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A stakeholder approach to sustainable development in UK aviation

by

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"Once you have tasted flight, you will forever walk the earth with your eyes turned skyward, for there you have been, and there you will always long to return."

- *Leonardo da Vinci*

Abstract

Aviation has become an integral component of a modern transportation system. The economic and social benefits of flight are numerous and extensive. Increasing concern about the negative environmental and social costs of aviation has begun to question projected growth of the industry. Sustainable development has become an accepted principle of development in both government policy and business. Aviation development involves the complex interaction of a wide network of stakeholders, and the resultant perceived socio-economic and environmental impacts. This complex interaction forms the basis of this thesis.

The development of UK aviation is concerned with not just the development of *new* infrastructure and technology, but also the utilisation of *existing* infrastructure and technology. Future development could be by any number of alternative scenarios. However, which future scenario is superior to others? And, how should this comparison be assessed?

Sustainable development evolved as a multi-disciplinary concept and this thesis draws from a wide variety of disciplines to explore the phenomenon. The stakeholder research tradition is utilised to develop a participatory stakeholder-based methodology to identify and measure the relevant impacts of sustainable development. This new 'stakeholder-sustainable development framework' can analyse and evaluate the current system and inform the selection and integration of assessment techniques, and the rationale behind their selection.

This methodology is applied to UK aviation to identify perceived impacts and explore epistemological interpretations of sustainable development. Through semi-structured interviews, participants are invited to share the perceived impacts and their understanding of sustainable development in relation to aviation. Methods of assessment, for the identified impact of noise, are reviewed and one applied.

The research proposes a network of stakeholder actors key to the future development of aviation in the UK, and whose needs should be considered. The make-up of stakeholder representation at the airport level is relatively consistent at different airport scales.

Acknowledgements

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Acronyms and Notes

Acronym	
ACARE	Advisory Council for Aeronautics Research in Europe
ACC	Airport consultative committee
AEF	Aviation Environment Federation
AOA	Airport Operators Association
APD	Air passenger duty
APF	Aviation Policy Framework
ANSPs	Air navigation service providers
ATAG	Air Transport Action Group
ATM	Air traffic movement
BAA	British Airports Authority (presently Heathrow Airports Holdings)
BoE	Bank of England
CAA	Civil Aviation Authority (UK)
CAEP	Committee on Aviation Environmental Protection
CCC	Committee on Climate Change (UK)
CFRP	Carbon-fibre reinforced polymers
CVM	Contingent valuation method
DCLG	Department for Communities and Local Government
DECC	Department of Energy and Climate Change
DEFRA	Department for Environment and Rural Affairs
DETR	Department of the Environment, Transport and the Regions
DfT	Department for Transport
EC	European Commission
END(EU)	European Noise Directive (EU)

Acronym	
EPNdB	Effective perceived noise level
EU	European Union
EU ETS	European Union Emission Trading Scheme
FAA	Federal Aviation Authority (US)
GDP	Gross domestic product
GNP	Gross national product
GHG	Greenhouse gas
GWP	Global warming potential
HMRC	Her Majesty's Revenue & Customs
HPM	Hedonic price method
IATA	International Air Transport Association
ICAO	International Civil Aviation Organisation
IPCC	Intergovernmental Panel on Climate Change
LAP	Local air pollution
LOSU	Level of scientific understanding
LTO	Landing and take-off
MAG	Manchester Airports Group
MBM	Market based mechanism
OECD	Organisation for Economic Co-operation and Development
OEF	Oxford Economics Forecasting
OEM	Original equipment manufacturer
Pax	Passengers
PPP	Polluter pays principle
RCEP	Royal Commission on Environmental Pollution
SBAC	Society of British Aerospace Companies (presently ADS)
SDC	Sustainable Development Commission

Acronym	
TBL	Triple bottom line
UKACC	UK Airport Consultative Committee
UN	United Nations
UNDP	United Nations Development Programme
WCED	World Commission on Environment and Development
WHO	World Health Organisation
WTA	Willingness to accept
WTP	Willingness to pay

Notes

Unless indicated otherwise, tons are metric and all units are standard SI units. Prices are given in the stated currency for the year specified. Dollars are current U.S dollars.

Currency conversion

Where comparison between monetary values in different currencies has been made conversions were calculated utilising the following conversion rates. To maintain accuracy and transparency of reporting within this thesis the original unconverted valuations have been provided.

1 GBP = 1.565 USD

1 GBP = 1.266 EUR

Symbols and Units

CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
dB	Decibel (a unit of noise measure scaled logarithmically)
dB(A)	Decibel noise unit weighted with an A filter to account for human hearing characteristics
HC	Hydrocarbons
NO_x	Nitrogen oxides
NO_2	Nitrogen dioxide
PM	Particulate matter
PM_{10}	Particulate matter <10μm
SO_x	Sulphur oxides
SO_2	Sulphur dioxide

Glossary

Presented below are standard definitions for technical terms used within this report.

Term	Definition
Air traffic movement (ATM)	All scheduled movements (whether loaded or empty) and loaded charter movements. Empty positioning flights by scheduled aircraft and empty charter movements are excluded.
Domestic services	Entirely within the United Kingdom, Isle of Man and Channel Islands
Freight	Excludes mail and passengers' and crews' permitted baggage, but all other property carried on an aircraft is included. Thus excess baggage is included, as diplomatic bags. Freight in transit through an airport on the same aircraft is excluded
International services	Services flown between the United Kingdom airports and points in other countries
Terminal Passengers	All revenue and non-revenue passengers joining or leaving an aircraft at a United Kingdom airport (a passenger who changes from one aircraft to another, carrying the same flight number, is counted as a terminal passenger both on arrival and departure). Transit passengers who arrive and depart on the same aircraft are not included.
Time horizons	
Medium term	From present to 2030
Long term	From present to 2050

Notes to reader

This piece of research is fundamentally an interdisciplinary piece; a philosophy that runs through its very core. This philosophy has not only influenced the topic of enquiry, but also the research philosophy applied, and subsequently the methodology.

Throughout the duration of this project it has been described as being aligned to many academic research traditions and disciplines: strategic management, transport studies and ecological economics to name but a few. The author would propose that it belongs not solely to one particular discipline, but its identity shifts within the research narrative. A narrative which is driven by the phenomenon under question: sustainable development.

The author, and this thesis, form part of the E-Futures Doctoral Training Centre (DTC). The DTC represents a 'new route' PhD that encourages and promotes interdisciplinary collaboration in the field of low-carbon energy. The first year, of the four-year programme, is spent undertaking energy related research projects and placements in departments different from the participant's original area of study, in this case civil engineering. The project's supervisory team further reflects the interdisciplinary nature of this project, with the primary supervisor drawn from Sheffield University Management School and the secondary supervisor having affiliation with the Department of Mechanical Engineering, The University of Sheffield.

Publications and conferences

Publications

Timmis, A.J., Hodzic, A., Koh, L., Bonner, M., Soutis, C., Schäfer, A., Dray, L. (2015) Environmental impact assessment of aviation emissions reduction through the implementation of composite materials, *International Journal of Life Cycle Assessment*, 20(2), 233-243.

Conferences

Timmis, A.J., Hodzic, A., Koh, L., Bonner, M., Soutis, C., Schäfer, A., Dray, L. *Lifecycle Assessment of CFRP Aircraft Fuselage*. 16th European Conference on Composite Materials, Seville, Spain, July 2014.

1. Introduction

1.1 The aviation growth paradox

Civil aviation, both passenger and freight operations, form an integral part of any modern transportation system. Flight offers unique advantages in range and speed of travel over other modes of transportation, which are often irreplaceable, connecting continents and remote locations over vast distances. The economic and social benefits of air travel and the aviation industry are numerous and well publicised at the global and national scale. The aviation industry claims to directly support $606 billion of direct global economic activity (in 2012) and up to $2.4 trillion when taking into consideration direct, indirect, induced economic activity and tourism catalytic effects (ATAG, 2014).

Over the course of the last century, the commercial aviation industry has grown from a single flight, carrying one paying passenger on a twenty-minute flight from St. Petersburg to Tampa, Florida, to carrying an estimated 3,320 million passengers in 2014 and a turnover of $746 billion (IATA, 2014a).

As the civil aviation industry celebrates the centenary of commercial aviation there is growing societal concern at the international, national and local level of the negative impacts of flight on the environment and society. This growing consensus, about the environmental burdens society are placing on nature and the Earth, is not just confined to the aviation sector, but transcend all forms of human activity and development (Banister, 2005; Rockström, 2009; IPCC, 2014). As such, the detrimental social and environmental burdens of aviation, particularly with respect to anthropogenic climate change and the emissions of greenhouse gases (GHGs), have impacted how we consider the growth projections of the industry and its future development (DfT, 2003; 2013; IATA, 2009; Sustainable Aviation, 2012). It is quite pertinent that this thesis, on the civil aviation industry's one hundredth anniversary, asks fundamental questions about its future.

The Intergovernmental Panel on Climate Change's (1999) landmark report highlighted the specific sectoral challenges faced by the aviation industry regarding atmospheric emissions of GHGs. Passenger traffic growth (expressed as revenue passenger-kilometres, RPK) since 1960 has been approximately 9% per annum, 2.4 times the global gross domestic product (GDP) growth rate. Though global aviation demand

forecasts predict a reduction in growth to approximately 5% through to 2030 and beyond (Airbus, 2011; Boeing, 2013), it still exceeds GDP growth.

Though the contribution of the global aviation sector emissions is small, 2% (0.71GtCO_2) of global energy related CO_2 emissions (Sims *et al.,* 2014), in comparison to the transport sector as a whole (23%; 6.7 GtCO_2), its share of global emissions are set to increase. The trends in aviation growth, highlighted above, are far in excess of likely improvements in fuel efficiency, 1-1.5% per annum (Kahn Ribeiro, 2007), thus leading to annual increase in emissions of around 3-4% per annum. It is appreciated by the aviation industry itself that it is unacceptable to have an increasing share of global greenhouse gas emissions (IATA, 2009).

The combustion products of aviation fuel includes a range of gaseous emissions, mainly CO_2, nitrogen oxides (NO_x), water vapor (H_2O), sulphur oxides (SO_x) and soot; CO_2, NO_x and H_2O being greenhouse gases The IPCC (2014), in their latest report *Climate Change 2014: Impacts, Adaptation, and Vulnerability*, have highlighted, with a high degree of scientific confidence, the potential impact of increased levels of greenhouse gases, both CO_2 and non-CO_2, on the global atmospheric environment. Climate change is a pertinent and extreme example of *'the market'* failing to protect the environment (Stern, 2007). Anthropogenic climate change is but one example of much wider socio-economic failings of the current market, which fits into the much wider discourse of *sustainable development* (Fleurbaey *et al.* 2014).

Discussion up to this point has focussed on the gaseous emissions associated with the combustion of aviation fuel during the stages of flight, and the industry's global impact on the atmospheric chemistry, particularly related to anthropogenic climate change. However, the impacts of aviation occur at various scales; global, regional and local. On the global scale is aviation's contribution to anthropogenic global climate change and wider changes to atmospheric chemistry (e.g. ozone production/depletion). However, due to the release of these gases at various altitudes within different atmospheric layers, their effects are intensified comparative to emissions of an equal quantity emitted at ground-level, hence the relative emphasis placed here.

Flight and aviation activity at a local scale generates noise, local air pollution (LAP) and a number of other geophysical, geospatial (land-use change) and hydrological impacts. Noise pollution, or more accurately noise-nuisance, is *the* most widely considered and perceived impact of aviation activity (Sustainable Aviation, 2013).

Projected passenger growth rates and demand for aviation are higher than likely efficiency gains as a result of technological development, resulting in an increased environmental and social burden (Kahn Ribeiro, 2007). As Black (1998, p.342) proclaims "it is not the transport vehicle...[but its]...excessive use that creates the problem". The trend of demand growth and the rate of environmental (and social) improvement "is unsustainable and must be reversed because of its impact on climate change and the quality of life and health of European [and global] citizens" (EC, 1999).

The impacts of aviation whether they be the emission of combustion products (CO_2. NO_x etc.), noise or resource use and potential technological and policy solutions are often interconnected, conflicting and asynchronous. The use of open-rotor engines may improve fuel efficiency, and therefore reduce the emission of CO_2, but may increase noise levels and flight times due to reduced cruise speeds (SBAC, 2007). The widespread adoption and utilisation of bio-derived Jet A fuel substitutes have been projected to reduce lifecycle CO_2 emissions, the reduction in non-CO_2 climate impacts will be less and not proportional to CO_2 reductions (Krammer, 2013). Which detrimental impacts should be reduced, and how are they prioritised? How do we balance the benefits of GHG emission reduction against increased levels of noise and the socio-economic opportunities of flight?

Herein lies the central issue facing the UK aviation sector, policy makers and associated actors and institutions; how do they enable and meet projected future growth whilst reducing and mitigating the detrimental environmental and social impacts of aviation? In other words, how does the industry achieve sustainable development?

1.2 Sustainable development and stakeholder thinking

Sustainable development, as a concept, is generally traced to the 1987 UN report *Our Common Future*, also known as the "*Brundtland Report*". The report introduced the most commonly cited definition of sustainable development "Development that meets the needs of current generations without compromising the ability of future generations to meet their needs and aspirations" (WCED, 1987, p.43). Crudely, sustainable development has been characterised as balancing economic, environmental and social impacts and issues.

'Sustainable transport', arising from the concept of sustainable development, aims to provide accessibility for all, to help meet the basic daily mobility needs consistent with

human and ecosystem health, but whilst also constraining GHG emissions by, for example, decoupling mobility from oil dependence (Fleurbaey, 2014).

