief summary of Plan, DO, Check, Act',* [Online], Available at http://www.hse.gov.uk/managing/plan-do-check-act.htm (Accessed on 23 November 2015)

Head, S. (2011), '*The Grim Threat to British Universities', The New York Book Review,* Volume 58 (1), [Online], Available at http://islab.dico.unimi.it/content/wordpress/2011/01/SimonHead.pdf (Accessed on 05 August 2013)

Heasc (2013), '*Higher Education Associations Sustainability Consortium'*, [Online], Available at http://heasc.aashe.org/content/about-heasc (Accessed on 12 February 2014)

Hefce1 (2011), '*Arrangements for second Capital Investment Framework',* [Online] Available at *http://www.hefce.ac.uk/pubs/circlets/2010/cl17_10/* (Accessed on 17 July 2013)

Hefce2 (2009), '*Consultation on a carbon reduction target and strategy for higher education in England',* [Online] Available at http://www.hefce.ac.uk/pubs/hefce/2009/09_27/ (Accessed on 17 July 2013)

Hefce2a (2009), '*New action plan for a more sustainable sector'*, [Online], Available at http://www.hefce.ac.uk/news/newsarchive/2009/name,62210,en.html (Accessed on 04 August 2013)

Hefce (2010), '*Carbon management strategies and plans: a guide to good practice'*, [Online], p.8, Available at http://www.hefce.ac.uk/media/hefce1/pubs/hefce/2010/1002/10_02.pdf (Accessed on 12 March 2014)

Hefce3 (2012), '*Supply sector emissions'*, [Online], Available at http://www.hefce.ac.uk/pubs/rdreports/2012/rd01_12/supplysectoremissions.pdf (Accessed on 17 July 2013)

Hefce4 (2012), '*Measuring scope 3 carbon emissions – transport'* [Online] Available at http://www.hefce.ac.uk/media/hefce/content/pubs/2012/201202/12_02.pdf (Accessed on 23 April 2013)

Hefce5 (2012), '*Reducing carbon emissions'*, [Online], Available at ht*tp://www.hefce.ac.uk/whatwedo/lgm/sd/carbon/* (Accessed on 23 April 2013)

Hefce6 (2010), '*Higher education commits to reducing carbon emissions'*, [Online], Available at *http://www.hefce.ac.uk/news/newsarchive/2010/name,62223,en.html* (Accessed on 23 April 2013)

Hefce6a (2010), '*Carbon baselines for individual Higher Education Institutions in England – Report to Hefce by SQW'*, p.1-6, [Online], Available at https://www.hefce.ac.uk/media/hefce/content/pubs/2010/rd1410/rd14_10.pdf (Accessed on 09 February 2014)

Hefce7 (2009), '*Carbon management strategies and plans: a guide to good practice – Draft guide by SQW'*, [Online] Available at *https://www.hefce.ac.uk/media/hefce1/pubs/hefce/2009/0927/09_27b.pdf* (Accessed on 23 April 2013)

Hefce7a (2009). '*Research into a carbon reduction target and strategy for Higher Education in England', A report to HEFCE - July 2009* [Online] Available at https://www.hefce.ac.uk/media/hefce/content/pubs/2009/rd1609/rd16_09.pdf (Accessed 31 May 2013

Hefce8 (2010), '*Outcomes of consultation of carbon reduction target and strategy for HE in England',* Available at http://www.hefce.ac.uk/media/hefce/content/pubs/consultationoutcomes/2009/200927outcomes-carbonreduction/carbon.pdf [Online] (Accessed on 31 May 2013)

Hefce9 (2013), '*Sustainable development'* [Online], Available at http://www.hefce.ac.uk/whatwedo/lgm/sd/ (Accessed 31 May 2013)

Hefce10 (2012), '*Carbon Management strategies and plans'*, p.3 [Online] Available at http://www.hefce.ac.uk/media/hefce1/pubs/hefce/2010/1002/10_02.pdf (Accessed on 31 May 2013)

Hefce11 (2009),*'Strategic Development Strategy 2005'*, [Online] Available a http://www.hefce.ac.uk/media/hefce/content/whatwedo/leadershipgovernanceandmanagement/sustainabledevelopment/SIA_SD.pdf (Accessed on 31 May 2013)

Hefce12 (2012), '*Measuring scope 3 carbon emissions – transport'*, [Online], Available at http://www.hefce.ac.uk/media/hefce/content/pubs/2012/201202/12_02.pdf (Accessed 08 August 2013)

Hefce13 (2013), '*Reducing carbon emissions',* [Online], Available at https://www.hefce.ac.uk/whatwedo/lgm/sd/carbon/ (Accessed on 17 February 2014)

Hefce14 (2014), '*Measuring Scope 3 Carbon Emissions'*, [Online], Available at http://www.hefce.ac.uk/pubs/rereports/Year/2012/scope3carbon/Title,92283,en.html #supply (Accessed on 20 November 2015)

Hefce15 (2010), 'Carbon reduction target and strategy for higher education in England', *Hefce,* [Online], Available at http://www.hefce.ac.uk/media/hefce1/pubs/hefce/2010/1001/10_01a.pdf (Accessed on 05 February 2016)

Helton, J.C., Pilch, M., and Sallaberry, C.J. (2014), 'Probability of loss of assured safety in systems with multiple time dependent failure modes: Representations with aleatory and epistemic uncertainty, *Reliable Engineering and Systems Safety,* Volume 124, pp.171-200. *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.ress.2013.11.012 (Accessed on 17 March 2014)

Henders, S. and Ostwald, M. (2014), 'Accounting methods for international land related leakages and distant deforestation drivers', *Ecological Economics*, Volume 99, pp. 21-28, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.ecolecon.2014.01.005 (Accessed on 10 February 2014)

Henri, J-F., and Journeault, M. (2008). 'Environmental performance indicators: An empirical study of Canadian manufacturing firms', *Journal of Environmental Management*, Volume 87, pp.165-176, *Sciencedirect* [Online], Available at doi:10.1016/j.jenvman.2007.01.009 (Accessed on 19 December 2014)

Hensher, D.A. (2008), 'Climate change, enhances greenhouse gas emissions and passenger transport – What can we do to make a difference', Transportation Research Part D: *Transport and Environment,* Volume 13 (2), pp.96-111, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.trd.2007.12.003 (Accessed on 10 February 2014)

Herremans, I and Allwright, D.E. (2000),'Environmental management systems at North American Universities – What drives good performance?', *International Journal of Sustainability in Higher Education,* Volume 1 (2), pp.168-181, *Emeraldinsight* [Online] Available at doi: 10.1108/1467630010371902 (Assessed on 03 July 2013)

Hesa (2014), '*Higher Education Statistics Agency',* [Online] Available at https://www.hesa.ac.uk/component/studrec/show_file/12042/a%5E_%5EScope3CarbonEmissionsFromBusinessTravel.html (Accessed 20 March 2014)

Hesa (2015), '*Estates Management Record'*, [Online], Available at https://www.hesa.ac.uk/index.php?option=com_studrec&task=show_file&mnl=14042&href=Mandatory.html (Accessed on 20 November 2015)

Hewson, C., Yule, P., Laurent. D., and Vogel, C. (2004), '*Internet Research Methods'*, pp11-12, Sage Publications, London.

Higdem, U. (2014), 'The co-operation of regional futures: Facilitating action research in regional foresight', *Futures*, Volume 57, pp. 41-50 *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.futures.2014.01.006 (Accessed on 07 February 2014)

Hill, T. and Westbrook, R. (1997), 'SWOT Analysis: It's time for a product recall', *Long Range Planning*, Volume 30 (1), pp.46-52, *Sciencedirect* [Online], Available at doi:10.1016/S0024-6301(96)00095-7 (Accessed on 03 March 2016)

Hitz, J-M (2007), 'The decision usefulness of fair value accounting – a theoretical perspective', *European Accounting Review*, Volume 16 (2), pp.323-362, *TaylorFrancisonline* [Online], Available at doi:10.1080/09638180701390974 (Accessed on 12 September 2013)

Hjorland, B. (2005), 'Empiricism, rationalism and positivism in library and information science', Journal of Documentation, Volume 61 (1), pp.130-155, *Emeraldinsight* [Online], Available at doi: 10.1108/00220410510578050, (Accessed on 06 December 2013)

Hoffmann, V.H., and Busch, T. (2008), 'Corporate Carbon Performance Indicators – Carbon Intensity, Dependency, Exposure and Risk', *Journal of Industrial Ecology*, Volume 12 (4), pp.505-520, *Wiley* [Online] Available at http://onlinelibrary.wiley.com/doi/10.1111/j.1530-9290.2008.00066.x/pdf (Accessed on 15 February 2014)

Holden, E., Linnerud, K. and Banister, D. (2013), 'Sustainable passenger transport: Back to Brundtland', *Transportation Research Part A*, Volume 54, pp.67-77, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.tra.2013.07.012 (Accessed on 15 November 2015)

Holland, L. and Foo, Y.B. (2003), 'Differences in environmental reporting practices in the UK and the US: the legal and regulatory context', *The British Accounting Review,* Volume 35, pp.1-18, *Sciencedirect* [Online], Available at doi:10.1016/S0890-8389(02)00127-0 (Accessed on 09 August 2013)

Holmberg, J, Jubdqvist, U., Svanstrom, M., and Arehag, M. (2011), 'The University and transformation towards sustainability-The strategy used at Chalmers University of Technology', *International Journal of Sustainability in Higher Education*, Volume 13(3), pp.219-231 *Emeraldinsight* [Online] Available at doi:10.1108/14676371211242544 (Assessed on 03 July 2013)

Holm, C., and Rikhardsson, P. (2008), 'Experienced and novice investors: does environmental information influence investment allocation decisions'?, *European Accounting Review*, 17(3), 537–557, *TaylorFrancisonline* [Online], Available at doi:10.1080/09638180802016627 (Accessed on 01 October 2013)

Hopkins, H.D. (2008). 'Successful turnaround strategies', *Strategic Direction*, Volume 24 (8), pp.3-5, *Emeraldinsight* [Online], Available at doi: 10.1108/02580540810884566 (Accessed on 27 February 2016)

Hoover, E., and Harder, M.K. (2014), 'What lies beneath the surface? The hidden complexities of organisational change for sustainability in higher education', *Journal of Cleaner Production*, (In Press), pp.1-14, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2014.01.081 (Accessed on 10 February 2014)

Hopkins, H.D. (2008), 'Successful turnaround strategies', *Strategic Direction*, Volume 24 (8), pp.3-5, *Emeraldinsight* [Online], Avialable at http://dx.doi.org/10.1108/02580540810884566 (Accessed on 06 March 2016)

Hopkinson, P. [Eds Hoslett, France and Gedye](2011), 'Developing the campus as a learning resources for student engagement on low carbon futures', *Pedagogy of Climate Change, University of Bradford*, [Online], Available at http://www.gees.ac.uk/pubs/other/pocc/Climate%20Change.pdf#page=8 (Accessed on 09 August 2013)

Hopwood, A.G. (2009), 'Accounting and the environment', *Accounting, Organisations and Society'*, Volume 34, pp.433-439, *Sciencedirect* [Online], Available at doi:10.1016/j.aos.2009.03.002 (Accessed on 09 August 2013)

Hotton, I., Glars, J. and Price-Andrew, D.F. (2010), 'Managing for sustainability: Findings from four company case studies in the UK Precast concrete industry', *Journal of Cleaner Production*, Volume 18(2), pp. 152-160, Volume 18 (2), *Sciencedirect* [Online], Available at doi:10.1016/j.jclepro.2009.09.016 : (Accessed on13 May 2013)

Hopwood, A. (2009), 'Accounting and the environment', *Accounting, Organisations and Society*', *Issue 3-4, pp.433-439*, [Online], Available at http://econpapers.repec.org/article/eeeaosoci/v_3a34_3ay_3a2009_3ai_3a3-4_3ap_3a433-439.htm (Accessed on 08 February 2014)

Hopwood, A., Unerman, J. and Fries, J. (2010), *'Accounting for sustainability: Practical Insights',* pp.17-20, Earthscan Books, UK (Accessed on 10 August 2013)

Howitt, O.J.A., Renol, V.G.N., Smith, I.J. and Rodger, C. J. (2010), Carbon emissions from international cruise ship passengers' travel to and from New Zealand', *Energy Policy,* Volume 38, pp.2552-2560, *Sciencedirect* [Online], Available at doi:10.1016/j.enpol.2009.12.050, (Accessed on 20 February 2014)

Hoyningen-Huene, P (1990) [Kuhn, 1970], 'Kuhn's conception of incommensurability', *Studies in History and Philosophy of Science Part A*, Volume 21(3), pp.481-492, *Sciencedirect* [Online], Available at http://ac.els-cdn.com/003936819090006T/1-s2.0-003936819090006T-main.pdf?_tid=b49b089e-a325-11e4-b5fe-00000aab0f6b&acdnat=1422034486_b30dd47e0530cd7d09cced702112beb1 (Accessed on 15 January 2015)

Hsu, A., Lloyd, A., Emerson, J.W. (2013). 'What progress have we made since Rio? Results from the 2012 Environmental Performance Index (EPI) and Pilot Trend EPI', *Environmental Science & Policy 33*, pp.171-185, *Sciencedirec*t [Online], Available at http://dx.doi.org/10.1016/j.envsci.2013.05.011 (Accessed on 12 February 2016)