Despite the rise of the concept of sustainable development, and subsequently that of sustainable transport and sustainable aviation, no single agreed operational definition or framework of sustainable development has developed (Bell & Morse, 1999; Holden *et al*., 2013). Hence, sustainable development runs the risk of becoming meaningless in terms of practical action and reduced to "an article of faith, a shibboleth;" (Daly, 1991) and the concept being "elusive" (Goldwin and Winters, 1995). If sustainable development is to be adopted as the normative guiding principle of future development in aviation, it must be able to answer such questions as: what does it mean for each and every community? How can it go beyond mere generalities and out into practice? How do we know if we are moving to a more sustainable future?

Due to the lack of an agreed comprehensive theoretical framework of sustainable development, the concept has developed in multiple directions and in multiple disciplines.

Through the theoretical development of the concept, sustainable development is considered to consist of four primary dimensions: intra- and inter-generational equity, satisfying basic human need and long-term environmental protection (Holden *et al*. 2013). Subservient to these are a number of secondary principles: promoting public participation, satisfying aspirations for a better quality of life, preserving nature's intrinsic value, promoting causal-orientated protection of the environment and endorsing long term aspects. Central to the majority of sustainable development concepts is the notion of '*the stakeholder'* in addressing many of the dimensions: social equity, public participation and social justice (Amekudzi *et al*., 2009; Xenias and Whitmarsh, 2012).

The notion of *stakeholder* stems from developments in the field and discourse of strategic management, business ethics and business-society relations (Freeman, 1984; Clarkson, 1995; Jones, 1995). Rooted in Freeman's (1984) seminal publication is the most cited definition of a stakeholder: "any group or individual who can affect or is affected by the achievement of an organisation's purpose" (p.53). The concept of the stakeholder has, much like that of sustainable development, become a trans-disciplinary concept; a simple Web of Knowledge keyword search highlights the breadth of applications from supply chain management, public health through to marketing. The applications of the stakeholder concept within the sustainable development discourse

have been broad, ranging from indicator development, policy preferences and metrics. However, its application has lacked an appreciation of the robust analysis of stakeholder status; simply, what defines the *stake* and who is the *holder* in sustainable development. The adoption and application of the stakeholder concept and stakeholder model had been devoid of an appreciation of its development within the extant management and business literature over the past thirty-years.

1.3 A UK policy perspective

In 2012 the UK air service sector processed and transported over 220 million terminal passengers, 10% less than the peak witnessed in 2007 (239 million) (see Figure 1), but a number several orders of magnitude greater than the 2.1 million passengers conveyed in 1950 (DfT, 2013). The astonishing historic annual growth rates witnessed in the latter half of the 20th Century are not set to continue.

Growth in the UK aviation market, through to 2050, like other mature Western European markets, will fall to approximately 2% per annum (Airbus, 2011; Boeing, 2013). Despite reduced growth rates through to 2050, central projections forecast passenger demand of 470 million passengers per annum (mppa), with a range of 380-515 mppa (see Figure 2), a percentage increase of 110% and 70-130% respectively from present (DfT, 2011b; 2013a).

Aviation in the UK has been identified as a key piece of a national infrastructure; it is viewed and is well documented as an important economic contributor in its own right, directly contributing £21.3 billion (OEF, 2011), but also as a facilitator of wider economic activity and trade (Airports Commission, 2013).

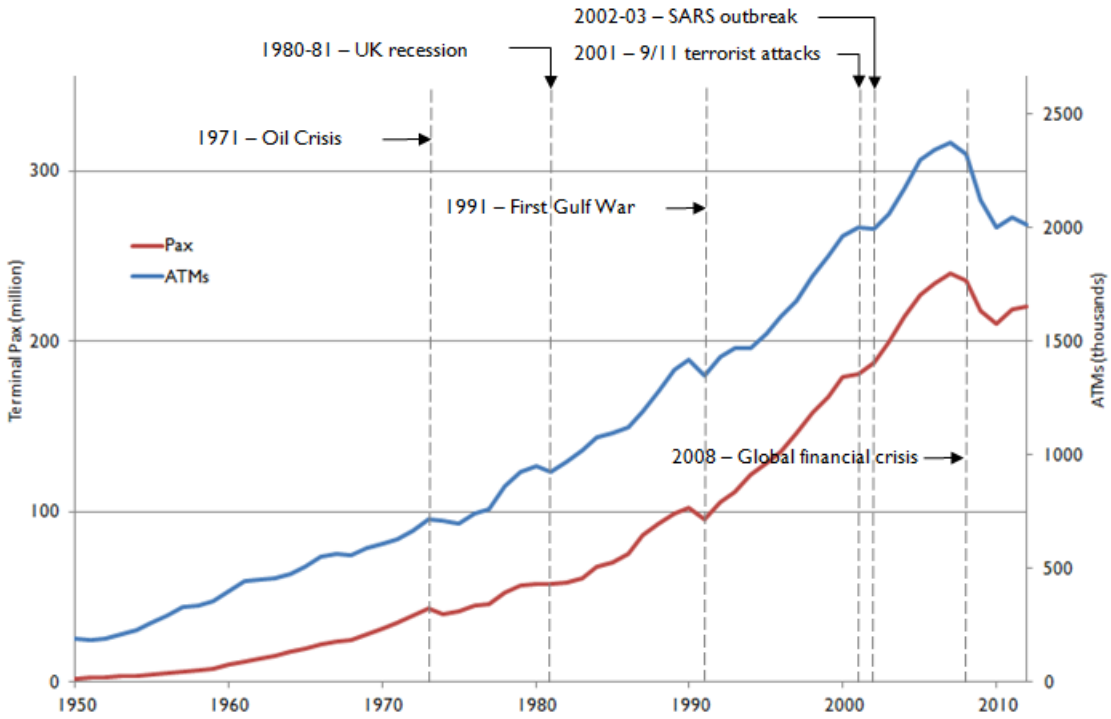


Figure 1 Historic annual passenger numbers (Pax) and ATMs from 1950-2012 (DfT, 2013)

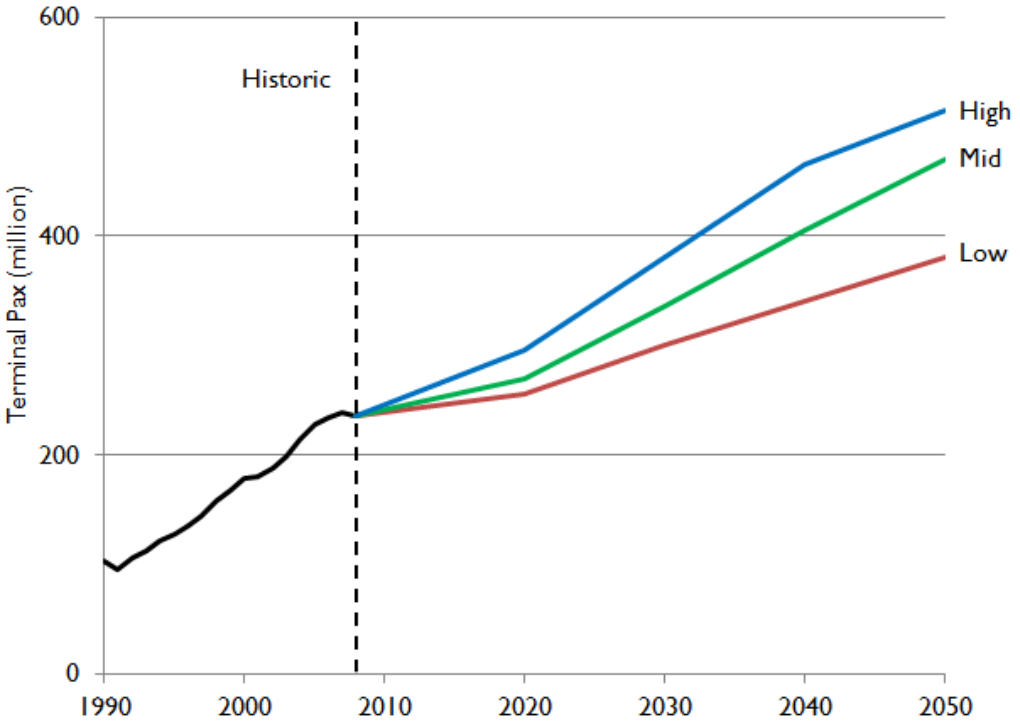


Figure 2 UK annual passenger numbers forecast range from 2008 through to 2050 (DfT, 2011b)

Given the widespread popularity of air travel in the UK (see **Error! Reference source not found.**), demand for air travel is set to increase and be compounded by the macro-economic trend of globalisation (Daley, 2010), both in business and tourism.

Despite airport infrastructure being geographically well dispersed along the length and breadth of the UK mainland (see **Error! Reference source not found.**), aviation activity is highly concentrated in the South East of England (see **Error! Reference source not found.**), primarily at two airports: London Heathrow and London Gatwick.

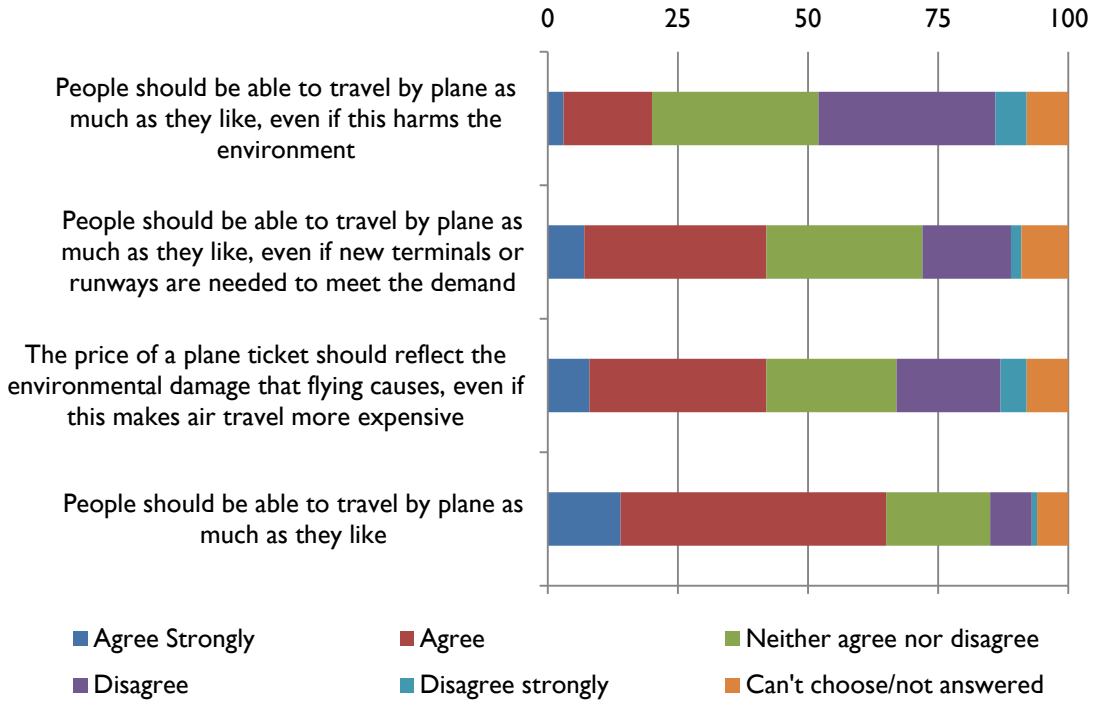


Figure 3 Attitudes towards air travel and the environment (Data source: British Social Attitudes Survey, 2012; DfT, 2013c)

Figure 4 Mainland airports of Great Britain and Scottish Isles (DfT, 2013)

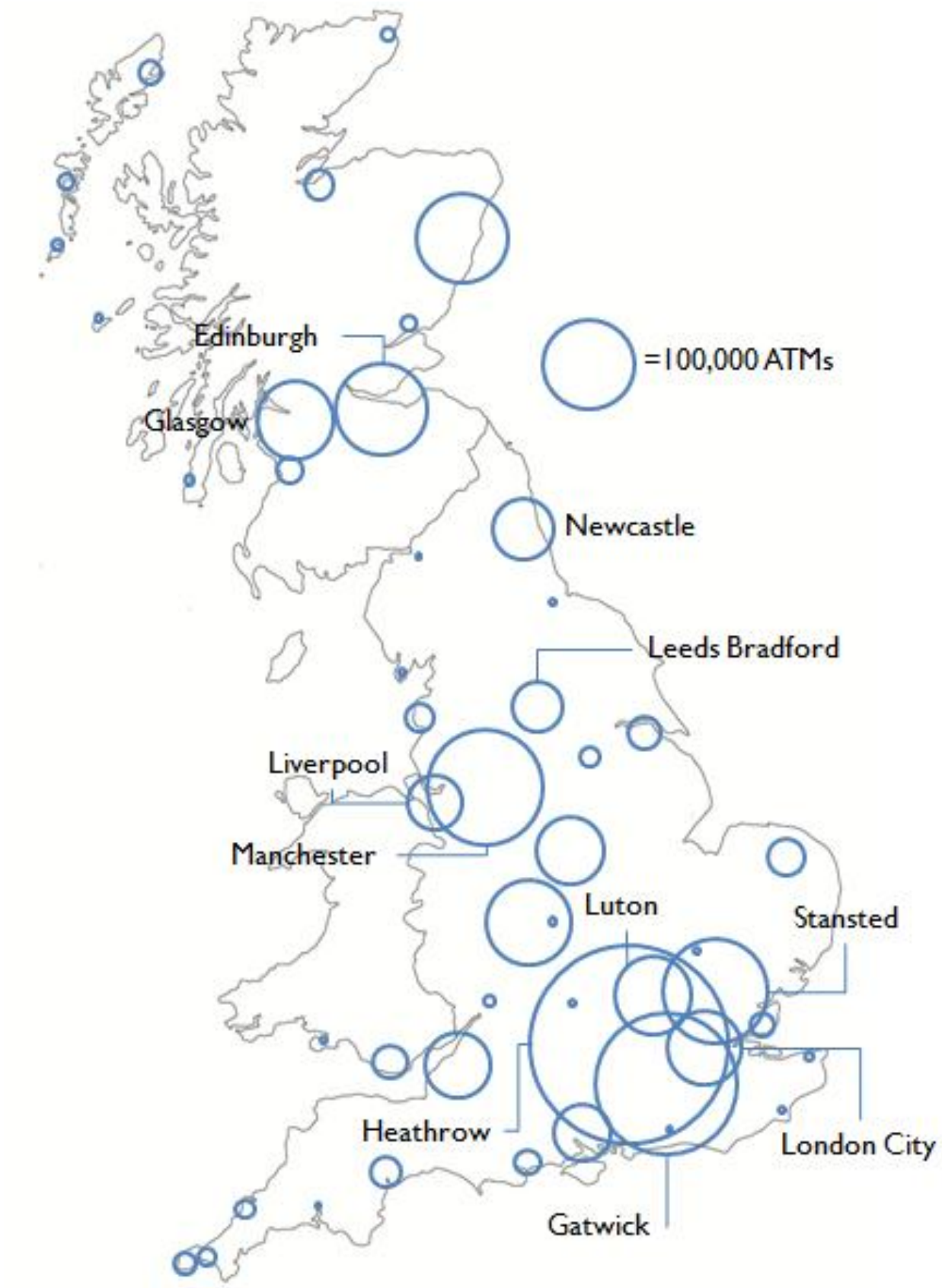


Figure 5 Mainland airports of Great Britain and Scottish Isles depicting 2012 ATMs (DfT, 2013)