Huang, Y.A., Weber, C.L. and Matthews, S. (2009),'Categorisation of Scope 3 Emissions for Streamlined Enterprise Carbon Footprint', *Environmental Science and Technical 43 (22),* pp.8509-8515, [Online] Available at http://pubs.acs.org/doi/abs/10.1021/es901643a (Accessed on 02 June 2013)

Hudson, J. and Orviska, M. (2013), 'Firms' adoption of international standards: One size fits all', *Journal of Policy Modelling*, Volume 36 (2), pp.289-306, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jpolmod.2012.04.001 (Accessed on 17 February 2014)

Hyde, K. F. (2000), 'Recognising deductive processes in qualitative research', *Qualitative Market Research: An International Journal*, Volume 3 (2), pp.82-90, *Emeraldsinsight* [Online], Available at http://dx.doi.org/10.1108/13522750010322089 (Accessed on 14 May 2015)

Iraldo, F., Testa, F., and Frey, M. (2009), 'Is an environmental management system able to influence environmental and competitive performance? The case of the eco-management and audit scheme (EMAS) in the European Union', *Journal of Cleaner Production*, Volume 17, pp.1444-1452, *Sciencedirect* [Online], Available at doi:10.1016/j.jclepro.2009.05.013 (Accessed on 05 December 2014)

Indrani, R.H., Purba, H. R., (2010), 'Does awareness to climate change lead to behavioural change?', *International Journal of Climate Change Strategies and Management*, Volume. 2(1) pp.6 – 22, *Emeraldinsight* [Online] Available at 10.1108/17568691011020229 (Accessed on 31 May 2013)

Institutional (2015), 'Institutional Investors Group on Climate Change', [Online], Avilable at http://www.iigcc.org/ (Accessed on 12 December 2015)

Ipcc (2007), '*IPCC Assessment Reports'*, [Online] Available at http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml#1 Hefce (2010)(Accessed on 01 July 2013)

Ipcc1 (2007), '*Climate Change 2007: Systesis Report'*, p.5 [Online], Available at http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf (Accessed on 25 Janaury 2016)

Ipcc2 (2015). '*IPCC: Organisation'*, [Online], Available at https://www.ipcc.ch/organization/organization.shtml (Accessed on 26 Janaury 2016)

Iso (2009). '*Environmental management systems – requirements with guidance for use*', [Online], Available at www.bsigroup.com (Accessed on 21 November 2015)

Iso (2014), ' *ISO 26000:2010 – Social Responsibility'*, [Online], Available at http://www.iso.org/iso/home/standards/iso26000.htm (Accessed on 15 March 2014)

International (2015). '*Institutional Investors Group on Climate Change'* [Online], Available at http://www.iigcc.org/ (Accessed on 27 May 2015)

Jabbour, C.J.C. (2013), Environmental training in organisations: From a literature review to a framework for future research', *Resources, Conservation and Recycling 74*, pp.144-155, *Sciencedirect* [Online] Available at http://dx.doi.org/10.1016/j.resconrec.2012.12.017 (Accessed on 03 July 2013)

Jain, S., and Pant, P. (2010), 'Environmental management systems for educational institutions – A case of TERI University, New Dehli, *International Journal of Sustainability in Higher Education*, Volume 11(3),pp.236-249, *Emeraldinsight* [Online] Available at http://dx.doi.org/10.1108/14676371011058532 (Accessed on 03 July 2013)

James, M., and Card, K. (2012), 'Factors contributing to institutions achieving environmental sustainability', *International Journal of Sustainability in Higher Education*, Volume 13 (2), pp.166-176, *Emeraldinsight* [Online], Available at doi 10.1108/14676371211211845 (Accessed on 11 August 2013)

Jmp (2012), '*JMP Consultants – Measuring Scope 3 carbon emissions – transport'*, [Online], Available at http://www.hefce.ac.uk/media/hefce/content/pubs/indirreports/2012/measuringscope3carbonemissions/transport.pdf (Accessed on 01 December 2013)

Jick, T.D. (1979), 'Mixing Qualitative and Quantitative Methods: Triangulation in Action', *Administrative Science Quarterly*, Volume, 24 (4), pp.602-611, [Online], Available at http://www.jstor.org/stable/2392366?origin=crossref&seq=1#page_scan_tab_contents (Accessed on 15 January 2016)

Jiraro, S., Sujiwa, S., Wongwanich, S. (2014), 'An Application of Action Research for Teacher Empowerment to Develop Teachers' Test Construction Competency Development Models', *Procedia – Social and Behavioural Sciences*, Volume 116, pp.1264-1267, *Sciencedirect* [Online], Available at doi: 10.1016/j.sbspro.2014.01.380 (Accessed on 17 March 2014)

Johnson, H., Johansson, M., and Anderson, K. (2014), 'Barriers to improving energy efficiency in short sea shipping: an action research case study', *Journal of Cleaner Production*, Volume 66, pp.317-327, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2013.10.046 (Accessed on 17 March 2014)

Johnson, R.B., Onwergbuzie, A.J. and Turner, L. (2007), 'Toward a definition of mixed methods research', *Journal of Mixed Methods Research*, Volume 1 (2). pp.122-132, *Sagejournals* [Online], Available at doi: 10.1177/1558689806298224 (Accessed on 06 July 2013)

Johansson, R.C., Cattaneo, A. (2006), 'Indices for working land conservation: form affects function', *Review of Agricultural Economics*, Volume 28 (4), pp. 67–584, *Oxford Journals*[Online], Available at doi: 10.1111/j.1467-9353.2006.00323.x (Accessed on 04 December 2013)

Jonas, W. (2007), ‘Research through Design through research: A cybernetic model of designing design foundations’, *Kybernetes*, Volume 36 (9/10), *Emeraldinsight* [Online], Available at doi: 10.1108/03684920710827355 (Accessed on 18 Janaury 2016)

Jones, M.J., and Solomon, J.F. (2013), ‘Problematising accounting for biodiversity’, *Accounting, Auditing and Accountability Journal,* Volume 26, pp.668-687, *Emerldinsight* [Online], Available at doi: 10.1108/AAAJ-03-2013-1255 (Accessed on 17 March 2014)

Jones, M. J. (2010), ‘Accounting for the environment: Towards a theoretical perspective for environmental accounting and reporting’, *Accounting Forum*, Volume 34, pp.123-138, *Sciencedirect* [Online], Available at 0.1016/j.accfor.2010.03.001 (Accessed on 09 August 2013)

Kajanus, M., Leskinen, P., Kurttila, M., and Kangas, J. (2012), ‘Making use of MCDS Methods in SWOT analysis = Lessons learnt in strategic natural resources management’, *Forest Policy and Economics,* Volume 20, pp.1-9, *Emeraldinsight* [Online], Available at doi:10.1016/j.forpol.2012.03.005 (Accessed on 05 November 2013).

Katiliute, E. and Neverauskas, B. (2009), ‘Development of Quality Cultures in the Universities’, Economics and Management, Volume 14, pp.1069 – 1076. [Online], Available at http://www.erem.ktu.lt/index.php/Ekv/article/view/9512/4836 (Accessed on 23 October 2015)

Kamal, A.S.Md., and Asmuss, M. (2013), ‘Benchmarking tools for assessing and tracking sustainability in higher education institutions’, *International Journal of Sustainability in Higher Education,* Volume 14 (4), pp.449-465, *Emeraldinsight* [Online], Available at doi 10.1108/IJSHE-08-2011-0052 (Accessed on 10 February 2014)

Karakosta, C. and Askounis, D. (2010), ‘Developing countries’ energy needs and priorities under a sustainable development perspective: A linguistic decision support approach’, *Energy for Sustainable Development,* Volume 14 (4), pp/ 330-338, *Sciencedirect* [Online], Available at doi:10.1016/j.esd.2010.07.008 (Accessed on 27 June 2015)

Katoppo, M.L. and Sudradjat, I. (2015), ‘Combining Participatory Action Research (PAR) and Design Thinking (DT) as an Alternative Research Method in Architecture’. *Procedia – Social and Behavioural Sciences* 184, pp.118-125, *Sciencedirect* [Online], Available at doi: 10.1016/j.sbspro.2015.05.069 (Accessed on 18 Janaury 2016)

Kazozcu, S.B. (2011), ‘Role of strategic flexibility in the choice of turnaround strategies: A resource based approach’, *Procedia Social and Behaviour Sciences 24,* pp.444-459, *Sciencedirect* [Online], Available doi:10.1016/j.sbspro.2011.09.039 (Accessed on 08 March 2016)

Kenis, A, and Mathijs, E. (2014), ‘Climate change and post-politics: Repoliticising the present by imaging the future?’, *Geoforum*, Volume 14, pp.148-156, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.geoforum.2014.01.009 (Accessed on 17 February 2014)

Khan, T. (2013), Sustainability accounting courses, Tolloires Declaration and academic research’, *International Journal of Sustainability in Higher Education*, Volume 14 (1), pp.42-55, *Emeraldinsight* [Online], Available at doi: 10.1108/14676371311288949 (Accessed on 21 February 2014)

Kharrazi, A., Kraines, S., Hoanh, L., and Yarime, M.(2014), ‘Advancing quantification methods of sustainability: A critical examination emery, exergy, ecological footprint and ecological information-based approaches’, *Ecological Indicators*, Volume 37, pp.81-89, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.ecolind.2013.10.003 (Accessed on10 February 2014)

Klein-Banai, C. and Theis, T.L. (2011), ‘An urban university’s ecological footprint and the effect of climate change’, Ecological Indicators, Volume 11 (3), pp. 857-860, Sciencedirect [Online], Available at doi:10.1016/j.ecolind.2010.11.002 (Accessed on 20 February 2015)

Klenke, K. (2008), ‘*Qualitative Research in the Study of Leadership’*, p.47, Emerald Publishing, UK

Kohler, J., Whitmarsh, L., Nykvist, B., Schilperoord, M., Bergman, N., and Haxeltine, A. (2009), ‘A transitions model for sustainability mobility’, *Ecological Economics*, Volume 68 (12), pp.2985-2995, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.ecolecon.2009.06.027 (Accessed on 10 February 2014)

Knox-Hayes, J. and Levy, D. (2011), ‘The politics of carbon disclosure as climate governance’, *Strategic Organisations*, Volume 9 (1), pp.1-9, [Online], Available at doi: 10.1177/1476127010395066 (Accessed on 31 Janaury 2016)

Kolk, A., Levy, D., and Pinkse, J. (2008), ‘Corporate Responses in an Emerging Climate Regime: The Institutionalization of Commensuration of Carbon Disclose’, *European Accounting Review Volume 17 (4)*, pp.719-748, *Tandfonline* [Online], Available at www.dx.doi. 10.1080/09638180802489121 (Accessed on 02 July 2013)

Koning, A., Schowanek, D., Dewaele, J., Weisbrod, A., and Guinee, J, (2010), ‘Uncertainties in a carbon footprint model for detergents: quantifying the confidence in a comparative result’, *The International Journal of Life Cycle Assessment*, Volume 15 (1), pp.79-89, *Springer* [Online], Available at doi. 10.1007/s11367-009-0123-3 (Accessed on 12 February 2014)

Kruse, C. and Lundgergh, S. (2010), ‘The Governance of Corporate Sustainability’, *Rotman International Journal of Pension Management*’, Volume 3 (2), pp.46- 51, [University of Toronto online journals], Available at http://utpjournals.metapress.com/content/f466v26642565727/fulltext.pdf (Accessed on 11 August 2013)

Kemmis, S. and McTaggart, R. (2005), '*Participatory Action Research',* [Online], Available at http://www.corwin.com/upm-data/21157_Chapter_10.pdf (Accessed on 17 July 2014)

Kuo, L., and Chen, V.Y-J. (2013), 'Is environmental disclosure an effective strategy in establishment of environmental legitimacy for organisation?', *Management Decisions*, Volume 51 (7), pp.1462-1487, *Emeraldinsight* [Online], Available at doi: 10.1108/MD-06-2012-0395 96 (Accessed on 31 October 2013)

Kyoto (2014), '*United Nations Framework Convention on Climate Change – Kyoto Protocol'*, [Online], Available at http://unfccc.int/kyoto_protocol/items/2830.php (Accessed on 21 June 2014)

Labatt, S. and White, R., (2007), *Carbon Finance: The Financial Implications of Climate Change*, pp.71-76, John Wiley & Sons, Inc, New Jersey.