It has long been recognised that the UK aviation sector faces many development challenges in satisfying future demand forecasts (DfT, 2003; 2011a; 2013b, Airports Commission, 2013b), and there remains on-going debate on the appropriate scale and nature of the UK aviation industry given on the one-hand the widespread popularity and value of flying against the recognised need to address global and national environmental and social targets (Bows, 2007). Despite a protracted policy debate over the last decade, an explicit coherent national policy for new air infrastructure development (e.g. new runways in the south east of England) is lacking. Additionally, how aviation growth should be exploited within the existing infrastructure capacity.

Sustainable development has been an explicit component of UK aviation policy over the last decade (DfT, 2003; 2013b). The *Aviation Policy Framework* stating:

> *"The Government's intention is that the Aviation Policy Framework should support sustainable development and be delivered in a way which is consistent with its principles...stimulating economic growth and tackling the deficit, maximising wellbeing and protecting our environment, without negatively impacting on the ability of future generations to do the same".*
>
> (DfT, 2013; p.11)

Explicit also is the need for stakeholder participation in both the development of aviation, but also the ongoing operations of airports. *A Better Quality of Life: A Strategy for Sustainable Development in the United Kingdom* (DETR, 1999) set the principles for the inclusion of sustainable development in the UK. The report outlined four main objectives of sustainable development:

- Social progress that recognises the needs of everyone
- Effective protection of the environment
- Prudent use of natural resources
- Maintenance of high and stable levels of economic growth and employment

1.4 Framing the research

Over the previous sections, the future and present challenges in aviation have been outlined: how should we integrate sustainable development in the future of UK aviation? In the extant academic literature regarding sustainable development, and in

governmental policy regarding the development of UK aviation, authors pay little attention to the nuances of the application of stakeholder thinking. Previous applications of stakeholder thinking have lacked an appreciation of the theoretical developments in the stakeholder discourse within the management and business literature. Lacking within the development of the concept of sustainable development is an effective framework to implement a new stakeholder based orientation of development, a means of identifying salient system stakeholders and what the implications would be on sustainable development assessment. Hence, the focus of this study is the development of a theoretical framework for the integration of stakeholder thinking into sustainable development.

1.5 Aims and objectives

This focus leads the study to answer two research questions. The primary research question is: *How can a stakeholder management framework be utilised as a means of understanding the sustainable development of aviation in the UK*? The second question, considered subsequent to the first: *How can a stakeholder approach inform the assessment of sustainable development?*

1.5.1 Aims

Aim	
A1	Develop a stakeholder based empirical framework for the assessment of sustainable development
A2	Consider the implication of the developed stakeholder approach in the implementation and assessment of impacts related to sustainable development

1.5.2 Objectives

The following objectives have been developed in order to achieve the stated aims. Additionally, highlighted is how each objective relates to the specified research aims.

Objective	
O1	Identify the perceived network of aviation system stakeholders (A1/A2)
O2	Explore the range of epistemological interpretations of sustainable development held by identified stakeholders (A1)
O3	Establish how stakeholders and their respective interests are related and their responsibility in the realisation of sustainable aviation (A1/A2)
O4	Review assessment methodologies for an identified impact related to the sustainable development of aviation in the UK (A2)

1.6 Thesis overview

This thesis is presented in eight chapters which can be divided into five discrete sections: introduction, theoretical approach, methods, presentation and discussion of empirical results and conclusions (see Figure 6). This current chapter has presented the context within which this research is undertaken: the challenges of framing aviation development within the concept of sustainable development.

Chapters Two and Three explore the theoretical discourse and research tradition of sustainable development and stakeholder management respectively. Chapter Two, focussing on sustainable development, explores the difficulties of defining and developing the concept of sustainable development into an operational management theory, and identifies areas for additional research and theoretical development. Chapter Three explores the stakeholder research tradition from the field of business and management. It critiques the extant development in light of the concept of sustainable development explored in the previous chapter. Finally, this chapter develops the theoretical basis of this research: an empirical framework to operationalise the assessment of sustainable development.

Chapter Four presents the research process of this thesis. It explores the epistemological and ontological orientations of interpretivism and social constructivism which underpins this research, and their impact on the research strategy. A grounded theory methodology is presented, centred on semi-structured stakeholder interviews, with the aim of exploring and providing a rich source of empirical primary data related to the phenomena of sustainable development and stakeholder perceptions. With consideration of the existing literature of organisational lifecycles and stakeholder management, an airport typology is constructed separating the study airports into three classifications; small regional, large regional and London regulated.

The following chapter, Chapter Five, describes and presents the analysis of the semi-structured interviews by the outlined grounded theory method. The developed codes and visual display of ideas provide the reader an insight into the construction of the four developed grounded theory categories: '*balance and trade-off*', '*power and influence*', '*responsibility*' and '*context and process*'.

Chapter Six draws from the findings of the research interviews and the developed understanding of sustainable development to review available methods of monetisation and assessment of the identified impact of aviation noise. It identifies the Hedonic Price

Method as an appropriate valuation technique within the developed theoretical framework. Subsequently, the study undertakes a valuation of the social cost of aircraft noise at the 15 study airports for the year 2013.

Chapter Seven is divided into three distinct, but complimentary, parts. Part One brings together the theoretical developments and insights from the empirical findings, these are then in turn discussed with regard to the extant literature from both sustainable development and that of the stakeholder research tradition. Part Two discusses the review of the monetisation of aviation externalities and its implications. Part Three brings together these two discussions and relates them to the development of aviation in the UK.

Finally, Chapter Eight draws together the various strands of research and reviews the findings in relation to the identified research aims and objectives. Additionally, the specific contributions to knowledge, the sustainable civil aviation debate and policy and practice are highlighted. Finally, future research developments and directions are identified.

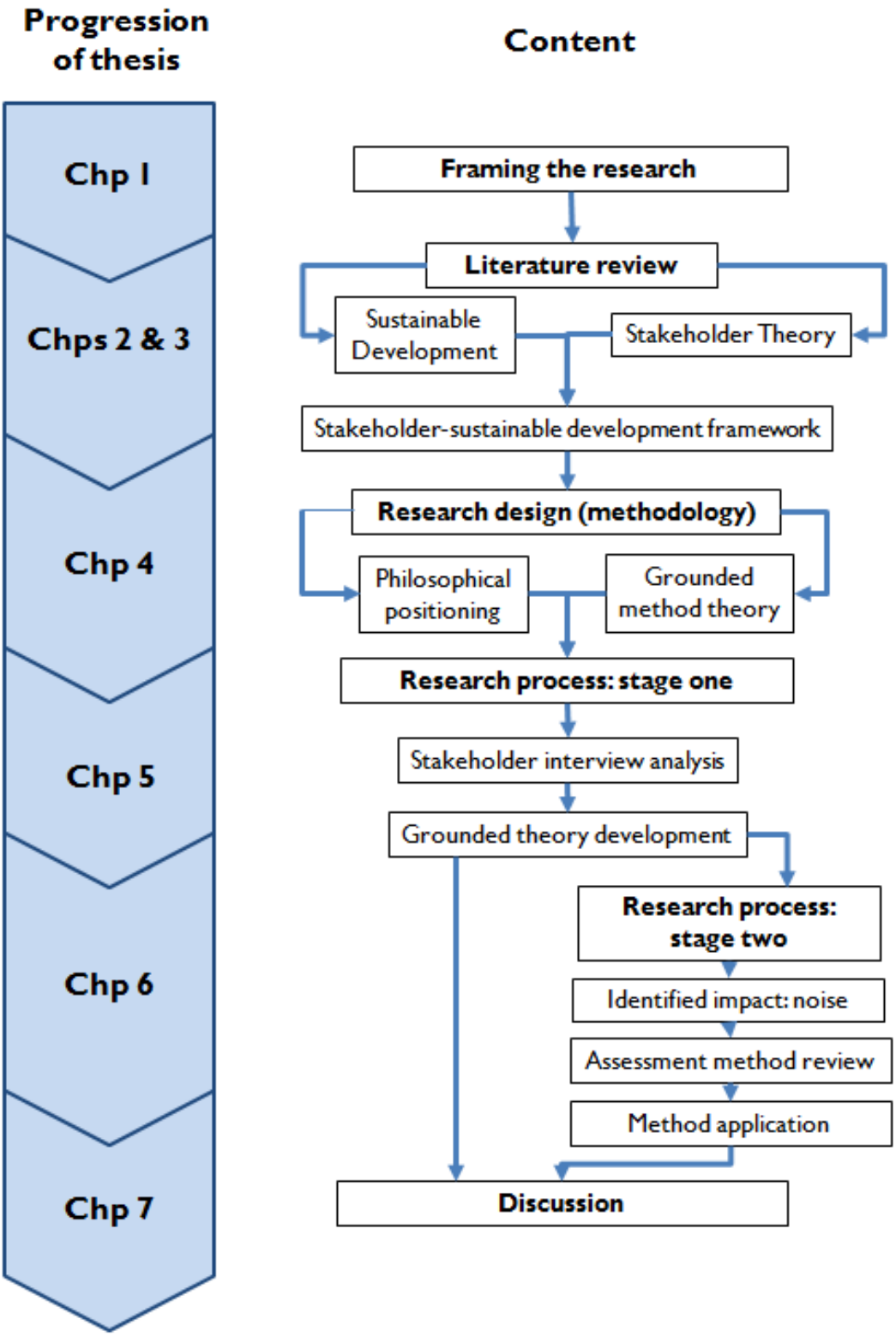


Figure 6 Flow chart of thesis progression

2. Sustainable Development

2.1 Chapter overview

The objective of Chapter Two is to establish an overview of the theory and concept of sustainable development since its popularisation post-*Brundtland Report*. The chapter reviews and critiques the literature of sustainable development, particularly the challenge of operationalising the concept from a strategic management perspective, and identifies scope for development. These identified areas of development are built upon in the following chapter, utilising the stakeholder research tradition.

Section 2.2 explores the origins of sustainable development and how it has developed into a globally accepted concept and as the idealistic normative core of future socio-economic development. The following section examines the range of conceptual interpretations in relation to the role of *balance* between the competing economic, environmental and social dimensions.

Section 2.4 builds on the previous to include a review of the identified second-order dimensions of sustainable development. These second order dimensions highlight the process-driven nature of sustainable development and the importance of stakeholder inclusion; a facet built upon in the subsequent chapter in the development of a stakeholder-based empirical framework.

Section 2.5 reviews a range of current techniques in measuring sustainable development, or the move towards a more sustainable system. The choice of measurement technique is a value laden decision, though contentious, it is needed to ensure the development of appropriate policy and investment.

The environmental and social impacts of aviation activity are broadly discussed and reviewed in Section 2.6. Additionally, aviation system interventions and developments are identified which have the potential to mitigate the negative impacts of flight. This section provides a knowledge and evidence base of the impacts of aviation and is utilised in later sections and chapters of this research.

A review of government and industry sustainable development policy is presented in Section 2.7. The important notion of 'stakeholder status' within sustainable development theory and policy is summarised. Though the notion of the stakeholder is widely used in relation to the concept of sustainable development, there is identified to

be a lack of rigour in its application and understanding. Finally, the chapter is drawn to a conclusion in Section 2.8 by summarising and identifying knowledge and research gaps within the concept and literature of sustainable development.

The following chapter builds upon the identification of stakeholder status being central to the concept of sustainable development. The development of stakeholder thinking, from the strategic management field, is reviewed and utilised to develop a framework for understanding and operationalising sustainable development in the future development of UK aviation.

2.2 The origins of sustainable development

2.2.1 An historical evolution

Sustainable development has become the salient guiding principle of 'development' not just at the governmental level, but has been seen to permeate all levels of society, including business. As Daly (1996, p1.) states "although there is an emerging political consensus on the desirability of something called sustainable development, this term - touted by many and even institutionalised in some places – *is still dangerously vague* [emphasis in the original]". In a situation where a concept is desirable, in this case that of sustainable development, how can we make intelligent decisions in the future planning of development within a ill-defined concept where "the border between sustainability and un-sustainability is not sharp" (Azar, 1996; p.108), or "changing a non-sustainable state to a less non-sustainable state is positive, but the result cannot be regarded as sustainable [development] (Holden *et al*., 2013; p.69). Thus, in making plans for strategic development in a specific sector, we have to be able to ask: What does it mean for local communities and the nation? How can we go beyond generalities to practice? How do we know if we are moving to a more sustainable scenario?

Many cite the rise and popularisation of the concept 'sustainable development' to the publication of the report *Our Common Future* by the World Commission on Environment and Development (1987), more commonly known as the *Brundtland Report*. Herein lies the most commonly cited definition of the term sustainable development:

> *Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*

*(*ibid; *p.43)*

Though often cited as the 'classic' definition of sustainable development, the concept can be traced to the June 1972 United Nations Conference on the Human Environment held in Stockholm (UN, 1972). Though this conference gave no definition of the term, nor an operational framework, it did establish a broad range of 26 principles which have subsequently developed into modern interpretations of sustainable development. A selection of the 26 principles is highlighted below (Table 1).

Table 1 A summary of selected principles from the United Nations Conference on the Human Environment (UN, 1972)

Principle	Summary
Principle 1	Man has a fundamental right to freedom, equality and adequate conditions of life. There exists a solemn responsibility to protect and improve the environment for present and future generations.
Principle 2	Through careful planning and management ecosystems, the environment and natural resources should be protected for present and future generations.
Principle 8	Economic and social development is essential for ensuring a favourable living and working environment for man and for creating conditions on earth that are necessary for the improvement of the quality of life.
Principle 13	States should adopt an integrated and coordinated approach to their development planning to ensure the development is compatible with the need to improve and protect the environment.
Principle 24	Cooperation through multilateral or bilateral arrangements or other appropriate means is essential to effectively control, prevent, reduce and eliminate adverse environmental effects resulting from activities conducted in all spheres.

Following the work of the *Brundtland Report*, the 1992 UN Conference on Environment and Development, also known as the *Rio Earth Summit*, co-ordinated a global agreement on the high–level principles of sustainable development. *Agenda 21*, as the output of the

summit is called, broadly restated the agreed *Stockholm Principles* (highlights in Table 1), except with the addition of a precautionary approach (UN, 1992). This precautionary approach is embedded with Principle 15:

> *In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.*

(*ibid*)

In addition, the declaration endorsed the polluter pays principle (PPP) within a sustainable development framework through Principle 16:

> *National authorities should endeavour to promote the internalisation of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of the pollution, with due regard to the public interest and without distorting international trade and investment.*

(*ibid*)

The *Agenda 21* principles have since formed the basis of global agreement on sustainable development and their usage has been reaffirmed at the Rio+10 World Summit on Sustainable Development in 2002 in the *Johannesburg Declaration* (UN, 2002) and the 2012 Rio+20 United Nations Conference on Sustainable Development (UN, 2012). Despite earlier calls by the WCED (1986), prior to the landmark *Brundtland Report,* for the development of a commonly accepted definition of sustainable development by actors in the development process it is still lacking.

Sustainable development is often linked to the process of development bounded by the preservation of both ecosystems and species (Prescott-Allen, 1980). Common to these foundational definitions of sustainable development is the need to globally satisfy basic human need. Though the foundation of sustainable development frameworks could be viewed to be aligned with the development of less economically advanced

countries it is "...equally relevant for rich countries concerned with growth, well-being, human development, and lifestyles" (Fleurbaey, 2014; p. 11).

The spectrum of epistemological interpretation of sustainable development is reviewed in the following section. However, central to interpretations and concepts of sustainable development are four agreed principles:

- Satisfying basic human need
- Long-term environmental protection
- Inter-generational-equity
- Intra-generational equity

Satisfying basic human need

This is one of the central concepts of sustainable development, and featured prominently in the *Brundtland Report* explicitly in reference to the World's poor: "[sustainable development] contains... the concept of "needs", in particular the essential needs of the World's poor, to which overriding priority should be given" (WCED, 1987; p. 43). It should be noted that there is a clear definition between satisfying basic human needs (food, shelter, water, employment) and that of aspiring for an improved standard of living, a topic that is covered later in this chapter.

Long-term environmental protection

Explicit within the *Brundtland Report* are references to the protection of the natural environment and ecological sustainability: "At a minimum, sustainable development must not endanger the natural systems that support life on Earth: the atmosphere, the waters, the soils, and the living beings" (WCED, 1987; p.44); further "the case for the conservation of nature should not rest only with the development goals. It is part of our moral obligation to other living beings and future generations" (WCED, 1987; p.57).

Intra-generational equity

The most cited definition of sustainable development, from the *Brundtland Report* "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987; p.43) enshrines social equity at the core of the concept. The needs of populations are context specific and socially and culturally determined. However,

within sustainable development is the provision of basic human needs: food, clothing, shelter, jobs. Beyond these basic human needs are aspirations for a better quality of life, a dimension discussed in Section 2.4

Inter-generational equity

In a similar vein to the considerations of the intra-generational dimension of sustainability, development must not hinder or prevent future generations satisfying their basic human needs. A society may hinder the ability of future generations in many ways: the over exploitation of natural resources and the destruction of critical ecological systems for example. In many cases, environmental limits are unknown and knowledge about such limits is evolving, but limits there are. Different limits will exist for energy, materials, water and land, which shall vary between geographies (WCED, 1987).

Sustainable development is often presented as the balance between often competing economic, environmental and social impacts (both positive and detrimental). This triple perspective, or tri-partite model, over emphasises the importance of economic 'growth' within the sustainable development concept. It is clear from the outlined four primary principles above that at the core of sustainable development are the environmental and social dimensions, and not economic growth. As contained within the *Brundtland Report*:

> *"...sustainable development clearly requires economic growth in places where such [human] needs are not being met. Elsewhere, it can be consistent with economic growth in places where such needs are not being met. Elsewhere it can be consistent with economic growth, provided that the content of growth reflects the broad principles of sustainability."*

(WCED, 1987; p.27)

Though sustainable development introduces less quantifiable considerations, the environmental and social dimensions of development, they cannot be considered in isolation of economic ones – business ethicists and accountants commonly refer to this as the triple bottom line (Elkington, 1998).

Sustainable development is not an end goal, but as much about the process of change and journey of development (Robinson, 2004). This process of development is

concerned with the development of human potential through social change. The desired social change may require a change in governance structures (Baker, 2006; Banister, 2005; Robinson, 2004), where traditional governance structures have failed to address such issues as environmental degradation; a case in point being the failure to address anthropogenic climate change (Rogelj *et al.* 2010). As Baker (2006, p. 9) attests, "rather than being the task of national governments acting alone and using traditional policy means, promoting sustainable development requires engagement across all levels of social organisation, from the international, national, sub-national, societal to the level of the individual". It is viewed that traditional governance structures view sustainable development within a sectoral focussed framework, where as "[s]ustainable development is all embracing and requires new thinking so that cross-sectoral decisions can be made" (Banister, 2005; p. 3).

The *Brundtland report* has laid the foundations of modern interpretations and utilisation of the concept of sustainable development (Holden *et al.*, 2013). The sustainable development literature, particularly that relating to transport, has evolved into tackling the concept from a broad range of perspectives: that of environment and social equity (Gudmundsson and Höjer, 1996), health and security (Black, 2010) and economic dimensions (Amekudzi *et al.*, 2009; Castillo and Pitfield, 2010). However, "the diversity of definitions and interpretations of the concept has raised the risk that the concept will end up as mere rhetoric that offers little guidance for policy makers and scientists" (Holden *et al.*, 2013; p. 67).

The following section explores in more detail the diversity of definitions of sustainable development and expands the concept from its historical development.

2.3 Pluralism in interpretations

Despite the acceptance of the concept 'sustainable development' as being a guiding normative principle at an international level (Fleurbaey, 2014), a governmental-level (DETR, 1999; DfT 2013b) and within industry (Sustainable Aviation, 2012; IATA 2009), sustainable development lacks a clear operational definition and framework (Bell & Morse, 1999; Holden *et al.,* 2013).

The lack of clear definition is not necessarily perceived as a bad thing, as it allows for wide political and societal acceptance of the term, though Daly (1991) attests this could be because "it sounds better than unsustainable nondevelopment" (p.1). However, "the issue here is not how sustainable development is defined in principle but how it is

measured in practice" (Robinson, 2004; p.374). Moreover, competing definitions are more reflective of the political and philosophical position of those proposing the definitions, than ambiguity in the scientific understanding of the issues (Mebratu, 1998). The ambiguity of the term sustainable development was intentional within the original *Brundtland Report* (WCED, 1987) where the goals of social and economic development would be specific to each country reflective of differing cultural and social need.

The development of the concept of 'sustainable development' must overcome the influence of institutional and group self-interest, as each have formed their own interpretations of the concept (Mebratu, 1998). Therefore, understanding the diverse range of interpretations is seen a prerequisite to the concept development and its practical application.

Interpretations of sustainable development are often presented in a dyadic manner: strong or weak (Nilsen, 2010). Pezzy (1992) offered one of the first and most influential assessments of the theoretical developments of sustainable development, identifying divergence in definitions in how significant, essential, or substitutable the various natural and man-made forms of capital were. Most notably, this review defined the concepts of weak and strong sustainable development. Though the two paradigms are often viewed as epistemological opposites, there exists within each definition a spectrum of interpretations, as presented in **Error! Reference source not found.**.

Table 2 Sustainability spectrum (Pearce 1993a; p. 18-19)

	Technocentric		Ecocentric	
	Cornucopian	**Accommodating**	**Communalistic**	**Deep ecology**
Green labels	Resource exploitive, growth oriented position	Resource conservationist and managerial position	Resource preservationist position	Extreme preservationist position
Type of economy	Anti-green, unfettered markets	Green economy, green markets guided by economic incentive instruments (e.g. pollution charges etc.)	Deep green economy, steady-state economy, regulated by macro-environmental standards and supplemented by economic incentive instruments	Very deep green economy, heavily regulated to minimise 'resource take'
Management strategies	Primary economic policy to maximise growth (GNP) Taken as axiomatic that unfettered free markets in conjunction with technical progress will ensure infinite substitution possibilities capable of mitigating all 'scarcity/limits' constraints (environmental sources and sinks)	Modified economic growth (adjusted green accounting to measure GNP) Decoupling but infinite substation rejected. Sustainability rules: constant capital rule	Zero economic growth; zero population growth Decoupling plus no increase in scale 'Systems' perspective – 'health' of whole ecosystems very important; Gaia hypothesis and implications	Scale reduction imperative; at the extreme for some there is the literal interpretation of Gaia as a personalised agent to which moral obligations are owed
Ethics	Support for traditional ethical reasoning; rights and interests of contemporary individual humans: instrumental value (i.e. of recognized value to humans) in nature	Extension of ethical reasoning: 'caring for others' motive – intra-generational and inter-generational equity (i.e. contemporary poor and future people); instrumental value in nature	Further extension of ethical reasoning: interests of the collective take precedence over those of the individual; primary value of component functions and services	Acceptance of bioethics (i.e. moral rights/interests conferred on all non-human species and even the abiotic parts of the environment); intrinsic value in nature (i.e. valuable in its own right regardless of human experience.
Sustainability labels	**Very weak sustainability**	**Weak sustainability**	**Strong sustainability**	**Very strong sustainability**

Weak sustainable development is based upon neoclassical economics (Banister, 2005; Neumayer, 2003) and within the anthropocentric and technocentric discourse (Pearce, 1993a). The aim of weak sustainability is to maximise human utility (DesJardins, 2013), where utility is defined in satisfying human need or addressing aspirations of a better quality of life (Holden *et al.,* 2013; Nilsen, 2010; WCED, 1987). Critical of the substitutability between the forms of natural and manmade capital, Daly (1996, p.77) notes that "the complementarity of man-made and natural capital is made obvious at a concrete and common-sense level by asking: what good is a saw-mill without a forest, a fishing boat without populations of fish, a refinery without petroleum deposits, an irrigated farm without an aquifer or river?"

Weak sustainable development is synonymous with *sustainable growth* (Holliday, 2001), in that, sustainable development does not preclude economic growth and development. The *Brundtland Report* explicitly included economic development, though primarily aimed at alleviating the wants and needs of the World's poor: "technology and social organization can be both managed and improved to make way for a[n] era of economic growth" (WCED, 1987; p.24).

Central to the concept of weak sustainable development is that neither natural (environmental) nor physical (human) capital has intrinsic value. Instead, development should seek to enhance, in a sustained manner, utility or consumption over time "by replacing depleted or degraded natural capital with human or produced production factors" (Banister, 2005; p.37). Therefore the primary difference between weak and strong sustainability is the degree of substitution between natural (environmental), physical (economic, human) and social stock (Holden, 2013). As Daly and Cobb (1989) argued in their seminal study, the challenge is the existence and difficulty in aggregating natural and produced capital, how should it be measured and valued; how should capital be distributed?

A further complication with the weak interpretation of sustainable development is the inter-generational consideration of natural capital: which generations will bear the cost of environmental use? (Farrow, 1998). The implications of such a question would entail consideration of potential compensation of future generations and introduce the challenge of developing methods relating to how natural capital stock is valued on potentially a decadal, centurial, or even millennial timescale.

Strong sustainable development is grounded in the ecocentric discourse of sustainable development (Pearce, 1993a; UNDP, 2011) and places limits on human interest, i.e. the economic and social dimensions of human development are complementary to that of nature (Daly, 1999). A strong interpretation applies limits to the utilisation of natural capital stock (resources, carrying capacities of ecosystems e.g. the atmosphere, hydrosphere etc.) through the creation of critical thresholds, an example being the global climate system, biodiversity and recognising the intrinsic value of the protection of nature (Fleurbaey *et al*. 2014). The development of ecological and biophysical constraints on human activity would necessitate decoupling economic growth from non-renewable resource utilisation or non-growth (Meadows *et al.,* 1972), or where these constraints have already been exceeded 'de-growth' (Jackson, 2009).