Lander J, Cain, D. and Andrews, P. (2011), '*The Corporate Executives Guide to Enterprise Green House Gas and Energy Management', IHS GHG Solutions*, [Online], Available at https://www.ihs.com/pdf/The-Corporate-Executives-Guide-to-Global-Climate-Change_202343110913052132.pdf (Accessed on 13 May 2013)

Lafreniere, K. C., Deshpande, S., Bjornlund, H., and Hunter, M.G. (2013), 'Extending stakeholder theory to promote resource management initiatives to key stakeholders: A case study of water transfers in Alberta, Canada', *Journal of Environmental Management*, Volume 129, pp.81-91, *Sciencedirect* [Online], Available at Ltd. All rights reserved. http://dx.doi.org/10.1016/j.jenvman.2013.06.046 (Accessed on 04 February 2014)

Lai, J.H.K. (2015), 'Carbon footprints for hotels: Analysis of three archetypes in Hong Kong', Sustainable Cities and Society,Volume 14, pp.334-341, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.scs.2013.09.005 (Accessed on 12 February 2014)

Lannelongue, G. and Gonzalez-Benito, J. (2012), 'Opportunism and environmental management systems: Certificate as a smokescreen for stakeholders', *Ecological Economics*, Volume 82, pp. 11-22, *Sciencedirect* [Online], Available at doi:10.1016/j.ecolecon.2012.08.003 (Accessed on 08 December 2014)

Lansiluoto, A., Jarvenpaa, H., and Krumwiede,K. (2013), 'Conflicting interests but filtered key targets : Stakeholder and resource dependency analysis at a University of Applied Sciences;, *Management Accounting Research*, Volume 24, pp.228-245, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.mar.2013.02.001 (Accessed on 10 February 2014)

Larsen H. N, Pettersen, J., Solli, C. and Hertuich, E.G (2013). 'Investigating the carbon footprint of a University – The case study of NTNU', *Journal of Cleaner Production*, pp.1-9, *Sciencedirect* [Online], Available at doi:10.1016/j.jclepro.2011.10.007 (Accessed on 10 February 2014)

Lash, J and Wellington, F. (2007), 'Competitive advantage on a warming planet', *Harvard Business Review,* pp 2-8, [Online], Available at http://www.greenomics.ca/green-admin/wp-content/uploads/2010/12/Harvard-Business-Review-on-Climate-Change.pdf (Accessed on 17 May 2013)

Latrobe (2014), '*La Trobe University – Sustainability Report 2013'*. [Online], Available at http://www.latrobe.edu.au/sustainability/report (Accessed on 15 October 2014)

Lazarus, R.J. (2008), 'The Making of Environmental Law', pp. 222-223, Library of the Congress, USA

Leed (2014), '*Leadership in Energy and Environmental Design (LEED)*', [Online], Available at http://www.usgbc.org/leed (Accessed on 20 May 2014)

Lee, M-D.P. (2008), 'A review of the theories of corporate social responsibility: its evolutionary path and the road ahead', *International Journal of Management Reviews*, Volume 10 (1), pp.53-73, *Wiley* [Online], Available at doi: 10.1111/j.1468-2370.2007.00226.x (Accessed on 17 July 2013)

Lenzen, M., Murray, J., Sack,F. and Wiedmann,T. (2007), 'Shared producer and consumer responsibility – theory and practice', *Ecological Economics*, Volume 61,pp.27-42, *Sciencedirect* [Online], Available at doi:10.1016/j.ecolecon.2006.05.018 (Accessed on 10 February 2014)

Levy, D.I., Brown, H.S.m and Jongm M de. (2010), 'The Contested Politics of Corporate Governance', *Business & Society*, Volume 49 (1), pp.88-115, *Sage Journal,* [Online], Available at doi: 10.117/0007650309345420 (Accessed on 31 January 2016)

Levy, B.L.M. and Marans, R.W. (2011), 'Towards a campus culture of environmental sustainability – Recommendations for a large university, *International Journal of Sustainability in Higher Education,* Volume 13 (4), pp.366-377, *Emeraldinsight* [Online] Available at doi:10.1108/14676371211262317 (Accessed on 03 July 2013)

Liamputtong, P. (2009), '*Qualitative Research Methods'*, pp. 78-89, 3th Edition, Oxford University Press. Australia and New Zealand.

Li, X. (2006). 'Diversification and localization of energy systems for sustainable development and energy security', *Energy Policy,* Volume 33(17), pp.2237-2243, *Sciencedirect* [Online], Available at doi:10.1016/j.enpol.2004.05.002 (Accessed on 17 January 2015)

Liesen, A., Hoepner, A.G., Patten, D.M., and Figge, F. (2015), 'Does stakeholder pressure influence corporate GHG emissions reporting? Empirical evidence from Europe', *Accounting, Auditing & Accountability Journal,* Volume 28 (7), pp.1047-1074, *Emeraldinsight* [Online], Available at doi: 10.1108/AAAJ-12-2013-1547 (Accessed on 02 February 2016)

Lilley, D. (2009), ‘Design for Sustainable Behaviour: Strategies and Perceptions’, *Design Studies*, Volume 30(6), pp.704-720, *Sciencedirect* [Online], Available at doi:10.1016/j.destud.2009.05.001 (Accessed on 17 July 2013)

Liou, J.J.H. (2015), ‘Building an effective system for carbon reduction management’, *Journal of Cleaner Production,* Volume 103, pp.353-361, *Sciencedirect* [Online], Available at doi:10.1016/j.jclepro.2014.10.053 (Accessed on 17 July 2014)

Livescience (2015), ‘*What are Greenhouse Gases and How do they warm the earth*?’, [Online], Available at http://www.livescience.com/32691-what-are-greenhouse-gases-and-how-do-they-warm-the-earth.html (Accessed on 14 November 2014)

Lockwood, M. (2013), ‘The political sustainability of climate policy: The case of the UK Climate Change Act’, *Global Environmental Change,* Volume 23. Pp.1339-1348, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.gloenvcha.2013.07.001 (Accessed on 10 February 2014)

Lodhia, S.K. (2006), ‘Corporate perceptions of web based environmental communication: AN exploratory study into companies in the Australian minerals industry’, *Journal of Accounting & Organizational Change*, Volume 2 (1), pp. 74-88, *Emeraldinsight* [Online], Available at 10.1108/18325910610654135 (Accessed on 09 August 2013)

Loncar, M., Barrett, N.E., and Liu, G-Z. (2014), ‘Towards the refinement of forum and asynchronous online discussions in educational contexts worldwide: Trends and investigative approach within a dominant research paradigm, *Computers & Education*, Volume 73, pp.93-110, *Sciencedirec*t [Online], Available at http://dx.doi.org/10.1016/j.compedu.2013.12.007 (Accessed on 10 February 2014)

Lopez-Gamero, M.D., Molina-Azorin, J.F., and Claver-Cortes, E. (2009), ‘The whole relationship between environmental variables and firm performance: Competitive advantage and firm resources as mediator variables’, *Journal of Environmental Management*, Volume 90, pp.3110-3121, *Sciencedirect* [Online], Available at doi:10.1016/j.jenvman.2009.05.007 (Accessed on 18 December 2014

Lorenzoni, I., Nicholson-Cole, S. and Whitmarsh, L (2007), ‘Barriers perceived to engaging with climate change among the UK public and their policy implications’, *Global Environmental Change 17,* pp.445-459, *Sciencedirect* [Online], Available at doi:10.1016/j.gloenvcha.2007.01.004 (Accessed on 07 July 2013

Lovell, H. and Liverman, D. (2010), “Understanding carbon offset technologies”, *New Political Economy,* Volume 15 (2), pp. 255-73, *TaylorFrancisOnline* [Online], Available at doi:10.1080/13563460903548699 (Accessed on 11 August 2013)

Lozano, R (2009), ‘Diffusion of sustainable development in Universities curricula: an empirical example from Cardiff University’, *Journal of Cleaner Production 18,* pp.637-644, *Sciencedirect* [Online] Available at doi:10.1016/j.clepro.2009.07.005 (Assessed on 03 July 2013)

Lozano, R. and Huisingh, D. (2011), 'Inter Linking issues and dimensions in sustainability reporting', *Journal of Cleaner Production*, Volume 19, pp.99-107, *Sciencedirect* [Online], Available at doi:10.1016/j.jclepro.2010.01.004 (Accessed on 07 July 2013)

Lozano, R., Lukman, R., Lozano, F.J., Huisingh, D., and Lambrechts, W. (2013), 'Declarations for sustainability in higher education: becoming better leaders, through addressing the university system', *Journal of Cleaner Production*, Volume 48, pp.10-19, *Sciencedirect* [Online], Available at doi:10.1016/j.jclepro.2011.10.006 (Accessed on 10 February 2016)

Lozano, M., Valles, J., (2007), 'An analysis of the implementation of an environmental management system in a local public administration', *Journal of Environmental Management*, Volume 82 (4) pp.495–511, *Sciencedirect* [Online], Available at doi:10.1016/j.jenvman.2006.01.013 (Accessed on 12 November 2013)

Lozano, R. (2011), 'The state of sustainability reporting in universities', International *Journal of Sustainability in Higher Education*, Volume 12 (1), pp.67-78, *Emeraldinsight* [Online], Available at doi: 10.1108/14676371111098311(Accessed on 20 February 2014)

Lozano, R., Lozano, F.J., Mulder, K., Huisingh, D., and Waas, T. (2013a), 'Advancing Higher Education for Sustainable Development: international insights and critical reflections, *Journal of Cleaner Production*, Volume 48, pp.3-9, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2013.03.034 (Accessed on 17 September 2013)

Lukka, K. (2010), 'The roles and effects of paradigms in accounting research', *Management Accounting Research*, Volume 21, pp.110-115, *Scienedirect* [Online], Available at doi:10.1016/j.mar.2010.02.002 (Accessed on 11 February 2014)

Lukman, R. and Glavic, P. (2007), 'What are the key elements of a sustainable university?', *Clean Tech Environ Policy*, pp.103-114, *Springer* [Online], Available at doi:10.1007/S10098-006-0070-7 (Accessed on 30 June 2013)

Lukman, R., Krajic, D. and Glavic, P. (2010), 'University ranking using research, educational and environmental indicators, *Journal of Cleaner Production*, Volume 18 (7), pp. 619-628, *Sciencedirect* [Online], Available at doi:10.1016/j.jclepro.2009.09.015 (Accessed on 01 December 2013)

Lundberg, K., Balfors, B., and Folkeson, L. (2009), 'Framework for environmental performance measurement in a Swedish Public Sector Organisation', *Journal of Cleaner Production*, Volume 17, pp.1017-1024, *Sciencedirect* [Online], Available at doi:10.1016/j.jclepro.2009.01.011 (Accessed on 03 July 2013)

Lundin, M. and Morrison, G.M. (2012), "A life cycle assessment based procedure for development of environmental sustainability indicators for urban water systems", *Urban Water 4* pp.145-152, *Sciencedirect* [Online], Available at doi: 10.1016/S1462-0758(02)00015-8 (Accessed on 13 May 2013)

Mac (2012), '*Breaking new ground in Higher Education Carbon Foot printing'*, [Online], Available at http://www.mca.org.uk/sites/default/files/Arup%20with%20De%20Montfort%20Uni.pdf (Accessed on 08 August 2013)

McDermott, C.C. (2009), 'Corporate Agenda 21: a unified global approach to CSR and Sustainability', *Corporate Communications: An International Journal,* Volume 14(3), pp.286-302, *Emeraldinsight* [Online], Available at http://dx.doi.org/10.1108/13563280910980078 (Accessed on 17 July 2014)

McKeman, J. (2013), *'Curriculum Action Research: A Handbook of Methods and Resources for the Reflective Practitioner*', pp.3-5, University College Dublin, Ireland

MacKenzie, D. (2009), 'Making things the same: Gasses, emission rights and the politics of carbon markets', *Accounting, Organisations and Society,* Volume (3-4), pp.440-455, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.aos.2008.02.004 (Accessed on 10 February 2014)

Mahony, B. (2013), 'Boundary spaces: Science, politics and epistemic geographies of climate change in Copenhagen, 2009', *Geoforum*, Volume 49, pp.29-39, *Sciencedirect* [Online] Available at http://dx.doi.org/10.1016/j.geoforum.2013.05.005, (Accessed on 31 May 2013)

Marimom, F., Alonso-Almeida, M del Mar., Rodriquez, M.del Pilar, Alejandro, K.A.C. (2012), 'The worldwide diffusion of the Global Reporting Initiative: what is the point', *Journal of Cleaner Production,* Volume 33, pp.132-144, *Sciencedirect* [Online], Available at doi: 10.1016/jclepro.2012.04.017 (Accessed on 17 May 2013)

Manne, A.S. and Richels, R.G. (2000), 'The Kyoto Protocol: A Cost Effective Strategy for Meeting Environmental Objectives', *Efficiency and Equity of Climate Change Policy*, Volume 15, pp.43-61, *Springer Link* [Online], Available at doi: 10.1007/978-94-015-9484-4_3 (Accessed on 16 November 2015)

Marginson, S., Van der Wende, M. (2007), 'To rank or to be ranked: the impact of global rankings in higher education', *Journal of Studies in International Education*, Volume 11 (3/4), *Sagejournals* [Online], Available at doi: 10.1177/1028315307303544 (Accessed on 30 November 2013)

Marsh (2014), '*ISO14001: Analysis into its strengths and weaknesses, and where potential opportunities could be deployed for tomorrows Global Business'*, [Online], Available at http://www.greenleansolutions.com/resources/ISO14001.pdf (Accessed on 21 November 2015)

Mathiassen, L. (2002), 'Collaborative practice research', *Information Technology & People,* Volume 15 (4), pp.321-346, *Emeraldinsight* [Online], Available at doi: 10.1108/09593840210453115 (Accessed on 23 January 2016)

Martineau, H. (2000), '*The Positive Philosophy of Auguste Comte'*, p.12 [Online], Batoche Books, Available at http://socserv2.mcmaster.ca/~econ/ugcm/3ll3/comte/Philosophy1.pdf (Accessed on 04 December 2013)

Martini, G., Paffumi, E., De Gennaro, M., and Mellios, G. (2014), 'European type-approval test procedure for evaporative emissions from passenger cars against real world mobility data from two Italian provinces', *Science of the Total Environment 487*, pp.506-520, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.scitotenv.2014.04.053 (Accessed on 31 January 2015)