An extreme weak or very weak interpretation of sustainable development is routed in Naess' *Deep Ecology* (1973), and the symbiosis of man not being 'in-nature' but reliant on ecosystems. Life itself, whether human or non-human has equal inherent and intrinsic value, rejecting anthropocentrism and the valuation of nature through human experience.

Despite strong interpretations of sustainable development being limited and bounded by critical thresholds, an example being emissions of carbon, even these 'critical thresholds' such as the UNFCC set aim of "avoiding dangerous anthropogenic interference with the climate system", judging what is classified as dangerous is a matter of ethics (Kolstad, 2014). *How*, and *who,* should define what is considered and accepted as dangerous?

As explored over the previous section, interpretations of sustainable development involve a number of value judgements. In order to inform policy, infrastructure and business development is the need for a robust framework to explore and understand the array of epistemological stances and where possible provide a form of reconciliation with the aspiration of advancing sustainable development.

2.4 Second-order dimensions

The four primary dimensions of sustainable development (satisfying basic human need, environmental protection, inter-generational equity and intra-generational equity) are supplemented by the development of secondary dimensions: preserving nature's intrinsic value, promoting protection of the environment, promoting public participation and satisfying aspirations for an improved standard of living (or quality of life) (summarised in Table 3). It is important to note is that these secondary dimensions of sustainable development are subservient to the primary dimensions (Holden *et al.* 2013).

Table 3 A summary of the primary and secondary dimensions of sustainable development (Adapted from Holden *et al.,* 2013).

Level	Principles
Primary	• Satisfying basic human need • Long-term environmental protection • Inter-generational-equity • Intra-generational equity
Secondary	• Preserving nature's intrinsic value • Promoting protection of the environment • Promoting public participation • Satisfying aspirations for an improved standard of living (or quality of life)

2.4.1 Stakeholder participation

Stakeholder, or public, participation has been perceived as a key stage in achieving sustainability and sustainable development (Holden *et al.,* 2013). Stakeholder participation, within the implementation of sustainable development, has been viewed to range from the identification and creation of sustainable development indicators (Castillo and Pitfield, 2010), a means of developing metrics of sustainable development (Amekudzi *et al*., 2009), or assessing policy and technological preferences (Xenias and Whitmarsh, 2013).

The inclusion of stakeholder participation has been seen as a means of addressing both the primary dimensions of sustainable development, but also those of the second-

order, as highlighted above in Table 3: promoting protection of the environment (Sharma, 2005; Buysse, 2003) and promoting public participation (Bäckstrand, 2006; Baker, 2006). However, though the notion of stakeholder participation has been mooted as a means of operationalising sustainable development, the use and definition of a 'stakeholder' has been non-systematic. By non-systematic, the sustainable development literature has not developed the notion of stakeholder saliency, identity and their inclusion to the same degree as within the management and business field, which is covered in the following chapter.

The term 'stakeholder' has been taken from the field of strategic management, a concept popularised by Freeman (1984) and the topic of the following chapter. The utilisation of the stakeholder concept in turn results in a number of issues to be addressed: the identification of *legitimate* stakeholder groups, determination of stakeholder interests and the evaluation of the type and level of stakeholder power (Andirof and Waddock, 2002; Wolfe and Putler, 2002). This three-step 'stakeholder process' is complex, as discussed in the next chapter, and not addressed fully in the extant literature of sustainable development. To date, adoption of the stakeholder concept has lacked the robust investigation of what is entailed in 'stakeholder status'.

2.4.2 Satisfying aspirations

Sustainable development is not just about satisfying basic human needs. Where these basic human needs are being met sustainable development is consistent with improving the human condition and well-being beyond mere survival. Satisfying societal aspirations is explicit within the original *Brundtland Report*, where sustainable development is "a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations" (WCED, 1987; p.46). The issue of satisfying human aspirations and notions of social equity raises normative questions: which aspirations should development fulfil, how should the benefits of development, beyond the fulfilment of basic needs, be distributed?

Hediger (2000) argued that the social dimensions of sustainability should be defined by human-ascribed system goals (the objectives of development) and functioning of the overall system. The aspirations of different societies will in turn be affected by social and cultural influences, and may change with time.

2.5 Attempts of measurement

Sustainable development by its very nature is trans- and inter-disciplinary, and new fields of study have subsequently developed: sustainability economics (Baumgartner, 2010) and sustainability science (Gasparatos, 2012). As such, attempts of measurements of sustainability, or progress towards sustainable development, have evolved from a range of disciplinary fields and given rise to a variety of proposed assessment techniques.

There has been great emphasis within the literature on the environmental aspects of sustainable development. As such, sophisticated tools such as life cycle assessment (LCA) have been developed to understand the environmental impacts of a product or service over its lifecycle, from production, through use and end of life disposal. Such tools can provide insight into the emission of GHGs and where in supply chains they are concentrated (Koh *et al*., 2012; Acquaye *et al*., 2011), from which mitigation strategies can be developed. Despite a strong emphasis on understanding environmental impacts, there has been increasing attempts to integrate additional dimensions of sustainable development, specifically economic and business performance (Bai, 2012; Shi *et al.,* 2012). However, within such tools there exists a common problem with considerations of sustainable development more broadly: the lack of a common definition and framework for the concept (Linton, 2007).

The variety of developed sustainability assessment tools can be divided into three broad categories: monetary tools, biophysical tools and indicator tools (Bebbington, 2007; Singh, 2009). Within each of these three broad categories of assessment tools there exists a range of techniques. The choice of technique is value laden (Vatn, 2009). However, what is lacking are robust guidelines to differentiate between available assessment tools and techniques and the resultant impacts of the assessors decision (Gasparatos, 2012). The choice of assessment tool can have significant implications in the philosophical understandings of the concept of value, the role of stakeholder participation and it's (the assessment method's) relative stance of reductionism, i.e. the philosophical position that a complex system can be broken down into its constituent parts (see Table 4).

Table 4 Main features of sustainability assessment tool categories (adapted from Gasparatos, 2012)

Tool category	Concept of value	Valuation perspective	Role of participant	Stance of reductionism
Biophysical	Cost of production theory of value, donor system valuation	Eco-centric	Human preferences become irrelevant	Reductionist
Monetary	Neoclassical monetary valuation/aggregation	Anthropocentric	Individual consumer	Reductionist
Indicator-based	Lost during normalisation and aggregation	Lost during normalisation and aggregation	Lost during normalisation and aggregation	Reductionist

As Pearce (1993b, p.103) asserts "the measurement of sustainable development is not without considerable difficulties, yet this should not detract from the positive advances that can be made in this direction". Gasparatos (2012) offered four proposals for the choice of technique:

i. According to the desired perspective(s) of the assessment
ii. According to the desirable features of the sustainability assessment
iii. According to the acceptability of the criterion adopted
iv. According to the value of the affected stakeholders

Gasparatos (*ibid*) further highlights the importance of stakeholder participation as integral to the process of advancing the concept of sustainable development, in the stage of measurement and assessment. Therefore, as part of the assessment of sustainable development impacts is the need for a participatory stage to capture the values, needs and expectations of affected stakeholders (OECD, 2008). These methodological steps would make explicit the reasoning and rationale for the adoption of chosen measurements techniques, the relative relationships between impacts, the relation of the impact to the concept of sustainable development and the distribution of impacts (both positive and negative).

Within the decision making process for complex project evaluation – projects contain multiple objectives and multiple stakeholder groups - De Brucker *et al* (2013) state that if subscribing to the tripartite definition of sustainable development, balancing economic, environmental and social dimensions, then:

i. Project evaluation entails making choices, whereby not all projects considered contribute to sustainable development equally
ii. In complex cases some subsets of objectives typically reflect the interests of stakeholder groups
iii. Selection of distributional consequences which have varying effects on different stakeholder groups making winners and losers with certain groups gaining net benefit and others bearing net cost

Considering the questions that arise from the adoption of sustainable development, highlighted previously in Section 2.2 , this procedural advancement made by De Brucker *et al* (2013) highlights the importance of stakeholder participation in the process of measurement and project evaluation; the notion of stakeholder being linked to the primary dimensions of inter- and intra-generational equity and the secondary dimension of public participation.

However, despite what could be interpreted as procedural advancement, there remain questions associated with the stakeholder concept: which stakeholder views should be considered? How should stakeholders be integrated into the decision making process? Which impacts, both costs and benefits, are perceived by different stakeholder groups? How should the distribution of net costs and benefits be distributed within the stakeholder network?

These questions provide the basis for the following chapter: exploring the concept of stakeholder theory from the discourse of strategic management and how it can be developed and applied to sustainable development.

2.6 The impacts of aviation

Having explored the theoretical development of the concept of sustainable development, the following sections provide an overview of the main environmental impacts of aviation. It is not the intention of this thesis to provide a comprehensive characterisation of pollutants, nor extensive detail of the complex atmospheric chemistry involved with the impacts of aviation. The author would refer the reader to the highlighted and utilised sources for further information and detail. The review

presented is intended to add depth and context to the proceeding empirical results and discussion.

For an in-depth and detailed overview of aviation impacts on the atmosphere and the climate the reader is directed to Lee *et al* (2010), the work of the IPCC (1999) and Mahashabde *et al* (2011).

The impacts of aviation occur at varying scales and levels: global, regional, national and local. The impacts occur due to a number of factors: the provision of services (flights), the stages of flight (take-off, cruise and landing), the combustion of aviation fuel, ancillary land-based activities and services at the airport level, the manufacturing and decommissioning of aircraft, and the movement of passengers to and from their point of origin to the airport destination. A more comprehensive list of environmental impacts is presented below (see Table 5).

Table 5 ICAO inventory of aviation environmental impacts. Adapted from Daley (2010)

Environmental impact	Example
Aircraft noise	Aircraft operations
	Engine testing
	Airport sources
	Sonic boom (due to the operation of supersonic aircraft)
Local air pollution	Aircraft engine emissions
	Emissions from airport motor vehicles
	Emissions from airport access traffic
	Emissions from other airport sources
Global phenomena	Long-range air pollution (e.g. acid rain)
	Global warming and anthropogenic climate change
	Stratospheric ozone depletion
Airport/infrastructure construction	Loss of land
	Soil erosion
	Impacts on the water tables, river courses and field drainage (local hydrosphere)
	Impacts on flora and fauna

Environmental impact	Example
Water/soil pollution	Pollution due to contaminated run-off from airports
	Pollution due to leakage from storage tanks
Waste generation	Airport waste
	Waste generated in-flight
	Toxic materials from aircraft servicing and maintenance
Aircraft accidents/incidents	Accidents/incidents involving dangerous cargo
	Other environmental problems due to aircraft accidents
	Emergency procedures involving fuel dumping

2.6.1 Aviation emissions

The gaseous emissions of aviation are due to the combustion of kerosene in turbofan and turboprop gas turbine engines. Aviation fuel, Jet A-1 fuel, is a combustible hydrocarbon. Production is standardised across the globe and derived from crude oil. Biomass derived fuel is a niche product still in the experimental stage of development (IATA, 2014b). In a jet gas-turbine engine kerosene undergoes combustion in ambient air, primarily a mixture of nitrogen (N_2) and oxygen (O_2). In idealised conditions the combustion products would be carbon dioxide (CO_2) and water vapour (H_2O). In addition, a small proportion of SO_2 is produced due to the oxidation of sulphur additives in the fuel-mix; compounds added to increase lubrication (see Figure 7). Large quantities of ambient air pass through the gas-turbine engine during the combustion cycle and the combustion products only account for approximately 8.5% of the total mass flow leaving the engine (IPCC, 1999).

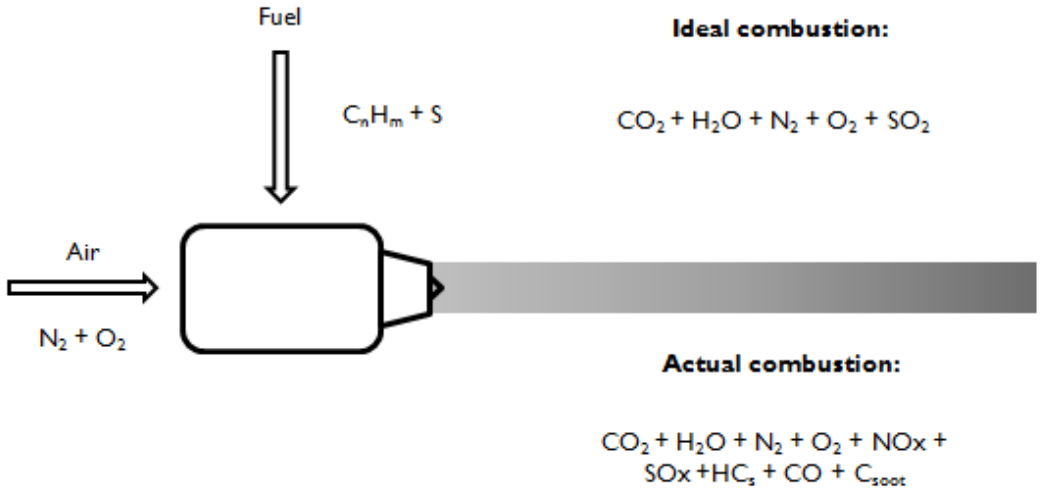


Figure 7 Simplified schematic of fuel combustion in a jet-engine

However, under 'real-world' conditions, idealised combustion does not occur. Instead, incomplete combustion exists; residual products of this combustion include nitrogen oxides (NO_x), hydrocarbons (HC), carbon monoxide (CO), soot particles (C_{soot}) and sulphur oxides (SO_x). These residual products of incomplete combustion represent 0.4% of the mass flow through the engine (see Figure 8).

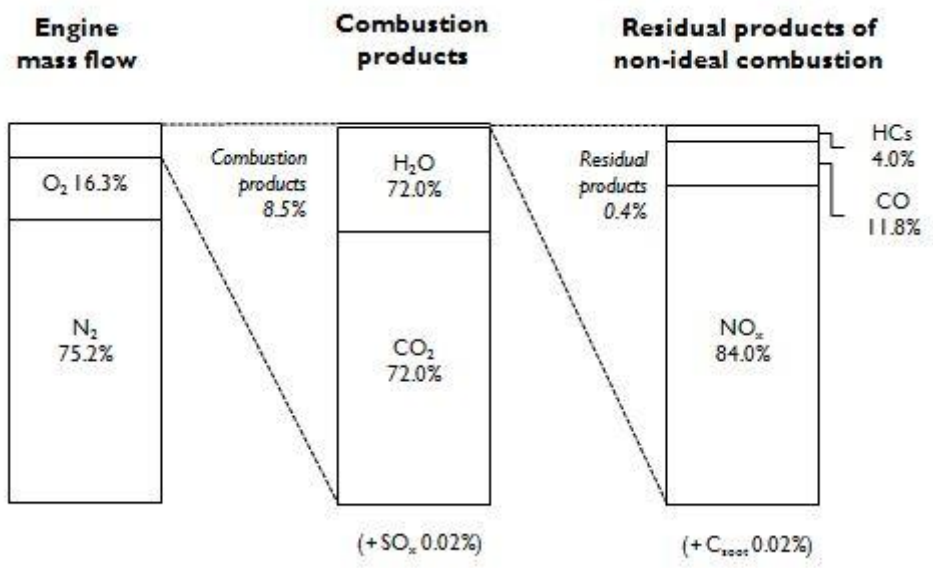


Figure 8 Jet fuel combustion products

The power settings of the engine, and subsequently the engine operating regime, can greatly affect the quantities and proportions of combustion products (see Table 6). Engine performance for the emission of all regulated pollutants (CO, HCs, NO_x and smoke) are contained within the ICAO Engines Emissions Databank (hosted and

available through the European Aviation Safety Agency (EASA)). It should be noted that all values given are produced at the time of certification and does not take into consideration the actual in-use engine performance or any temporal degradation in performance.

Table 6 Typical engine combustion products for various phases of flight

Product	Emissions (g) per kg kerosene burned		
	Idle	**Take-off**	**Cruise**
CO_2	3160	3160	3160
H_2O	1230	1230	1230
NO_x (as NO_2)			
Short –haul	4.5 (3-6)	32 (20-66)	7.9-11.9
Long –haul	4.5 (3-6)	27 (10-53)	11.1-15.4
CO	25 (10-65)	<1	1-3.5
HC (methane)	4 (0-12)	<0.5	0.2-1.3
SO_x (as SO_2)	1.0	1.0	1.0

The combustion products of aviation, though widely produced by other industries globally, are relatively unique in that they are emitted directly into the atmosphere at various altitudes. At cruise altitude, for subsonic commercial aircraft between 9-13km above ground, this is directly into the upper troposphere and lower stratosphere; aviation is the predominant anthropogenic source at these altitudes (RCEP, 2002).

The primary products of combustion, their impacts and effects on the atmosphere, are broadly discussed below. In addition to the overall impacts of the products they are discussed in relation to trends within the global and UK aviation sector.

2.6.1.1 Carbon dioxide

Carbon dioxide (CO_2) is a naturally occurring greenhouse gas (GHG). The emission of CO_2 is a function of fuel burn (see Figure 8). Though CO_2 is a naturally occurring GHG, human industrial activity is increasing its quantities within the atmosphere to levels unrecorded in modern history (Cubasch *et al.,* 2014). Due to the long residency

time of CO_2 in the atmosphere (approximately 100 years), it is well mixed and its impact spatially homogeneous on global scale (Lee, 2009; Cubasch *et al.,* 2014). The emission of CO_2 directly into the atmosphere at high altitudes is no different than ground-based sources.

Despite efficiency improvements in fuel burn per passenger kilometre, and predicted future improvements of between 1-1.5% per annum (Kahn Ribeiro, 2007), as a result of engine, airframe and operational improvements, this is forecast to be surpassed by demand increase of 5% per annum (Airbus, 2011; Boeing 2013). Aviation CO_2 emissions in the UK are forecast to double by 2050, from a base of 2005 (CCC, 2009).

2.6.1.2 Water Vapour

Water vapour (H_2O) is a relatively strong greenhouse gas and its production during the combustion process is directly proportional to fuel use. Due to the relative humidity of the lower atmosphere (the troposphere), the layer in which commercial sub-sonic aircraft operate, water emissions due to aviation do not have a major climate impact (Myhre, 2013; Lee, 2009; IPCC, 1999). Water vapour emitted into the troposphere may have a residency time of weeks and quickly removed by precipitation, and its influence is generally hemispheric.

2.6.1.3 Carbon Monoxide

Carbon monoxide (CO) production in the combustion of aviation fuel is due to incomplete combustion (see Figure 7). The quantities produced, unlike CO_2 and H_2O, is dependent on the operational power settings of the engine; the emission factor of CO is inversely proportional to the combustion efficiency of the engine. As a result CO production is high at low power settings e.g. in the taxiing phase of take-off, from the stand to the runway (see Table 6). CO is also an environmental pollutant at the local-level leading to local air pollution (LAP) contributing to the formation of low-level ozone (O_3).

2.6.1.4 Nitrogen Oxides

Nitrogen oxides (NO_x) are produced by the incomplete combustion of aviation fuel. NO_x production within the aircraft engine is a complex function of combustion temperature, pressure and combustor design (Lee and Raper, 2003). As such, NO_x emissions vary during the phases of flight (see Table 6). NO_x gases are not in themselves a greenhouse gas, but they have two indirect effects on global warming:

warming from ozone production and cooling from the destruction of atmospheric methane. In addition the production of NO_x during the LTO phases, and whilst idle, may contribute to local air pollution concerns in the vicinity of airports.

The emission of NO_x into the upper atmosphere, at altitudes where commercial aircraft operate, causes a number of complex chemical processes (IPCC, 1999). Primarily, the oxidation of CH_4, CO and non-methane hydrocarbons result in the production of a hydroperoxy radical (HO_2). Methane concentrations in the atmosphere are from non-aircraft sources (Lee and Raper, 2003). The HO_2 reacts with nitric oxide (NO) to form NO_2, liberating a highly reactive atomic oxygen (O). This highly reactive atomic oxygen reacts with atmospheric O_2 to form O_3. The production of O_3 has a positive radiative effect, where as the destruction of CH_4 has a cooling effect. The net effect of this NO_x-CH_4-O_3 reaction is a positive radiative forcing.

2.6.1.5 Sulphur Oxides

Sulphur oxides (SO_x) refer to a range of combustion products including sulphur dioxide (SO_2), sulphur trioxide (SO_3) and gas-phase sulphuric acid (H_2SO_4). SO_x emissions at the local level may have adverse health effects; evidence suggests a "causal relationship between respiratory morbidity and short-term exposure to SO_x" (EPA, 2008). However, no clear evidence suggests a clear dose-response relationship for SO_x alone but it may be a contributing factor with a mixture of other pollutants.

Sulphur dioxide, through additional transformation, can form secondary sulphate aerosol products. Sulphate aerosols reflect sunlight and have a cooling effect, and therefore a negative radiative forcing. In addition these aerosols play a role in the generation of cirrus clouds, a topic discussed further below.

2.6.1.6 Particulate Matter

Particulate matter (PM) refers to a range of emissions with dimensions ranging from 3nm to 4μm. Of particular interest and concern are those particles with a diameter less than 2.5μm, often referred to as $PM_{2.5}$ (Lee, 2004; Mahashabde, 2011) due to their detrimental impact on human respiratory health.

PM is primarily composed of non-volatile carbon particles (soot) emitted directly from the engine. Secondary PM are reaction products derived from the gaseous emission of SO_x and NO_x (see above). These secondary reaction products include ammonium sulphates, ammonium nitrates and other constituents, the result of light and dark

reactions in the atmosphere (Mahashabde, *ibid*). This heterogeneous group of particles within the emission gases, and as a result of secondary atmospheric reactions, are collectively referred to as aerosols: primary aerosols and secondary aerosols respectively.

Soot, a primary aerosol, produces a positive contribution to global warming (see **Error! Reference source not found.**) (Lee, 2009; IPCC, 1999). Additionally, aerosols in the upper atmosphere may precipitate the formation of contrails and/or cirrus clouds acting as condensation nuclei, a fact discussed below.

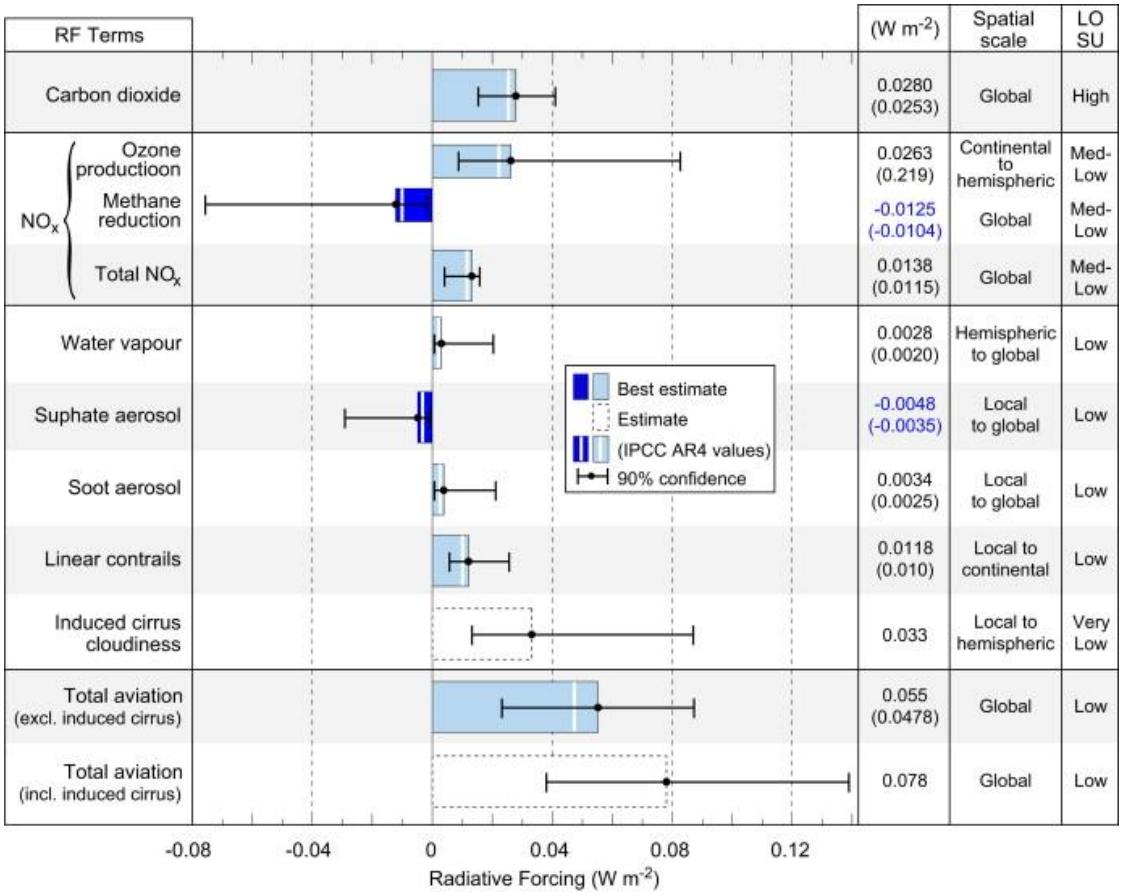


Figure 9 Radiative forcing of aviation emissions in 2005 (Lee, 2009)

2.6.1.7 Climate Impacts

Several of the gaseous emissions from aviation have effects on the planetary climate, and its radiative balance (Myhre *et al.,* 2013). The effect of each of the emission species on the planetary atmosphere is dependent on the species radiative forcing (RF). The RF is a "measure of the influence that a factor [gaseous emission specie] has in altering the balance of incoming and outgoing energy in the Earth – atmosphere system" (*ibid*; p.665).

The RF varies between aviation emissions; **Error! Reference source not found.** presents the relative impact that these sources are having *today* and the relative level of scientific understanding (LOSU). The climate change mechanisms of some emissions may have a cooling effect on the global climate, and thus have a negative RF. The LOSU of some climate mechanisms are relatively well understood and others poorly. Of particular note is poor understanding of the induced cirrus cloud formation due to aviation. Due to the uncertainties in the impacts of particular aviation emissions on the environment and global atmosphere it is important to appreciate the variation in LOSU. As demonstrated below (**Error! Reference source not found.**) the uncertainty range in RF can be considerable.

Contrails and the cirrus cloud effect

Condensation trails (hence contrails) are linear ice clouds that form behind an aircraft due to the emission of water vapour and particulates in the combustion products. Contrails form as a result of the increase in relative humidity during the mixing of the warm and moist engine exhaust gases and the colder and less humid ambient atmosphere. Due to the consistency in the engine exhaust gases during the cruise stages, the formation of contrails is governed by the relative environmental conditions of the air (Lee and Raper, 2003).

The lifetime of a contrail is governed by atmospheric conditions; they may evaporate rapidly or persist and spread through diffusion and wind-shear, and thus their lifetime may range from seconds to hours (Lee, 2004). Contrails can make both a positive and negative effect, and their net contribution to climate effects is positive. Negative radiative forcing occurs as a result of contrails reflecting incoming solar radiation. A positive radiative forcing occurs when contrails absorb infrared radiation emitted from the Earth. The IPCC (2007) estimated the net radiative forcing of contrails at 10 mWm^{-2} (see **Error! Reference source not found.**).