Marquez-Ramos, L. (2015), 'The relationship between trade and sustainable transport: A quantitative assessment with indicators of the importance of environmental performance and agglomeration externalities', *Ecological Indicators (52)*, pp.170-183, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.ecolind.2014.11.023, (Accessed on 02 January 2015)

Mascarenhas, A., Nunes, L.M. and Ramos, T. B. (2014), 'Exploring he self-assessment of sustainability indicators by different stakeholders', *Ecological Indicators*, Volume 39, pp.75-83, *Sciencedirect* [Online]. Available on doi:10.1016/j.ecolind.2013.12.001 (Accessed on 07 December 2014)

Matthews, H.S., Hendrickson, C.T. and Weber, C.L. (2008), 'The Importance of Carbon Footprint Estimation Boundaries', *Environmental Science and Technology*, Volume 42, pp.5839-5842 [Online], Available at http://pubs.acs.org/doi/pdf/10.1021/es703112w (Accessed on 07 August 2013)

Mauther, M., Birch, M., Jessop, J., and Miller, T. (2005), '*Ethics in Qualitative Research'*, pp. 71-140, Sage, London

Maxwell, J.A. (2012), '*Qualitative Research Design; An Interactive Approach: An interactive Approach*', p.4 and p.102, 3rd Edition, Sage, London

Mazhar, A.U., Bull, R. and Lemon, M. (2012), '*A Review and case study of strategic carbon management in the UK Higher Education Sector'*, [Online] Available at https://www.dora.dmu.ac.uk/bitstream/handle/2086/7553/Mahmar%20Bull%20et%20al%20RICS%202012.pdf?sequence=1 (Accessed 2 June 2013)
Mearns, L. (2010), "The drama of uncertainty", *Climatic Change Volume 100*, pp. 77-85. *Sagejournals* [Online] Available at http://www.dx.doi. 10.1007/s10584-010-9841-6 (Accessed on 02 July 2013)

Mebratu, D. (1998), 'Sustainable and sustainable development: Historical and conceptual review', *Environmental Impact Assessment Review*, Volume 15 (5), pp.493-520, *Sciencedirect* [Online], Available at doi:10.1016/S0195-9255(98)00019-5 (Accessed on 15 November 2015)

Menichini, T. and Rosati, F, (2013), 'A Managerial Tool for Environmental Sustainability', *Procedia APCBEE 5*, pp.551-556, *Scienedirect* [Online], Available at doi: 10.1016/j.apcbee.2013.05.092 (Accessed on 02 December 2013)

Mgh (2013), '*Mapping Greener Healthcare'*, [Online], Available at http://map.sustainablehealthcare.org.uk/staff-travel-survey (Accessed on 04 December 2013)

Miller, L.M. (2008), *'Double counting in Municipal Greenhouse Gas Emissions Inventories',* [Online], Available at http://www3.epa.gov/ttnchie1/conference/ei17/session5/miller.pdf (Accessed on 27 January 2016)

Milutinovic, S., and Nikolic, V. (2014), 'Rethinking higher education for sustainable development in Serbia: an assessment of Copernicus charter principles in current higher education practices', *Journal of Cleaner Production*, Volume 62, pp.107-113, *Sciencedirect* [Online] , Available at http://dx.doi.org/10.1016/j.jclepro.2013.05.028 (Accessed on 17 October 2013)

Minang, P.A., and Van Noordwijk, M. (2013), 'Design challenges for achieving reduced emissions from deforestation and forest degradation through conservation: Leveraging multiple paradigms at the tropical forest margins', *Land Use Policy,* Volume 31, pp.61-70, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.landusepol.2012.04.025 (Accessed on 10 February 2014)

Morey, M., Gottesman, A., Baker, E., and Godridge, B. (2009), 'Does better corporate governance result in higher valuations in emerging markets? Another examination using a new data set', *Journal of Banking and Finance*, Volume 33, pp.254-262, *Sciencedircct* [Online], Available at doi:10.1016/j.jbankfin.2008.07.017, (Accessed on 09 August 2013)

Morrow, D. and Rondinelli, D . (2012), 'Adopting Corporate Environmental Management Systems: Motivation and Results of ISO 14001 and EMAS Certification', *European Management Journal,* Volume 20 (5), pp. 159-171, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/S0263-2373(02)00026-9, (Accessed on 05 August 2013)

Mozner, Z.V. (2013), 'A consumption based approach to carbon accounting – sectoral differences and environmental benefits', *Journal of Cleaner Production,* Volume 42, pp.83-95, *Sciencedirect* [Online], Available from http://dx.doi.org/10.1016/j.jclepro.2012.10.014 (Accessed on 10 February 2014)

Maubane, P., Prinsloo, A., and Van Rooyen, N. (2014), 'Sustainability reporting patterns listed on the Johannesburg securities exchange', *Public Relations Review*, Volume 40(2), pp. 153-160, *Sciencedirect* [Online], Available at doi:10.1016/j.pubrev.2014.02.014 (Accessed on 17 July 2014)

Muller-Christ, G., Sterling, S., Van Dam-Miers, R., AdomBent, M., Ficher, D., Riecjmann, M. (2014), The role of campus, curriculum and development in higher education for sustainable development – a conference report, *Journal of Cleaner Production*, Volume 62, pp.134-137, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2013.02.029 (Accessed on 20 February 2014)

Nagamachi, M. (2011), '*Kansai/Affective Engineering'*, p.113, Taylor Francis Group, Florida USA

Nash, H.A. (2009), 'The European Commission's sustainable consumption and production and sustainable industrial policy action plan', *Journal of Cleaner Production*, Volume 17 (4), pp.496-498, *Sciencedirect* [Online], Available at doi:10.1016/j.jclepro.2008.08.020 (Accessed on 10 January 2015)

Natalicchio, A., Petruzzelli, A.M., and Garavelli, A.C. (2014), 'A literature review on markets for ideas: Emerging characteristics and unanswered questions', *Technovation,* Volume 34, pp.65-76, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.technovation.2013.11.005 (Accessed on 17 November 2015)

Nawrocka, D, and Parker, T. (2009), 'Finding the connection: environmental management systems and environmental performance', *Journal of Cleaner Production*, Volume 17 (6), pp.601-607, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2008.10.003 (Accessed on 17 February 2014)

Newcastle (2015), '*Newcastle University Travel Update: July 2015'*, [Online], Available at http://www.ncl.ac.uk/sustainable-campus/assets/documents/NUTRAVELPLANUPDATE2015.pdf Accessed on 17 Janaury 2016)

Neumayer, E. (2007), 'A missed opportunity: The Stern Review on Climate Change fails to tackle the issues of non substitutable loss of natural capital', *Global Environmental Change*, Volume 17 (3-4), pp.297-301 *Sciencedirect* [Online] Available at http://dx.doi.org/10.1016/j.gloenvcha.2007.04.001(Accessed 20 17 February 2014)

Nicolaides, A. (2006), 'The implementation of environmental management towards sustainable universities and education for sustainable development as an ethical imperative', *International Journal of Sustainability in Higher Education,* Volume 7 (4), pp.414-424, *Emeraldinsight* [Online], Available at http://dx.doi.org/10.1108/14676370610702217 (Accessed on 23 November 2015)

Nikolaou, I, E, and Evangelinos, K. L. (2010), 'A SWOT analysis of environmental management practices in Greek Mining and Mineral Industry', *Resources Policy*, Volume 35, pp.226-234, *Sciencedirect* [Online], Available at doi:10.1016/j.resourpol.2010.02.002 (Accessed on 12 September 2013)

Nitsche, P., Widhalm, P., Breuss, S., Brandle, N., and Maurer, P. (2013), '*Supporting large scale travel surveys with smartphones – A practical approach'*, Transportation Research Part C, Volume 43 (2), pp.212-221 *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.trc.2013.11.005 (Accessed on 10 February 2013)

Noeke, J. (2002), 'Environmental management systems for universities – A case study', *International Journal of Sustainability in Higher Education,* Volume 1 (3), pp.237-251, *Emeraldinsight* [Online], Available at http://dx.doi.org/10.1108/14676370010378167 (Accessed on 02 August 2013)

Novicevic, M.M, Harvey, M., Autry, C.W., and Bond III, E. U. (2004), 'Dual Perspective SWOT: a synthesis of marketing intelligence and planning', *Marketing Intelligence & Planning*, Volume 22 (1), pp.84-94, *Emeraldinsight* [Online], Available at doi: 10.1108/02634500410516931, (Accessed on 12 November 2013)

Ntu (2014), '*Nottingham Trent University'*, [Online], Available at www.ntu.ac.uk, (Accessed on 1 February 2014)

Ntu (2013a), '*EcoWeb'*, [Online], Available at http://www.ntu.ac.uk/ecoweb/sustainability/index.html (Accessed on 17 February 2014)

Nguyen, Q.A. and Hens, L. (2015), 'Environmental performance of the cement industry in Vietnam: the influence of ISO 14001 Certification, *Journal of Cleaner Production*, Volume 96, pp.362-378, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2013.09.032 (Accessed on 15 June 2015)

Odeh, N.A., and Cockerill, T. (2008), 'Life cycle GHG assessment of fossil fuel power plants with carbon capture and storage', *Energy Policy*, Volume 36 (1), pp.367-380, *Sciencedirect* [Online} Available at http://dx.doi.org/10.1016/j.enpol.2007.09.026 (Assessed on 01 July 2013)

Oecd (2014), '*Organisation for Economic Co-operation and Development'*, [Online], Available at www.oecd.org (Accessed on 17 February 2014)

Offset (2015), '*Radiative Forcing Index'*, [Online], Available at http://www.co2offsetresearch.org/aviation/RFI.html (Accessed on 24 October 2015)

Olson, E. G (2010), 'Challenges and opportunities from greenhouse gas emissions reporting and independent auditing', *Managerial Auditing Journal*, Volume 25 (9), pp.934-942 *Emeraldinsight* [Online], Available at http://dx.doi.org/10.1108/02686901011080071 (Accessed on 12 August 2013)

Olsen, K.H. (2007), 'The clean development mechanism's contribution to sustainable development: a review of the literature', *Climate Change*, Volume 84, pp.59-73, *Springer Link* [Online], Available at doi:10.1007/s10584-007-9267-y (Accessed on 11 November 2015)

O'Mahony, T. (2014), 'Integrated scenarios for energy: A methodology for the short term', *Futures*, Volume 55, pp.41-57, *Sciencedirect* [Online], Available from http://dx.doi.org/10.1016/j.futures.2013.11.002 (Accessed on 17 May 2013)

Ostlund, U., Kidd, L., Wengstrom, Y., and Rowa-Dewar. (2011), 'Combining qualitative and quantitative research within mixed method research designs: A methodological review', *International Journal of Nursing Studies*, Volume 48 (3), pp.369-383, *Sciencedirect* [Online], Available at doi:10.1016/j.ijnurstu.2010.10.005 (Accessed on 15 January 2016)

Ou, X., Zhang, X., and Chang, S. (2010), ‘Alternative fuel buses currently in use in Chine: Life Cycle fossil energy use, GHG Emissions and policy recommendations’, *Energy Policy,* Volume 38 (1), pp.406-418, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.enpol.2009.09.031 (Accessed on 01 July 2013)

Ozawa-Meida, L., Brockway, P., Letten, K., Davies, J. and Fleming P. (2013) ‘Measuring Carbon Performance in a UK University through a consumption based carbon footprint: De Monfort University Case Study’, *Journal of Cleaner Production*, pp.1-14, *Sciencedirect* [Online], Available at doi:10.1016/j.jclepro.2011.09.028 (Accessed on 17 July 2013)

Paez, A. and Whalen, K. (2010), ‘Enjoyment of commute: A comparison of different transportation modes’, *Transportation Research Part A*, Volume 44, pp. 537-549, *Sciencedirect* [Online], Available at doi:10.1016/j.tra.2010.04.003, (Accessed on 03 December 2013)

Paliwal, R. (2006), ‘EIA practice in India and its evaluation using SWOT Analysis’, *Environmental Impact Assessment Review.* Volume 26, pp.492-510, *Sciencedirect* [Online], Available at doi:10.1016/j.eiar.2006.01.004 (Accessed on 10 November 2013)

Pansari, J. (2009), ‘Evolution of a doctoral thesis research topic and methodology: A personal experience, *Tourism Management, Researchgate* [Online], Available at file:///C:/Users/user/Downloads/53d0b8a00cf2fd75bc5d3c85.pdf (Accessed on 10 October 2013)

Parry, M., Palutikof, J., Hanson, C., and Lowe, J. (2008). ‘Squaring up to reality’, *Nature Reports Climate Change,* [Online] Available at doi:10.1038/climate.2008.50 (Accessed on 17 May 2013)

Passey, R. and MacGill, I. (2009), ‘Energy sales targets: Alternative to White Certificate Schemes’, *Energy Policy 37*, pp.2310-2317, *Sciencedirect* [Online] Available athttp://ac.els-cdn.com/S0301421510006397/1-s2.0-S0301421510006397-main.pdf?_tid=bbd33688-d10b-11e2-b6e8-00000aacb35e&acdnat=1370786090_b07eb1467ee0a540cf2b769e35ed982d (Accessed on 31 May 2013)

Patidar, J (2015), ‘*Writing Research Objectives’*, [Online], Available at http://www.slideshare.net/drjayeshpatidar/writing-research-objectives (Accessed on 14 April 2015)

Patton, M.Q. (2014), ‘*Qualitative Research & Evaluation Methods: Integrating Theory and Practice,* pp. 135-148, Sage Publishers, USA

Pazirandeh, A. and Jafari, H. (2013), ‘Making sense of green logistics’, *International Journal of Productivity and Performance Management’*, Volume 62 (8), pp.889-904, *Emeraldinsight* [Online], Available at doi:10.1108/IJPPM-03-2013-0059, (Accessed on 17 October 2013)

Pearce, D. (2006), ‘The political economy of an energy tax: The United Kingdom’s Climate Change Levy’, *Energy Economics*, Volume 28 (2), pp.149-158, *Sciencedirect* [Online] Available at http://dx.doi.org/10.1016/j.eneco.2005.10.001 (Accessed on 01 July 2013)

Peopleandplanet (2006), ‘*Going Green – How UK Universities can improve their environmental performance and help stop climate chaos’*, pp.1-11, [Online] Available at http://peopleandplanet.org/dl/gogreen/goinggreenreport.pdf (Accessed on31 May 2013)

Pesonen, H-L and Horn, S. (2014), Evaluating the climate SWOT as a tool for defining climate strategies’, *Journal of Cleaner Production*, Volume 64, pp.562-571, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2013.10.013 (Accessed on 20 February 2014)

Petit, S.C. and Huault, I. (2008), ‘From Practice – based Knowledge to the Practice of Research: Revisiting Constructivist Research Works and Knowledge’, *Management Learning*, Volume 39 (1), pp.73-91, *Sagejpournals* [Online], Available at http://www.sagepub.com/gray/Website%20material/Journals/mlq.pdf and doi: 10.1177/1350507607085173 (Accessed on 06 December 2013)

Pretorius, M. (2008), ‘When Porter’s generic strategies are not enough: complementary strategies for turnaround situations’, *Journal of Business Strategy*, Volume 29 (6), pp.19-28, *Emeraldinsight* [Online], Available at doi: 10.1108/02756660810917200 (Accessed on 29 February 2016)

Plack, M. (2005), ‘Human nature and Research Paradigms: Theory Meets Physical Therapy Practice’, *The Qualitative Report*, Volume 10 (2), pp.223-245, [Online], Available at http:www.nova.edu/ssss/QR/QR10-2/plack.pdf (Accessed on 20 September 2013)

Plotnick, L., Gomes, E.A., White, C., and Turoff, M (2008), ‘*Development of a Unified Emergency Scale’,* pp. 412-418, [Online], Available at www.researchgate.net/...Thurstone's_law.../9fcfd506c4af50f4b2.pd (Accessed on 01 December 2013)

Prado-Lorenzo, J-M., Rodriguez-Dominguez, L., Gallego-Alvarez, I.,Garcia-Sanchez, I-M. (2009). ‘Factors influencing the disclosure of greenhouse gas emissions in companies worldwide’, *Management Decisions*, Volume 47 (7), pp.1133-1157, *Emeraldinsight* [Online[, Available at doi 10.1108/00251740910978340 (Accessed on 12 August 2013)

Prajogo, D., Tang, A.K.Y. and Lai, K-H. (2012), ‘Do firms get what they want from ISO 14001 adoption? ; an Australian perspective’, *Journal of Cleaner Production*, Volume 33. pp.117-128, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2012.04.019 (Accessed on 05 August 2013)

Price, T.J. (2005), 'Preaching what we practice: experiences from implementing 14001 at the University of Glamorgan', *International Journal of Sustainability in Higher Education,* Volume 6 (2) pp.161-178, *Emeraldinsight* [Online], Available at http://dx.doi.org/10.1108/14676370510589873 (Accessed on 24 November 2015)

Prion, S. and Adamson, K.A. (2013), 'Making Sense of Methods and Measurement: Levels of Measurement of Quantitative Research', *Clinical Simulation in Nursing,* Volume 9, pp.35-36, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.ecns.2012.10.001 (Accessed on 06 December 2013)

Provellio (2011), '*Guide to the realisation of strategic change and benefits: A Challenge to current thinking and practice', Hefce, University of Wolverhampton and Provelio,* [Online]. Available at http://www.provelio.com/lowRes.pdf (Accessed on 05 August 2013)

Potoski, M. and Prakash, A. (2005), 'Green Clubs and Voluntary Governance: ISO 14001 and Forms' Regulatory Compliance', *American Journal of Political Science,* Volume 49 (2), pp.235-248, *Wiley* [Online], Available at doi: 10.1111/j.0092-5853.2005.00120.x (Accessed on 06 August 2013).

Pulselli, F.M., Francesco, C., Christian, L., and Enzo, T. (2008), 'Integrating Methods for the environmental sustainability: The spin-eco project in the province of Siena', *Journal of Environmental Management,* Volume 86 (2), *Sciencedirect* [Online], Available at doi:10.1016/J.envman,2006-04-014 (Accessed on 07 July 2013)

Pun, K-F, Hui, I-K., Lau, H.C.W., Law, H-W and Lewis, W.G. (2002), 'Development of an EMS planning framework for environmental management practices', *International Journal of Quality & Reliability Management',* Volume 19 (6), pp.688-709, *Emeraldinsight* [Online], Available at doi: 10.1108/02656710210429573 (Accessed on 03 February 2016)

Ragsdell, G. (2009),'Participatory action research: a winning strategy for KM', *Journal of Knowledge Management,* Volume 13, (6), pp.564-576, *Emeraldinsight* [Online], Available at http://dx.doi.org/10.1108/13673270910997196 (Accessed on 02 March 2016)

Rahim, M.M. (2013), '*Legal regulation of corporate social responsibility: A meta-regulation',* p.61. Springer, UK

Ramos, T.B., Cecilio, T., Douglas, C.H. and Caeiro, S. (2013), 'Corporate sustainability reporting and the relations with evaluation and management framework; the Portuguese case', *Journal of Cleaner Production,* Volume 52, pp.317-328, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2013.03.002 (Accessed on 06 December 2013)

Ramos, T.B., Caeiro, S., Hoof. vB., Lozano, R., Huisingh, D., and Ceulemans, K, (2015), 'Experiences from the implementation of sustainable development in higher education institutions: Environmental Management for Sustainable Universities'. *Journal of Cleaner Production,*Volume 106, pp.3-10, *Scincedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2015.05.110 (Accessed on 22 October 2015)

Rasmussen, K.B. and Blank, G. (2007), 'The data documentation initiative: A preservation standard for research', *Architectural Science,* pp.55-71, Springer [Online], Available at
doi:10.1007/S10502-006-9036-0 (Accessed on 07 July 2013)

Rasmussen, K.B. and Thimm, H. (2009), 'Fact – Based Understanding of Business Survey Non-Response, *Electronic Journal of Business Research Methods*, Volume 7 (1), pp.83-92 [Online], Available at www.ejbrn.com, (Accessed on 02 December 2013)

Rachid, G. and Fadel, M. El. (2013), 'Comparative SWOT analysis of strategic environmental assessment systems in the Middle East and North African region', *Journal of Environmental Management,* Volume 125,pp.85-93, *Sciencedirect* [Online], Available at htttp://dx.doi.org/10.1016/j.jenvman,2013.03.053 (Accessed on 07 February 2014)

Ratnatunga, J., and Jones, S. (2012), '*Contemporary Issues in Sustainability Accounting, Assurance and Reporting',* pp.72-73, Emerald Publishing, UK

Ramos, T. B., Cecilio, T., Douglas, C.H., and Caeiro, S. (2013), 'Corporate sustainability reporting and the relations with evaluation and management frameworks: the Portuguese case', *Journal of Cleaner Production*, Volume 52, pp.317-328, *Sciencedirect* [Online], Available from http://dx.doi.org/10.1016/j.jclepro.2013.03.002 (Accessed on 20 February 2014)

Ramon, T.B., Caeiro, S., Hoof Van, B., Lozano, R., Huisingh, D. and Ceulemans, K. (2015), 'Experiences from the implementation of sustainable development in higher education institutions: Environmental Management for Sustainable Universities', *Journal of Cleaner Production,* Volume 106, pp.3-10, *Sciencedirec*t [Online], Available at doi:10.1016/j.jclepro.2015.05.110 (Accessed on 05 February 2016)

Rand (1988), '*Introduction to Objectivist Epistemology'*, [Online], Available at http://aynrandlexicon.com/lexicon/epistemology.html (Accessed on 22 April 2013)

Rauch, P. and Gronalt, M. (2011), 'The effects of rising energy costs and transportation mode mix on forest fuel procurement costs', *Biomass and Bioenergy,* Volume 35 (1), pp.693-699, *Sciencedirect* [Online], Available at doi:10.1016/j.biombioe.2010.10,015 (Accessed on 17 May 2013)

Rauch, J.N., and Newman, J. (2009), 'Defining sustainability metric targets in an institutional setting', *International Journal of Sustainability in Higher Education*, Volume 10 (2), pp.107-117, *Emeraldinsight* [Online], Available at doi:10.1108/14676370910945927 (Accessed on 18 May 2013)

Rayner, S. (2011), ‘Researching style: Epistemology, paradigm shifts and research interests groups’, *Learning and Individual Differences*, Volume 21, pp.255-262, *Sciencedirect* [Online], Available at doi:10.1016/j.lindif.2010.11.020 (Accessed on 06 December 2013)

Reed, M.S., Graves, A., Dandy, N., Postumus, H., Hubacek, K., Morris, J., Prell, C., Quinn, C.H., and Stringer, L.C. (2009), ‘Who’s in and why? A typology of stakeholder analysis methods for natural resource management’, *Journal of Environmental Management*, Volume 90, pp.1933-1949, *Sciencedirect* [Online], Available at doi:10.1016/j.jenvman.2009.01.001 (Accessed on 05 October 2013).

Reid, E. M. and Toffel, M.W. (2009), ‘Responding to public and private politics: corporate disclosure of climate change strategies’, *Strategic Management Journal*, Volume 30 (11), pp.1157-1178, *Wiley* [Online], Available at doi: 10.1002/smj.796 (Accessed on 07 August 2013)

Reinman, S.L. (2012), ‘Intergovermental Panel on Climate Change’ *Reference Reviews*, Volume 26 (2), pp.41-42, *Emeraldinsight* [Online], Available at http://dx.doi.org/10.1108/09504121211205250 (Accessed on 19 November 2015)

Reiska, P., Soika, K., Mollits, A., Rannikmae, M., and Soobard, R. (2015), ‘Using Conccpt Mapping Method for Assessing Students’ Scientific Literacy’, *Procedia – Social and Behavioural Sciences*, Volume 177, pp.352-357, *Sciencedirect* [Online], Available at doi: 10.1016/j.sbspro.2015.02.357 (Accessed on 17 November 2015)

Reschke, J., and Huttich, C. (2014), ‘Continuous field mapping of Mediterranean wetland using sub-pixel spectral signatures and multi-temporal Landsat data’, *International Journal of Applied Earth Observation and Geoinformation*’, Volume 28, pp.220-229, *Sciencedirect* [Online], Available from http://dx.doi.org/10.1016/j.jag.2013.12.014 (Accessed on 20 February 2014)

Riddell, W., Bhatia, K.K., Parisi, M., Foote, J., and Imperatore, J. (2009), ‘Assessing carbon dioxide emissions for energy use at a university’, *International Journal of Sustainability in Higher Education*, Volume 10 (3), pp.266-278, *Emeraldinsight* [Online], Available at doi: 10.1108/14676370910972576 (Accessed on 04 July 2013)

Rindfleisch, A., Malter, A.J., Ganesan, S., and Moorman, C. (2008), ‘Cross-sectional versus longitudinal survey research: concepts, findings and guidelines’, *Journal of Marketing Research*, Volume 45 (3), pp.261-279, *Emeraldinsight* [Online], Available at doi: 10.1509/jmkr.45.3.261 (Accessed on 08 February 2014)

Reason. P. and Bradbury, H. (2008), ‘*The Sage Handbook of Action Research, Participative Inquirey and Practice’*, pp.2-4, 2nd Edition, Sage Publications, UK

Rissel, C., Petrunoff, N. Wen, L. M., and Crane, M. (2014), ‘Travel to work and self-report stress: Findings from a workplace survey in south west Sydney, Australia’, *Journal of Transport and Health*, Volume 1, pp.50-53, *Sciencedirect* [Online], Available at doi:10.1016/j.jth.2013.09.001 (Accessed on 18 December 2014)

Rio (1992), '*UN Sustainable Development - Agenda 21'* [Online], Available at https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf (Accessed on 21 March 2014)

Robinson, J. (2004), Squaring the circle? Some thoughts on the idea of sustainable development', *Ecological Economics*, Volume 48 (4), pp.369-384, *Sciencedirect* [Online], Available at doi:10.1016/j.ecolecon.2003.10.017 (Accessed on 17 November 2015)

Robinson, O., Kemp, S. and Williams, I. (2015), 'Carbon management at universities: a reality check', *Journal of Cleaner Production*, Volume 106, pp.109-118, *Sceincedirec*t [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2014.06.095 (Accessed on 22 October 2015)

Roby, H, (2014), 'Understanding the development of business travel policies: Reducing business travel, motivation and barriers', *Transportation Research Part A 69*, pp.20-25, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.tra.2014.08.022 (Accessed on 06 January 2015)