Aviation has an additional indirect effect on the global climate through the formation of cirrus clouds, though this remains an active area of climate research and there is a high-degree of scientific uncertainty regarding its relative radiative forcing (Lee, 2009; IPCC, 2007).

Cirrus clouds may be formed as a result of aviation activity through two mechanisms: persistent linear contrails, which can spread through wind-shear to form cirrus cloud-like structures; and, the emission of particulates in engine exhaust gases which act as

cloud condensation nuclei in appropriate atmospheric conditions (Daley, 2010; Lee, 2009; IPCC, 1999). The cirrus cloud effect remains the least understood of aviation impacts on the environment relative to other chemical and indirect effects (IPCC, 2007). The reader may wish to review **Error! Reference source not found.** and notice the large error bars associated with the LOSU of the induced cirrus cloudiness relative to other mechanisms.

2.6.2 Noise

Noise is one of the most widely perceived and contentious issues not only in the future development of aviation, but also in its day-to-day operations, and the single most significant local environmental impact (AEF, 2005, Airports Commission, 2013, DfT, 2006; 2013b). Environmental noise has been recognised by the WHO (2011) as a significant burden of disease, and new contemporary studies have highlighted a causal link between aviation noise and cardiovascular disease (Hansell, 2013).

More broadly, aviation noise impacts surrounding an airport are the result of multiple (in some cases cumulative) sources: airport ground activity, aircraft flight and associated activities (e.g. movement of passengers to the airport). Noise, or levels of noise exposure, can be quantified by a number of physical variables. However, the effects of noise are highly subjective and depend on the respondents tolerance; a tolerance that can be influenced by a number of personality and social modifying factors. In many cases, and the case within this study, the "noise damage" caused by aviation activity is not direct auditory or health damage but indirect effects including annoyance and complaint, sleep disturbance and stress (Hume and Watson, 2003).

Noise nuisance is influenced by more than just the frequency and amplitude of noise (Thomas and Lever, 2003), but may include modifying factors that are relevant to noise integration within a sustainable development framework:

- Variation in affluence, attitude, culture and lifestyle may affect perceptions of disturbance and annoyance
- Awareness of the economic and social consequences of constraining airport growth on the local, regional and national communities served
- Variation in socio-economic need and the need for air route development in different regions and globally
- Level of public debate and support to airport development and the extent to which democratic systems are responsive to such actions

As the effects of noise are complex and variable it is difficult to measure. As such, a variety of noise metrics can be used: wavelength, frequency, or amplitude (Thomas and Lever, 2003). A common method of measurement utilises and measures noise in A-weighted decibels (dB(A)). This measure gives a weighting to certain frequencies relating to the perception of the human ear. This is the most accurate approximation of the human ear to sound (Daley, 2010). The noise generated by aircraft is from multiple sources: engine noise, movement of turbulent air over the airframe (especially at time of high-drag e.g. landing and take-off), runway operations and taxiing, engine testing and auxiliary power units (Smith, 1992).

There is no universally accepted method of noise measurement. Efforts through the EC and the Environmental Noise Directive (END) 2002/49/EC have sought to standardise measurement across the EU. END averages noise exposure at a particular location over a specific period of time, the L_{den}. Where:

L_{den} is the day, evening, night level. L_{den} is a logarithmic composite of the L_{day}, $L_{evening}$ and L_{night} but with penalty additions of 5 dB(A) to the $L_{evening}$ value and 10 dB(A) being added to the L_{night} value.

L_{day} is the A-weighted sound level over the 12-hour period of 0700 – 1900 hours.

$L_{evening}$ is the A-weighted average sound level over the 4-hour period 1900 – 2300 hours.

L_{night} is the A-weighted average sound level over the 8-hour period 2300 – 0700 hours.

The results and output of these measurements allow the creation of noise 'contour' maps surrounding airports, or noise sources more generally. Similar to standard map contour related to elevation the area bounded by a noise contour relates to the average calculated noise exposure L_{den}.

2.7 The response of industry to sustainable development and environmental pressures

Over the past few sections, an overarching view of the sustainable development discourse has been presented and the key environmental impacts of aviation have been discussed. As was highlighted at the very beginning of this project, sustainable development entails techno-economic, enviro-economic, socio-technical (amongst other permutations) considerations and trade-offs. Interventions and actions can be

split into three categories: technical, operational and policy. Often these interventions and actions have multiple effects across the different dimensions and impacts related to sustainable development, some positive, and others detrimental.

The primary focus of industry interventions to reduce the impact of aviation is concerned with climate effects (Sustainable Aviation, 2012; Boeing, 2011, Airbus, 2011; ACARE, 2011; 2002). Given the international scope of aviation, its rapid comparative growth, the level of technological and engineering maturity and long development and lead-in times, radical improvements in efficiency and step-changes in technology addressing emissions and impacts are limited (Daley, 2010; IATA 2009; Stern, 2007).

The aviation industry has developed a range of targets to reduce the future emission of gaseous combustion products, primarily concerning CO_2. Targets included a 1.5% per annum improvement in fleet fuel efficiency, carbon neutral growth from 2020 and a reduction in net CO_2 emissions of 50% by 2050 (ACARE, 2011; ICAO, 2013). In a similar vein, the industry has targeted the management, control and reduction in noise highlighted in the *Sustainable Aviation Noise Road Map* (Sustainable Aviation, 2013). The aim being to accommodate significant UK aviation growth through to 2050 (discussed In Chapter One) and maintain or reduce the overall noise output compared to 2010.

Improvements in the fuel efficiency and environmental performance of aircraft have been dramatic over the last half-century, with the specific emissions (emissions per passenger-kilometre) of most pollutants falling. The energy intensity of flying, measured as MJ/seat km has fallen significantly (see **Error! Reference source not found.**), with reductions in the order of 75% possible. As outlined previously improvements in fuel efficiency have direct correlation to CO_2 and other combustion products.

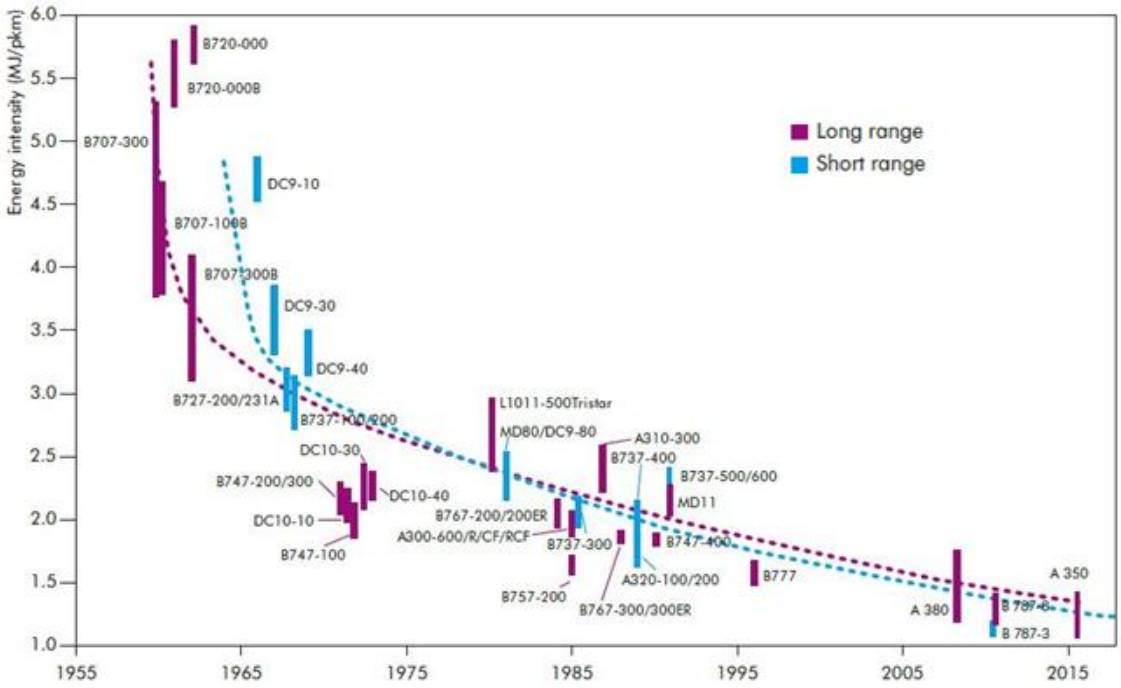


Figure 10 Historic improvements in energy consumption per passenger-kilometre. The range of points reflects the varying configurations of aircraft models. (IEA, 2009)

Technological improvements in engine and airframe technology can improve the fuel efficiency of aircraft (and hence CO_2 emissions), reduce NO_x emissions or particulate matter. Particular emphasis has been placed by industry on improvements in the fuel efficiency. Aviation fuel is the single most significant component of airline operating costs, approximately 30-40% (IATA, 2009), a cost that is highly dependent on a volatile oil price (EC, 2008). Profit margins within the airline industry are comparatively low, and for the most recent financial year ('13-'14) forecast to be as little as 1.8% (IATA, 2012), therefore cost control is highly important.

Aircraft fuel efficiency can be improved through improvements to the aerodynamic performance of the airframe, more efficient engines and reduction in aircraft weight. The airframe manufacturers have improved the aerodynamic performance of aircraft through the introduction of devices such as riblets and wing tip devices.

The aviation industry has placed particular emphasis on weight reduction to improve the energy efficiency of flights. A 1% reduction in the structural weight of the airframe can reduce fuel consumption by approximately 0.5% to 1.5% (ACARE, 2010). 'Light weighting' has been achieved through the introduction of new materials, particularly composite materials, e.g. carbon fibre reinforced polymers (CFRP). CFRP, typically 20% lighter than traditional aluminium structures, is widely used in the next-generation

aircraft Boeing 787-Dreamliner and the Airbus A350-XWB, and constitute up to 50% of the aircraft by weight (Boeing, 2013; Airbus, 2012).

The fuel efficiency of turbo-fan engines has improved greatly. The technical potential to reduce fuel efficiency further is limited (ACARE, 2010). The development of 'open rotor' engines offer the potential to reduce fuel consumption by 20-25% relative to current in-service short and medium haul aircraft. However, the introduction of open-rotor engines involves certain technical trade-offs: lower flight speeds and increased noise. The technology is affected by an 'emissions versus noise trade-off' (ACARE, 2010).

It is not just open-rotor engines that are affected by such impact trade-offs. The aviation sector has highlighted the reduction of CO_2, NO_x and noise as being a priority. CO_2 may be reduced by increasing the operating temperature and the overall pressure ratio of engines, the result being an increase in NO_x production (Lee, 2004).

A detailed understanding of the quantification and trade-offs between impacts is important to help deliver effective and efficient solutions to the externalities and challenges of the air transport system. Though, to this point, the examples presented highlight a potential conflict between different environmental impacts, assessing effective solutions extends far beyond just the environmental sphere and entails the consideration of the economic, social and political dimensions too. The IEA (2009) summarised the impacts of oft-cited technological and operational interventions (see Table 7**Error! Reference source not found.**), here there were few interventions that lead to positive reductions in all three categories (noise, local air quality and climate). The analysis is simplified and does not consider other operational or economic impacts.

Table 7 Range of mitigation interventions in aviation and their trade-offs between noise, local air quality and climate (adapted from IEA (2009) and supplemented with material from Sustainable Aviation (2013; 2012), IATA (2009), ACARE (2011, 2010). Red – negative effect; Yellow- mixed effects; Green – positive effect

System intervention	Noise	Local air quality	Climate
Nacelle modifications	• Reduced noise	• Increased HC & CO	• More fuel burn/CO_2
Increased air pressure ratio & temperature (engines)		• Increased NO_x • Reduced HC & CO	• Reduced fuel burn/CO_2
Reduce cruise altitude			• Reduced fuel burn/CO_2 • Increased NO_x • Less increase in Ozone • Reduced contrails
Increase engine bypass ratio	• Reduced noise	• Increased NO_x	• Reduced fuel burn/CO_2
New runways	• New noise exposures	• Reduced delay (fuel burn)	
Reduce polar flights	• Potentially increased noise exposures		• Less effects on the stratosphere • More fuel burn/CO_2
Steep climb	• Reduced noise	• More fuel burn	• More fuel burn/CO_2
Continuous descent approach	• Reduced noise	• Reduced delay (fuel burn)	• Reduce fuel burn/CO_2
Reduced thrust takeoff	• Reduced noise	• Reduced NO_x • Reduced PM • Increased SO_x	• More fuel burn/CO_2
Market based mechanism (CO_2)			• Reduced net CO_2
Demand reduction	• Reduced number of flights	• Reduced number of flights	• Reduced number of flights
'Quiet' slots	• Reduced noise		
Land use planning controls	• Reduced noise	• Limit population exposure	
Open rotor engines	• Increased noise	• Reduced fuel burn	• Reduced fuel burn/CO_2
Electric taxiing	• Reduced noise	• Reduced fuel burn	• Reduced fuel burn/CO_2

A recent analysis by Timmis *et al*. (2015) into the introduction of CFRP 'next-generation' aircraft could result in a reduction in fleet-wide CO_2 emissions less than the technical potential of a single aircraft due to interactions been technology and market. In this case, the introduction in CFRP aircraft resulted in a reduction in airline operating costs, which in turn reduced ticket prices, and resulted in increased future demand for flight. Additionally Krammer (2013) when investigating the CO_2 reduction potential of the aviation biofuels highlighted the interdependency of interventions, in this case the introduction of emissions trading to accelerate the adoption of biofuels.