Rogelj, J., Hare, B., Nabel, J., Macey, K., Schaeffer, M., Markmann, K., Meinshausen, M. (2009), '*Halfway to Copenhagen, no way to 2C'*, [Online], Available at doi:10.1038/climate.2009.57 (Accessed on 17 May 2017)

Rondinelli, D. and Vastag,G (2009), 'Panacea, common sense, or just a label?: The value of ISO 14001 environmental management systems', *European Management Journal*, Volume 18 (5), pp. 499-510, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/S0263-2373(00)00039-6, (Accessed on 02 August 2013)

Ross, A. and Chiasson, M. (2011), 'Habermas and information systems research: New directions', *Information and Organisation 21*, pp.123-141, *Sciencedirect* [Online], Available at doi:10.1016/j.infoandorg.2011.06.001 (Accessed on 05 December 2013)

Rowley, J. (2014), 'Designing and using research questionnaires', *Management Research Review*, Volume 37 (3), pp.308-330, *Emeraldinsight* [Online], Available at doi: 10.1108/MRR-02-2013-0027 (Accessed on 17 February 2014)

Roy, R., Potter, S. and Yarrow, K. (2008). 'Designing low carbon higher education systems', *International Journal of Sustainability in Higher Education*, Volume 9 (2), pp.116-130. *Emeraldinsight* [Online] Available at doi: 10.1108/14676370810856279 (Accessed on 31 May 2013 and 09 January 2015)

Ruwhiu, D. and Cone, M. (2010), 'Advancing a pragmatist epistemology in organisational research', *Qualitative Research in Organisations and Management: An International Journal*, Volume 5 (2), pp.108-126, *Emeraldinsight* [Online], Available at http://dx.doi.org/10.1108/17465641011068884 (Accessed on 01 December 2015)

Saadatian, O., Sopian, K. and Salleh, E. (2013),'Adaptation of sustainability community indicators for Malaysian Campuses as Small Cities', *Sustainable Cities and Society 6*, pp.40-50. *Sciencedirect* [Online] Available at http://dx.doi.org/10.1016/j.scs.2012.08.002 (Accessed on 31 May 2013)

Saizarbitoria, I.H., Dogui, K. and Boiral, O. (2013), 'Shedding light on ISO 14001 certification audits', *Journal of Cleaner Production,* Volume 51, pp.88-98, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2013.01.040 (Accessed on 05 August 2013)

Salvati, L., and Carlucci, M. (2014), 'A composite index of sustainable development at the local scale: Italy as a case study', *Ecological Indicators*, Volume 43, pp.162-171, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.ecolind.2014.02.021 (Accessed on 17 February 2014)

Sammalisto, K., and Arvidsson, K. (2005), 'Environmental management in Swedish higher education, *International Journal of Sustainability in Higher Education*, Volume 6 (1), pp.18-35, *Emeraldinsight* [Online], Available at doi: 10.1108/14676370510573113 (Accessed on 03 February 2016)

Sammalisto, K. and Brorson, T. (2008), 'Training and communication in the implementation of environmental management systems (ISO 14001) : A case study at the University of Gavle, Sweden', *Journal of Cleaner Production,* Volume 16 (3), pp. 299-309, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2006.07.029 (Accessed on 02 August 2013)

Sammut-Bonnici, T. and Parautis, S. (2013), 'Developing a dominant logic of strategic innovation', *Management Research Review,* Volume 36 (10), pp.924-938, *Emeraldinsight* [Online], Avaliable at doi: 10.1108/MRR-08-2013-0184 (Accessed on 21 April 2014)

Sari, D., and Bayram, A. (2013), 'Quantification of emissions from domestic heating in residential areas of Izmir, Turkey and assessment of the impact on local/regional air quality', *Science of the Total Environment*, Volume 488-489, pp.429-436, *Sciencedirect* [Online]. Available at doi: 10.1016/j.scitotenv.2013.11.033 (Accessed on 14 June 2014)

Savely, S.M., Carson, A.I. and Delclos, G.L. (2007), 'An environmental management system implementation model for U.S. colleges and universities', *Journal of Cleaner Production 15*, pp.660-670, *Sciencedirect* [Online], Available at doi:10.1016/j.jclepro.2006.01.013, (Accessed on 05 December 2014)

Scapens, R. W. (2008), 'Seeking the relevance of interpretive research: A contribution to the polyphonic debate', *Critical Perspectives on Accounting*, Volume 19 (6),pp.915-919, *Sciencedirect* [Online], Available at doi:10.1016/j.cpa.2007.02.006 (Accessed on 01 April 2015)

Schoenberg, R., Collier, N. and Bowman, C. (2013), 'Strategies for business turnaround and recovery: a review and synthesis', *European Business Review*, Volume 25 (3), pp.243-262, *Emeraldinsigh*t [Online], Available at doi: 10.1108/09555341311314799 (Accessed on 06 March 2016)

Schwanen, T., Banister, D., and Anable, J. (2011), 'Scientific research about climate change mitigation in transport', *Transportation Research Part A*, Volume 45, pp.993-1006, *Sciencedirect* [Online], Available at doi:10.1016/j.tra.2011.09.005 (Accessed on 10 February 2014)

Secondnature (2015), '*Secondnature'*, [Online], Available at http://secondnature.org/ (Accessed on 1 December 2015)

Setiawan, A.D. and Cuppen, E. (2013), 'Stakeholder perspectives on carbon capture and storage in Indonesia', *Energy Policy,* Volume 61, pp.1188-1199, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.enpol.2013.06.057 (Accessed on 06 December 2013)

Schaltegger, S. and Csitora, M. (2012), 'Carbon accounting for sustainability and management. Status quo and challenges', *Journal of Cleaner Production 36*, pp.1-16, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2012.06.024 (Accessed on 03 December 2013)

Schellnhuber, H.J. (2006), '*Avoiding Dangerous Climate Change'*, Cambridge University Press, UK

Schroder, R.G., Clark, M.W., Cathy, J.M. (2011), '*Financial Accounting Theory and Analysis: Texts and Cases,* 10th Edition, p.211, John Wiley & Son, USA

Sedac (2015), '*Socioeconomic Data and Applications Centre'*, [Online], Available at http://sedac.ciesin.columbia.edu/data/collection/epi (Accessed on 12 February 2016)

Seoketsa, L.M. (2014), 'Application of Turnaround Management Strategies for Improved Service Delivery with Reference to Madibeng Municipality in Brits-NorthWest Province', *International Journal of Scientific & Engineering Research*, Volume 5 (2), [Online], Available at http://www.ijser.org/researchpaper/Application-of-Turnaround-Management-Strategies-for-Improved-Service.pdf (Accessed on 27 February 2016)

Seuring, S. and Gold, S. (2013), 'Sustainability management beyond corporate boundaries: from stakeholders to performance', *Journal of Cleaner Production,* Volume 56, pp.1-6, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2012.11.033 (Accessed on 02 February 2014)

Shamah, R.A. (2012, 'Innovation with green service supply chains for a value creation', *Journal of Modelling in Management,* Volume 7 (3), pp.357-374, *Emeraldinsight* [Online] Available at doi: 10.1108/17465661211283313 (Assessed on 05 July 2013)

Shannon, T., Giles-Corti, B., Pikora, T., Bulsara, M., Shilton, T. and Bull, F. (2006), 'Active commuting in a university setting: Assessing commuting habits and potential for modal change', *Transport Policy,* Volume 13 (3), pp.240-253, *Sciencedirect* [Online], Available at doi:10.1016/j.tranpol.2005.11.002 (Accessed on 15 November 2015)

Shelton, D. (2008), 'Stockholm Declaration (1972) and Rio Declaration (1992)', *Oxford Public International Law* [Online], Available at http://opil.ouplaw.com/view/10.1093/law:epil/9780199231690/law-9780199231690-e1608 (Accessed on 16 November 2015)

Shelton, K., Davies, J., and Howels, K. (2012), '*Research in Practice for Forensic Professionals*', p.5, Routedge Publishers, UK

Shen, K-S. (2013), 'Measuring the sociocultural appeal of SNS games in Taiwan', *Internet Research*, Volume 23 (3), pp.372-392, *Emeraldinsight* [Online], Available at doi:10.1108/10662241311331781 (Accessed on 12 September 2013)

Shewan, L.G., Rosano, G., Henein, M., and Coats, A.J.S. (2014), 'A statement on ethical standards in publishing scientific articles in the International Journal of Cardiology family of journals', *International Journal of Cardiology*, Volume 170, pp.235-254, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.ijcard.2013.11.001 (Accessed on 17 May 2013)

Shi, H. and Lai, E. (2013), 'An alternative university sustainability rating framework with a structured criteria tree', *Journal of Cleaner Production*, Volume 61, pp.59-69, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2013.09.006 (Accessed on 30 November 2013)

Shukla, P. (2008), '*Essentials of Marketing Research: Exercises'*, p.36, Bookboon.com Publishers, USA

Shucksmith, R.J. and Kelly, C. (2014), 'Data collection and mapping – principles, processes and application in marine spatial planning', *Marine Policy*, Volume 50, pp.27-33, *Sciencedirect* [Online], Available at doi: 10.1016/j.marpol.2014.05.006 (Accessed on 17 June 2014)

Singh, N., Jain, S., and Sharma, P. (2015), 'Motivations for implementing environmental management practices in Indian Industries', *Ecological Economics,* Volume 109, pp.1-8, *Sciencedirect* [Online], Available at doi:10.1016/j.ecolecon.2014.11.003 (Accessed on 08 December 2014)

Singh, R.K., Murthy, H.R., Gupta, S.K., and Dickshit, A.K. (2011), 'An Overview of sustainability assessment methodologies', *Ecological Indicators,* Volume 15, pp.281-299, *Sciencedirect* [Online], Available at doi:10.1016/j.ecolind.2011.01.007 (Accessed on 30 November 2013)

Skelton, A. (2013), ‘EU corporate action as a driver for global emissions abatement: A Structural analysis of EU international supply chain carbon dioxide emissions’, *Global Environmental Change,* Volume 23, pp.1795-1806, *Sciencedirect* [Online], Available at doi:10.1016/j.gloenvcha.2013.07.024(Accessed on 10 February 2014)

Skouloudis, A., Kourmousis, F. and Evangelinos, K. (2007), ‘*Development of an evaluation methodology for sustainability reports using international standards on reporting’,* Confernce Paper, [Online], Available at http://www.srcosmos.gr/srcosmos/showpub.aspx?aa=10017 (Accessed on 31 Janaury 2016)

Smardon, R.C. (2008). ‘A comparison of Local Agenda 21 implementation in North American, European and Indian cities", *Management of Environmental Quality: An International Journal,* Volume 19 (1), pp.118 – 137, *Emeraldinsight* [Online], Available at http://dx.doi.org/10.1108/14777830810840408 (Accessed on 15 Janaury 2015)

Smith, M. and Graves, C. (2005), ‘Corporate turnaround and financial distress’, *Managerial Auditing Journal*, Volume 20 (3), pp. 304-320, *Emeraldinsight* [Online], Available at doi: 10.1108/02686900510585627 (Accessed on 18 August 2014)

Sneddon, C., Howarth, R.B. and Norgaard, R.B. (2006), ‘Sustainable development in a post-Brundtland world’, *Ecological Economics,* Volume 57, pp.253-268, *Sciencedirect* [Online], Available at doi:10.1016/j.ecolecon.2005.04.013 (Accessed on 15 November 2015)

Socialresearch (2006), ‘*Thurstone Scale’*, [Online], Available at http://www.socialresearchmethods.net/kb/scalthur.php (Accessed on 17 May 2014)

Sohn, L.B. (1973), ‘*The Stockholm Declaration on the Human Environment’,* [Online], Harvard Law International Law Journal, Volume 14 (1), Available at http://resources.spaces3.com/631e9a3e-f2f1-4fd8-ba02-2d8e46e215cc.pdf (Accessed on 23 October 2015)

Solomon. J.F. and Darby, L. (2005), ‘Is private social, ethical and environmental reporting mythicizing or demythologizing reality?’, *Accounting Forum 29,* pp.27-47, *Sciencedirect* [Online], Available at doi:10.1016/j.accfor.2004.12.003 (Accessed on 01 October 2013)

Somekh, B. (2008)[Ed, Given, L.], ‘*The Sage Encyclopaedia of Qualitative Research Methods’*. pp.5-8, Sage, USA

Soosay C., Fearne, A. and Dent, B. (2012), ‘Sustainable value chain analysis – a case study of Oxford Landing from ‘vine to dine’, *Supply Chain Management: An International Journal,* Volume 17 (1), pp. 68-77, *Emeraldinsight* [Online], Available at http://dx.doi.org/10.1108/13598541211212212 (Accessed 20 May 2013)

Soriano-Meier, H., Forrester, P.L. (2002), 'A model for evaluating the degree of leanness of manufacturing firms', *Integrated Manufacturing Systems*, Volume 13/2, pp.104-109, *Emeraldinsight* [Online], Available at doi:10.1108/09576060210415437 (Accessed on 03 December 2014)

Spangenberg, J., Pfahl, S. and Deller, K. (2002), 'Towards indicators for institutional sustainability: lessons from an analysis of Agenda 21, *Ecological Indicators*, Volume 2 (1-2), pp.61-77, *Sciencedirect* [Online], Available at doi:10.1016/S1470-160X(02)00050-X (Accessed on 15 November 2015)

Spangenberg, J. (2002), 'Environmental space and the prism of sustainability: frameworks for indicators measuring sustainability development', *Ecological Indicators*, Volume 2, pp.295-309, *Sciencedirect* [Online], Available at http://www.sciencedirect.com/science/article/pii/S1470160X02000651 (Accessed on 12 September 2013)

Spellerberg, I.F., Buchan, G.D., Englefield, R. (2004), 'Need a university adopt a formal environmental management system', *International Journal of Sustainability in Higher Education*, Volume 5 (2), pp.125-132, *Emeraldinsight* [Online], Available at doi: 10.1108/14676370410526215 (Accessed on 03 February 2016)

Stafford, S.L. (2010), 'How green is your campus? An analysis of the factors that drive universities to embrace sustainability', *Contemporary Economic Policy*, Volume 29 (3), pp.337-356, *Wiley* [Online], Available at doi: 10.1111/j.1465-7287.2010.00231.x (Accessed on 01 August 2013)

Stears, C (2013), '*Strategic reporting-conduct of costs'*, [Online], Available at http://eprints.lse.ac.uk/55034/1/21November2013.pdf (Accessed on 16 November 2015)

Sterling, S. and Scott, W. (2008),'Higher education and ESD in England: a critical commentary on recent initiatives', *Environmental Education Research*, Volume 14 (4), pp.386-398. *Tandfonline* [Online] Available at http://www.tandfonline.com/doi/pdf/10.1080/13504620802344001 (Accessed on 31 May 2013)

Stern N. (2006), '*Stern Review on Economics of Climate Change'*, London, HM Treasury

Stephens, J.C. and Graham, A.C. (2010), '*Towards an empirical research agenda for sustainability in higher education: exploring the transition management framework'*, *Journal of Cleaner Production*, Volume 18(7), pp.611-618, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2009.07.009 (Accessed on 15 February 2014)

Stringer, E.T. (2014), 'Action Research', p.5, 4th Edition, Sage USA.

Stopher, P. R., and Greaves, S. P. (2007), 'Household travel surveys: where are we going?', Transportation Research Part A*; Policy and Practice*, Volume 41 (5), pp.367-381, *Sciencedirect* [Online], Available at doi:10.1016/j.tra.2006.09.005 (Accessed on 18 December 2014)

Sullivan, R. and Gouldson, A. (2012), 'Does voluntary carbon reporting meet investors' needs?', *Journal of Cleaner Production*, Volume 36, pp. 60-67, *Sciencedirect* [Online], Available at doi:10.1016/j.jclepro.2012.02.020 (Accessed on 09 August 2013)

Sussex1 (2000), '*Characterising the UK Education Sector'* p.10 [Online] Available at http://www.sussex.ac.uk/Units/spru/publications/reports/barriers/SECT_2.pdf (Accessed on 31 May 2013)

Sustainable (2015),' *UN Sustainable Development Goals'*, [Online], Available at https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals (Accessed on 12 February 2016)

Suwartha, N. and Sari, R.F.(2013), 'Evaluating UI Green Metrics as a tool to support green universities development : assessment of the year 2011 ranking, *Journal of Cleaner Production*, Volume not published, pp.1-8, *Sciencedirect* [Online] Available at http://dx.doi.org/10.1016/j.jclepro.2013.02.034 (Accessed on 03 July 2013)

Sydney (2013), '*University of Sydney – Centre for Integrated Sustainability Analysis'*, [Online], Available at http://www.isa.org.usyd.edu.au/research/InformationSheets/ISATBLInfo17_new.pdf (Accessed on 19 November 2015)

Taddei-Bringas, J.L., Platt-Carrillo, J.E-P. and Platt-Carrillo, A. (2008), 'ISO 14001 and sustainability at universities: a Mexican case study', *Management of Environmental Quality: An International Journal*, Volume 19 (5), pp.613-636, *Emeraldinsight* [Online], Available at DOI 10.1108/14777830810894274 (Accessed on 21 November 2015)

Talbot, D. and Boiral, O. (2013), 'Can we trust corporates GHG inventories? An investigation among Canada's large final emitters, *Energy Policy*, Volume 63, pp.1075-1085, *Sciencedirect* [Online] Available at http://dx.doi.org/10.1016/j.enpol.2013.09.054 (Accessed on 11 February 2014)

Tashakkori, A and Teddle, C. (2010), '*Handbook of Mixed Methods in Social and Behavioural Research'*, pp.351-356, Sage Publications Inc, USA

Taylor, M.J., McNicholas, C., Nicolay, C., Darzi, A. Bell, D., and Reed, J.E. (2013), '*Systematic review of the application of the plan-do-study-act method to improve quality in healthcare'*, *BMJ Quality & Safety Online First*, [Online], Available at http://qualitysafety.bmj.com/content/early/2013/09/11/bmjqs-2013-001862.full.pdf+html (Accessed on 23 November 2015)

Teles, M. and Sousa, J. (2014), 'Environmental Management and Business Strategy: Structuring the Decision-Making Support in a Public Transport Company', *Transportation Research Procedia 3*, pp.155-164, *Sciencedirect* [Online], Available at doi: 10.1016/j.trpro.2014.10.101 (Accessed on 23 October 2015)

Terrados, J., Almonacid, G., and Hontoria, L. (2007), 'Regional energy planning through SWOT analysis and strategic planning tools: Impact on renewables development, *Renewable and Sustainability Energy Reviews,* Volume 11 (6), pp.1275-1287, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.rser.2005.08.003 (Accessed on 10 February 2014)

Thurston, M. and Eckelman, M., J. (2011), 'Assessing the greenhouse gas emissions from purchases', *International Journal of Sustainability in Higher Education*, Volume 12 (3), pp.225-235, *Emeralinsight* [Online], Available at doi: 10.1108/14676371111148018 (Accessed on 17 February 2014)

Thyer, B.A. (2008), 'The quest for evidence based practice? We are all positivists!, *Research on Social Work Practice,* Volume 18 (4), pp.339-345, *Sagejournals* [Online], Available at doi: 10.1177/1049731507313998 (Accessed on 11 February 2014)

Tikici, M., Omay, E., Derin, N., Seckin, S.N., and Cureoglu, M. (2011), 'Operating turnaround strategies during crisis periods: a research on manufacturing firms', *Procedia Social and Behavioural Sciences 24*, pp.49-60, *Sciencedirect* [Online], Available at doi:10.1016/j.sbspro.2011.09.046 (Accessed on 08 March 2016)
Tilbury, D (2011), *'Higher education for sustainability: a global overview of commitment and progress',* pp. 1-12, [Online], Available at http://insight.glos.ac.uk/sustainability/Education/Documents/GUNI%20HE%20in%20the%20World%204%20HE's%20Committment%20to%20Sus.pdf (Accessed on 12 August 2013)

Times (2010), '*Hefce reduces carbon targets after protests'*, [Online], Available at http://www.timeshighereducation.co.uk/news/hefce-reduces-carbon-targets-after-protests/410183.article (Accessed on 05 August 2013)

Times (2016), '*Overseas student number falls 'significant risk' to sector'*, [Online], Available at https://www.timeshighereducation.com/news/overseas-student-number-falls-significant-risk-to-sector (Accessed on 24 March 2016)

Tipper, R. (2013), [In Econometrica, 2013], '*Mandatory carbon reporting requirements are firmed up*', [Online], Available at http://ecometrica.com/blog/mandatory-carbon-reporting-requirements-are-firmed-up/ (Accessed on 07 August 2013)

Tolbert, P.S. and Zucker, L.G. (2012), [Eds, Clegg, S.R. and Hardy, C.] '*Studying Organisation: Theory and Method'*, pp.215-217, Sage Publications, UK

Too, L and Bajracharya, B. (2015), '*Sustainable campus: engaging the community in sustainability',* International Journal of Sustainability in Higher Education, Volume 16 (1), pp.57-71, *Emeraldinsight* [Online], Available at doi: 10.1108/IJSHE-07-2013-0080 (Accessed on 22 September 2015)

Townsend, J. and Barrett, J. (2015), 'Exploring the applications of carbon footprinting towards sustainability at a UK University: reporting and decision making', *Journal of Cleaner Production,* Volume 107, pp.164-176, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2013.11.004 (Accessed on 11 January 2015)

Trust (2014), '*Carbon Trust – helps GHG Protocol'*, [Online], Available at http://www.carbontrust.com/about-us/press/2013/04/carbon-trust-ghg-protocol-pragmatic-guidance-scope-3-emissions-measurement (Accessed on 17 May 2014)

Trust (2015), '*What are Scope 3 emissions'*, [Online], Available at http://www.carbontrust.com/resources/faqs/services/scope-3-indirect-carbon-emissions/ (Accessed on 22 October 2015)

Tung, A., Baird, K., Schoch, H. (2014), 'The relationship between organisational factors and effectiveness of environmental management', *Journal of Environmental Management 144*, pp.186-196, *Sciencedirect* [Online], Available at ttp://dx.doi.org/10.1016/j.jenvman.2014.05.025 (Accessed on 03 January 2015)

Uea (2015), '*University of East Anglia: ISO 14001*, [Online], Available at https://www.uea.ac.uk/about/sustainability/case-studies/iso14001-and-platinum-ems-success (Accessed on 24 November 2015)

Ulsf (2001). 'Tallories Declaration', *Association of University Leaders for a sustainable future* [Online] Available at http://www.ulsf.org/programs_talloires.html (Accessed on 31 May 2013)

UnGlobal (2013), '*UN Global Compact'*, [Online], Available at http://www.unglobalcompact.org/AboutTheGC/index.html (Accessed on 20 April 2014)

Unepfi (2006), '*A statement of investor expectations for comprehensive corporate disclosure'*, [Online], Available at http://www.unepfi.org/fileadmin/documents/global_framework.pdf (Accessed on 20 April 2014)

Unep (1972), '*Declaration of the United Nations Conference on the Human Environment'*, [Online], Available at http://www.unep.org/Documents.Multilingual/Default.asp?documentid=97&articleid=1503 (Accessed on 17 April 2015)

Unep (2014), '*United Nations Environmental Programme – World Conservation Monitoring Centre'.* [Online], Available at http://www.unep-wcmc.org/ (Accessed on 17 February 2014)

Unfccc1 (2014), '*United Nations Framework Convention on Climate Change'*, [Online], Available at http://unfccc.int/essential_background/convention/items/2627.php (Accessed 21 June 2014)

Unfcc2 (2014), '*UNFCC – Clean Development Mechanism'*, [Online], Available at https://unfccc.int/kyoto_protocol/mechanisms/clean_development_mechanism/items/2718.php (Accessed on 17 June 2014)

Unfcc3 (2015), '*United Nations Framework Convention on Climate Change: GHG Data from UNFCC*, [Online], Available at http://unfccc.int/ghg_data/ghg_data_unfccc/items/4146.php (Accessed on 25 January 2016)

Unglobal (2013), '*United Nations Global Compact'*, [Online], Available at www.unglobalcompact.org, (Accessed on 14 February 2014)

Untreaty1 (2008),' Declaration of the UN Conference on Human Environment (72) and Rio Declaration and Development (92)', *Audiovisual Library of International Law* [Online] Available at http://untreaty.un.org/cod/avl/ha/dunche/dunche.html (Accessed on 31 May 2013)

Upham, P. and Jakubowicz, T. (2008), 'Aircraft dominance in the transport-related carbon emissions of business schools students', *Journal of Transport Geography*, Volume 16, pp,73-76, *Sciencedirect* [Online], Available at doi:10.1016/j.jtrangeo.2007.05.002 (Accessed on 16 November 2015)

Uuk (2013), '*Efficiency and effectiveness in higher education: A report by the Universities UK Efficiency and Moderation Task Group'*, [Online], Available at www.universitiesuk.ac.uk/highereducation/Documents/2011/EfficiencyinHigherEducation.pdf (Accessed on 12 February 2014)

Ukconversion (2014), 'Government conversion factors for company reporting', *DEFRA*, [Online], Available at http://www.ukconversionfactorscarbonsmart.co.uk/ (Accessed 20 February 2014)

Vaishnai, V.K., and Kuechler, W. Jr. (2007), '*Design Science Research Methods and Patterns'*, p.25. Auerbach Publications, Florida.

Van Griensven, H., Moore, A. P., and Hall, V. (2014), 'Mixed Methods Research – The best of both worlds?', *Manual Therapy*, Volume 19, pp.367-371, *Sciencedirec*t [Online], Available at doi:10.1016/j.math.2014.05.005 (Accessed on 02 March 2016)

Van Staden, C.J., and Hooks, J. (2007), 'A comprehensive comparison of corporate environmental reporting and responsiveness', *The British Accounting Review*, Volume 39, pp.197-210, *Scienedirect* [Online], Available at doi:10.1016/j.bar.2007.05.004 (Accessed on 07 February 2014)

Vasquez, L., Iriarte, A., Almeida, M., and Villalobos, P. (2015), 'Evaluation of Greenhouse gas emissions and proposals for their reduction at a university campus in Chile', *Journal of Cleaner Production,* Volume 108, pp. 924-930, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2015.06.073 (Accessed on 24 October 2015)

Viebahn, P. (2002), 'An environmental management model for universities; from environmental guidelines to staff involvement', *Journal of Cleaner Production,* Volume 10, pp.3-12, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/S0959-6526(01)00017-8 (Accessed on 05 August 2013)

Villiers, C., Staden, C.J. van, (2010), 'Shareholders' requirements for corporate environmental disclosures: A cross country comparison', *The British Accounting Review,* Volume 42, pp.227-240, *Sciencedirect* [Online], Available at doi:10.1016/j.bar.2010.08.002 (Accessed on 01 October 2013).

Vuuren, Van D.P., Cofala, J., Eerens, H.E., Oostenrijk, R., Heyes, C., Klimont, Z., Elzenden M.G.J. and Amann, M. (2006). 'Exploring the ancillary benefits of the Kyoto Protocol for air pollution in Europe', *Energy Policy 34,* pp.444-460, *Sciencedirect* [Online], Available at doi:10.1016/j.enpol.2004.06.012 (Accessed on 07 July 2013)

Waas T, Verbruggen, A.and Wright, T. (2010), 'University Research for Sustainable development; definition and characteristics explained', *Journal of Cleaner Production*, Volume 18(7), *Sciencedirect* [Online], Available at doi:10.1016/j.clepro.2009.09.017 (Accessed on 10 July 2013)

Waheed, B., Khan, F., Faisak, I., Veitch, B., and Hawboldt, K. (2011), 'Uncertainty-based quantitative assessment of sustainability for higher education institutions', *Journal of Cleaner Production 19,* 720 -732, *Sciencedirect* [Online], Available at doi:10.1016/j.jclepro.2010.12.013 (Accessed on 17 July 2013)

Wals, A.E.J. (2013), 'Sustainability in higher education in the context of the UN DESD: a review of learning and institutionalisation process', *Journal of Cleaner Production*, Volume 62, pp.8-16, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2013.06.007 (Accessed on 02 July 2013)

Wals, A.E.J. and Jickling, B. (2012). 'Sustainability in Higher Education: From doublethink and newspeak to critical thinking and meaningful learning', *International Journal of Sustainability in Higher Education,* Volume 3 (3), pp.221-232, *Emeraldinsight* [Online], Available at 10.1108/14676370210434688 (Accessed on 05 December 2013)

Walsh, E. (2010), 'A model of research group mircoculture: environmental and cultural factors affecting the experiences of overseas research students in the UK', *Studies in Higher Education,* Volume 35 (5), pp.545-560, *TaylorFrancisOnline* [Online], Available at doi:10.1080/03075070903243092 (Accessed on 17 February 2014)

Wang, Y., Shi, H., Sun, M., Huisingh, D., Hansson, L., and Wang, R. (2013), ‘Moving towards an ecological sound society? Starting from green universities and environmental higher education’, *Journal of Cleaner Production*, Volume 61, pp.1-5, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2013.09.038 (Accessed on 10 January 2014)

Wang, X., Wong, T.N. and Fan, Z-P (2013a), ‘Ontology based supply chain decision for steel manufacturers in China’, *Expert Systems with Applications,* Volume 40, pp.7517-7533, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.eswa.2013.07.061 (Accessed on 09 February 2014)

Wang, X.P., Zhang, J. and Yang, T. (2014), ‘Hybrid SWOT Approach for Strategic Planning and Formulation in China Worldwide Expres Mail Service’, *Journal of Applied Research and Technology,* Volume 12 (2), pp.230-238, *Sciencedirect* [Online], Available at doi:10.1016/S1665-6423(14)72339-9 (Accessed on 03 March 2016)

Wachholz, S., Artz, N., and Chene, D. (2012), ‘Warning to the idea : University students’ knowledge and attitudes about climate change’, *International Journal of Sustainability in Higher Education’*, Volume 15(2),pp.128-141, *Emeraldinsight* [Online], Available at doi 10.1108/IJSHE-03-2012-0025 (Accessed on 09 February 2014)

Wbcsd (2014), ‘*World Business Council on Sustainable Development’* [Online], Available at http://wbcsd.org/home.aspx (Accessed on 23 September 2014)

Weidema, B.P., Thrane, M., Christensen, P., Schmidt, J., and Lokke, S. (2008), ‘Carbon Footprint, A catalyst for life cycle assessment’?, *Journal of Industrial Ecology*, Volume 12 (1) pp.3-6, *Wiley* [Online], Available on doi: 10.1111/j.1530-9290.2008.00005.x (Accessed on 07 August 2013)

Wells, C.W., Savanick, S. and Manning, C. (2009), “Using a class to conduct a carbon inventory: a case study with practical results at Macalester College”, *International Journal of Sustainability in Higher Education,* Volume. 10 No. 3, pp. 228-38. *Emeraldinsight* [Online] Available at doi: 10.1108/14676370910972549 (Assessed on 03 July 2013)

Westbrook, R. (1994), ‘Action research: a new paradigm for research in production and operations management’, *International Journal of Operations & Production Management*, Volume 15 (12), pp.6-20, *Emeraldinsight* [Online], Available at http://dx.doi.org/10.1108/01443579510104466 (Accessed on 17 July 2013)

Westerman, M.A.(2014), ‘Examining arguments against quantitative research ; case studies illustrating the challenge of finding a sound philosophical basis for a human sciences approach to psychology’, *New Ideas in Psychology,* Volume 32, pp.42-58, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.newideapsych.2013.08.002 (Accessed on 10 February 2014)

Westhyssen, J van der. (2014), ‘Optimising value extraction from turnarounds’, *Procedia Engineering 83*, pp.477-483. *Sciencedirect* [Online], Available at doi: 10.1016/j.proeng.2014.09.081 (Accessed on 08 March 2016)

Wellens, L., and Jegers, M. (2014), ‘Effective governance in non-profit organisations: A literature based multiple stakeholder approach’, European Management Journal, Volume 32, pp.223-243, *Sciencedirect* [Online], Available from http://dx.doi.org/10.1016/j.emj.2013.01.007 (Accessed on 12 March 2014)

Weidmann, T (2009), ‘A review of recent multi-region input-output models used for consumption based emission and resource accounting’, *Ecological Economics*, Volume 69, pp.211-222, *Sciencedirect* [Online], Available at doi:10.1016/j.ecolecon.2009.08.026 (Accessed on 20 February 2014)

Weidmann, T., and Minx. J. (2007), ‘Definition of carbon footprint’, ISA Report Project 07-01’, *Ecological Research Trends, Chapter 1, pp1-11*[Online], Available at http://www.censa.org.uk/docs/ISA-UK_Report_07-01_carbon_footprint.pdf], Nova Science Publishers, NY, USA (Accessed on 17 July 2013)

Weidema, B.P., Thrane, M., Christensen, P., Schmidt, J., and Lokke, S. (2008), ‘Carbon Footprint, A catalyst for life cycle assessment?’, *Journal of Industrial Ecology*, Volume 12 (1) pp.3-6, *Wileyonline* [Online], Available on http://onlinelibrary.wiley.com/doi/10.1111/j.1530-9290.2008.00005.x/epdf (Accessed on 07 August 2013

Wilburn, K. and Wilburn, R. (2013), ‘Using Global Reporting Initiative indicators for CSR programs’, *Journal of Global Responsibility*, Volume 4 (1), pp.62-75, *Emeraldinsight* [Online], Available at doi 10.1108/20412561311324078 (Accessed on 11 August 2013)

Wigmore, A. and Ruiz, M. (2010), ‘Sustainability assessment in higher education institutions. The stars system’, *Ramon Llull Journal of Applied Ethics,* Volume 1, pp,25-42, [Online], Available at http://www.rljae.org/article.asp?issn=2013-8393;year=2010;volume=1;issue=1;spage=25;epage=42;aulast=Wigmore (Accessed on 04 December 2013)

Wimmer, R. and Dominick, J. (2013), ‘*Mass Media Research’*, p.118, 10th Edition, Cengage Learning, USA

Wolf, J. (2008), ‘*The nature of supply chain management research: Insights from a content analysis of International Supply Chain’*, p.94, Springer International, UK

Woo, S-H., Pettot, S.J., Kwak, D-W., and Beresford, K.C. (2011), ‘Seaport research: A structured literature review on methodological issues since the 1980s’, *Transportation Research Part A 45,* pp.667-685, *Sciencedirect* [Online], Available at doi:10.1016/j.tra.2011.04.014 (Accessed on 05 July 2013)

Wrap (2015), ‘*Waste & Resources Action Programme’*, [Online], Available at http://www.wrap.org.uk/sites/files/wrap/WRAP%20EMS%20guide%20Mar2015.pdf (Accessed on 20 November 2015)

Wri (2013a), '*World Resources Institute'*, [Online], Available at http://www.wri.org/ (Accessed on 01 May 2013)

Wright, T.S.A. (2011), 'Definitions and frameworks for environmental sustainability in higher education', *International Journal of Higher Education 3(3),* pp.203-220, *Emeraldinsight* [Online], Available at doi: 10.1108/14676370210434679 (Accessed on 05 July 2013)

Yale (2008), '*Analysis of Yale Environmental Performance'*, p,8 [Online], Available at https://www.umweltbundesamt.de/sites/default/files/medien/publikation/long/3429.pdf (Accessed 10 February 2016)

Yale (2010), '*2010 Environmental Performance Index'*, pp.2-87 [Online], Available at http://www.ciesin.org/documents/EPI_2010_report.pdf (Accessed on 10 February 2016)

Yale (2014), '*Environmental Performance Index'*, [Online], Available at http://envirocenter.yale.edu/programs/environmental-performance-management/environmental-performance-index (Accessed on 01 July 2014)

Yale1 (2014), '*Environmental Performance Index - Our Methods'*, [Online], Available at http://www.epi.yale.edu/our-methods (Accessed on 04 March 2016)

Yam, S. (2013), 'The practice of corporate social responsibility by Malaysian developers', *Property Management,* Volume 31 (1), pp.76-91, *Emeraldinsight* [Online], Available at doi: 10.1108/02637471311295423 (Accessed on 12 August 2013)

Yang, R.J., and Zou, P.X.W. (2014),'Stakeholder associated risks and their interactions in complex green building projects: A social network model', *Building and Environment*, Volume 73, pp.206-222, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.buildenv.2013.12.014 (Accessed on 25 March 2014)

Yin, R.K. (2009), '*Case Study Research – Design and Methods'*, Volume 5 of Applied Social Research Methods, Sage, UK

York (2012), '*Measuring scope 3 carbon emissions –water and waste'*, *Hefce,* [Online], Available at http://www.york.ac.uk/energyconservation/what_we_are_doing/scope%203%20emissions.pdf (Accessed on 10 February 2014)

Young, A. (2010), 'Greenhouse gas accounting: global problem, national policy, local fugitives', *Sustainability, Accounting, Management and Policy Journal,* Volume 1 (1), pp.89-96, *Emeraldinsight* [Online], Available at DOI 10.1108/20408021011059269 (Accessed on 18 November 2015)

Zang N, William, I. D., Kemp, S. and Smith, N. F. (2011), 'Greening Academia: Developing Sustainable Waste Management at Higher Education Institutions', *Waste Management 31*, pp. 1016- 1616, *Sciencedirect* [Online] Available at http://dx.doi.org/10.1016/j.wasman.2011.03.006 (Assessed on 31 May 2013)

Zhang, X., Majid, S., and Foo, S. (2012), 'Environmental Scanning – An Emerging Discipline for LIS Education', *Library and Information Science Trends and Research: Asia-Oceania*
Library and Information Science, Chapter 6, p. 126-144, *Emeraldinsight* [Online], Available at doi:10.1108/S1876-0562(2011)002011b008 (Accessed on 17 May 2013)

Zhang, W., Wang, W., and Wang, S. (2014), 'Environmental performance evaluation of implementing ENS (ISO14001) in the coating industry: A Case study of a Shanghai coasting firm', *Journal of Cleaner Production*, Volume 64, pp.205-217, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.jclepro.2013.08.028 (Accessed on 17 February 2014)

Zhihong, Y., Ju,M., Zhou, Y.,Wang, Q., and Ma, N. (2010), 'An analysis of greenhouse gas trading system from the perspective of stakeholders', *Procedia Environmental Sciences 2*, pp.82-91, *Sciencedirect* [Online], Available at doi:10.1016/j.proenv.2010.10.012 (Accessed on 04 October 2013)

Zhao, Z-F., Dong, M-L., Bai, K., and Cao, K-Q. (2012), 'Evaluation Model for Apple pest Control Decision Based on Quantification Theory', *Procedia Engineering*, Volume 37, pp. 250-254, *Sciencedirect* [Online], Available at doi: 10.1016/j.proeng.2012.04.235 (Accessed on 10 February 2014)

Zinkmund, W.G., Babin, B.J., Carr, J .C., and Griffin, M. (2013), '*Business Research Methods'*, p.134, 9th Edition, South Western, Mason, USA.

Zobel, T. (2008), 'Characterisation of environmental policy implementation in an EMS context: a multiple case study in Sweden', *Journal of Cleaner Production*, Volume 16, pp.37-50 *Sciencedirect* [Online], Available at doi:10.1016/j.jclepro.2006.06.009 (Accessed on 06 August 2013)

Zorpas, A. (2010), 'Environmental management systems as suitable tools in the way of life for SMEs and VSMEs', *Bioresourse Technology 101*, pp.1544-1557, *Sciencedirect* [Online], Available at http://dx.doi.org/10.1016/j.biortech.2009.10.022 (Accessed on 02 January 2015)