Even when there exists strong scientific or technical evidence for interventions they are subordinate to safety considerations (Lee, 2004); a case in point being the angle of descent of aircraft and its impact on noise. The international standard Instrument Landing System glide path angle is 3 degrees and is recommended to member states by ICAO. Increasing an aircraft's glide path reduces noise in two ways: it increases the height of the aircraft above ground, increasing the distance over which sound travels; and secondly, an increased rate of descent reduces the amount of engine power required. For most airports, the ability to continue operations in low-visibility condition is a key requirement that would dissuade it from adopting approach angles of greater than 3.25 degrees. In addition, ICAO currently urges States not to adopt flight path angles greater than 3 degrees for other environmental reasons (CAA, 2014a).

In a similar vein to actions to reduce and mitigate the climate affects the aviation industry has developed future targets for the reduction of noise, and subsequently a range of technological and operational strategies for the control of its emission. For example in the UK, the industry has a target of accommodating projected future growth in aviation through to 2050, whilst maintaining 'UK aviation noise output' at the same level as 2010, with potential for further reduction dependant on the prioritisation of noise or carbon emissions in aircraft design (Sustainable Aviation, 2013). In addition, there have been calls for the controlling of local development surrounding airports within noise footprints.

Table 8**Error! Reference source not found.** demonstrates the significant improvement in noise emission of new variant aircraft relative to the current variants they are set to replace. Noise reduction is presented relative to minimum Chapter 3 certification levels.

Table 8 Certified noise levels of current aircraft and 'imminent' new aircraft variants (Sustainable Aviation, 2013)

Current aircraft	Bypass ratio	Arrival noise (dB)	Departure noise (dB)	Imminent aircraft	Bypass ratio	Arrival noise (dB)	Departure noise (dB)
B767	4-5	-4.9	-5.0	B787	9-11	-5.8	-10.4
B747-400	4-5	-1.9	-5.9	B747-8	9-10	-4.5	-11.2

The airframe and engine design are important in determining the total aircraft noise, with the engine traditionally being the major source of noise (Smith, 1989). Increasingly stringent noise regulation can lead to increased fuel-burn penalties and trade-offs. Additional noise reduction technology may result in increased weight or drag reducing fuel efficiency. Open-rotor engines were presented previously in this section and highlight the trade-off between fuel efficiency and noise emissions. The installation of additional cowling with noise absorption material can reduce its emission but increase aircraft weight and lead to additional fuel burn.

Additionally, the interventions outlined below and their respective impacts occur at different scales: from the aircraft level, to the operational, sub-system and global. A comprehensive understanding of the integrated and dependent effects is needed to optimise strategic decision making.

2.8 Sustainable development in UK Government policy

Sustainable development in UK Government policy is grounded in the report '*A Better Quality of Life*' (DEFRA, 1999), a response to the UN General Assembly call at the five-year review of the Rio Conference Declaration to implement national sustainability strategies (UN, 1997). The report outlined broad level principles for integrating sustainable development across government policy:

- Social progress that recognises the needs of everyone
- Effective protection of the environment
- Prudent use of natural resources
- Maintenance of high and stable levels of economic growth and employment

Subsequently, and most recently, the principles of sustainable development have been reaffirmed as central to government policy in *Mainstreaming Sustainable Development* (DEFRA, 2011). The report explicitly recognises the three dimensions or 'pillars' of sustainable development: economic, environmental and social. Whilst recognising the interrelated nature of the dimensions, and the challenges associated with sustainable development implementation, the responses of the report are mixed. In parts the report provides examples of discrete packages pertaining to a single dimension e.g. The Big Society to cross-cutting initiatives e.g. the Green Deal addressing carbon emissions, job creation and social equity (fuel poverty). Lacking is a cohesive strategy and blueprint to the implementation of sustainable development.

2.9 Identified gaps in the extant sustainable development literature

The following section summarises the identified gaps within the extant sustainable development literature, and relates them to the stated aims and objectives of this research, as outlined in Section 1.5

Despite the widespread popularisation and adoption of the concept of sustainable development as the normative basis for future development, the concept lacks an operational framework to guide policy, societal development and business strategy. In relation to this, this research builds from the notion of the 'stakeholder' inherent amongst conceptualisations of sustainable development. In relation to this we highlight two points.

First, though the notion of the 'stakeholder' has been profligated, and applied, as a means of achieving aspects of sustainable development. The term 'stakeholder' is utilised without a robust method of identification to determine who are system stakeholders, their legitimacy and interest. This runs contrary to the business and management fields, where the discourse originated and has subsequently been developed. Stakeholder participation, stakeholder engagement and stakeholder thinking have been applied in a myriad of ways within the sustainable development literature. However, they do not explore:

- Who are legitimate stakeholders and by extension who are illegitimate stakeholders
- How interpretations of the sustainable development concept may change amongst system stakeholders
- How stakeholders should be integrated into the process of development

Second, choosing how to develop a sector, such as aviation in the UK, entails decision-making about a variety of infrastructure, technology and policy options: how should this choice be made when each entails different social, economic and environmental impacts? Within sustainable development several valuation methods exist, each entails different and competing philosophical positions; the choice of a technique is a value laden technique, often left to the decision of the assessor. This explicitly refers to the secondary aim of this research (A2). Building from the development of stakeholder status within sustainable development, this research proposes that the development of the stakeholder notion can inform:

- Which impacts should be measured in relation to the dimensions of sustainable development
- How stakeholder interpretations of impacts, fairness and value can be utilised to inform and guide the choice of assessment technique

The assessment of impacts related to sustainable development relates to objectives O3 and O4.

Central to the identified gaps within the sustainable development discourse is the lack of a robust application of the concept of 'the stakeholder'. Stakeholder thinking forms the central topic of the next chapter, within which a proposed stakeholder-sustainable development framework is established to explore the sustainable development of UK aviation.

2.10 Chapter Summary

This chapter has introduced the concept of sustainable development. Sustainable development has become the salient notion behind future development at all levels of society from supra-national government bodies, national and local government and business. The major conceptual and operational aspects of sustainable development have been presented and reviewed.

Despite this widespread acceptance of the concept there exist barriers to its effective implementation, hindered by pluralism in its epistemological orientation, ranging from weak to strong interpretations. The route of this pluralism was shown to be the result of the competing avenues of development: the anthropocentric (routed in the weak and advocates substitution between natural, physical and social capital) and the eco-centric (defending the intrinsic value of nature).

Despite this 'confusion of sense', four primary principles of sustainable development have been developed: satisfying basic human need, long-term environmental protection and inter-and intra-generational equity. These primary principles are subordinated by a number of secondary principles: preserving nature's intrinsic value, promoting protection of the environment, public participation and satisfying aspirations for an improved standard of living.

Though the concept of the stakeholder has been identified as a means of addressing the primary dimensions of sustainable development (inter- and intra-generational equity), and also stakeholder participation itself being identified as a second-order dimension, most sustainable development studies, both theoretical and empirical applications of stakeholder status in the sustainable development field, fail in conducting any form of rigorous stakeholder analysis: the identification of relevant stakeholder groups, identification of stakeholder interests and saliency.

Additionally, a review of the most important environmental impacts of aviation was presented and the responses of industry to tackling its obligation to the challenges of sustainable development, most notably anthropogenic climate change.

The following chapter introduces and develops the concept of stakeholder status and stakeholder theory from the field of strategic management. It aligns stakeholder thinking with the concept of sustainable development, in turn developing an empirical framework for the investigation of sustainable development.

3. Stakeholder Theory

3.1 Chapter overview

Chapter Two identified four principles of sustainable development; satisfying basic human need, environmental protection, inter- and intra-generational equity, intrinsic to these principles is the notion of the 'stakeholder'. The present chapter aims to introduce and align the discourse of stakeholder theory, from the field of strategic and organisational management, with these four principles and develop a framework for how a stakeholder approach can be utilised in the operationalisation of sustainable development. Subsequently, the following chapter, Chapter Four, details how this framework guides the research process.

Section 3.2 presents the development of stakeholder theory from its popularisation in the mid 1980's into a discourse that transcends multiple disciplines and into the mainstream of academic, governmental and corporate thinking. Subsequently, second-order theory developments are critiqued in order to develop and demonstrate how a 'stakeholder approach' to sustainable development can be constructed and utilised.

Section 3.4 discusses the concept of the 'stakeholder', one of the central themes in the development of stakeholder theory: who are valid stakeholders? Linked to this section, the following section explores the role and identification of nature and the non-human environment in stakeholder theory, due to the environment being a key dimension in the concept of sustainable development.

In order to provide a full picture of the context of this study, the role of stakeholder representation in UK aviation is discussed. Finally, to close the chapter, the principles of sustainable development are aligned with those of stakeholder thinking and developed into an empirical stakeholder framework for the operationalisation of sustainable development.

3.2 The state of stakeholder theory

The concept of a 'stakeholder' and 'stakeholder management' has become a widely accepted term across academia, institutions, within government policy and business. However, despite its widespread acceptance, fundamental aspects of stakeholder theory are contested: its normative basis (Freeman, 1999; Phillips *et al.,* 2000; Friedman, 2002; Orts & Strudler, 2002; Hasnas, 2013), the nature of stakeholder identification (Mitchell, Agle & Wood, 1997; Phillips, 2000; Kaler, 2003) and how to operationalise the concept (Rowley, 1997; Frooman, 1999; Jawahar, 2001; Steurer *et al.,* 2005; Konrad *et al.,* 2006; Steurer, 2006). The contested aspects of stakeholder theory are often presented in a multitude of arguments with often contradictory interpretations (Donaldson and Preston, 1995). Even Freeman himself, the scholar credited as the father of stakeholder theorists, admits stakeholder theory is a challenging concept "owing in part to the ambiguity and breadth of stakeholder theory itself" (Phillips et al. 2003, p.480).

As such, and with the above contested issues in mind, this section shall examine the first. In turn, the secondary and tertiary identified issues are addressed in the following sections. The aim is to explore and critique the discourse of stakeholder theory in light of the principles of sustainable development.

Stakeholder theory, from its roots in *Strategic Management: a stakeholder approach* (Freeman, 1984), has developed from a "pure theory of the firm" into a much broader method of framing business-society relations, both its social responsibilities (Clarkson, 1995) and ethical obligations (Jones, 1995). These perspectives into business-society relations have evolved into three distinct perspectives: corporate-centric, stakeholder-centric and concept-centric (Steurer, 2006). For completeness the following review of stakeholder theory takes into consideration all three of these concepts.

Stakeholder theory was originally designed to address the failure of the input-output model, or production view, of a corporation in capturing the external business environment and influences (Freeman, 1984). The fundamental premise of stakeholder theory being that long-term value, and the continued existence of the firm, is achieved through proactively managing for the needs of its stakeholders.

This 'corporate centric' perspective is typified by the hub-spoke model of business-society interactions (Figure 11), with the organisation being the focal point of study. The purpose of both stakeholder theory and the definition of "stakeholder", were, and

still often are, very much defined in terms of this corporate-centric perspective: "...if you want to manage [the firm] effectively, then you must take your stakeholders into account in a systematic fashion" (Freeman, 1984; p. 48) *and* "any group or individual who can affect or is affected by the achievement of an *organisation's* purpose" (Freeman, 1984; p. 53) [emphasis added]. Though originally defined as a strategic management strategy for corporations in an attempt to explain business-society relations (Donaldson and Preston, 1995), it has developed into a more dynamic research paradigm to study the other actor-institution relations and actor-actor interactions within wider business and societal environments.

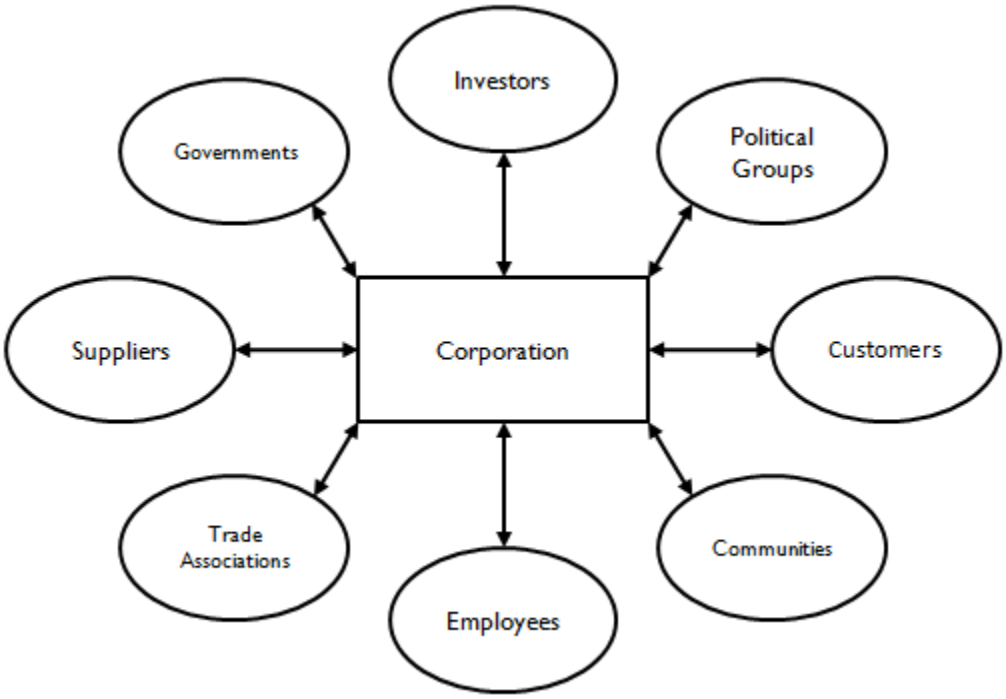


Figure 11 Hub-spoke conceptualisation of corporation-stakeholder relations. Adapted from Freeman (1984; p.55) and Donaldson and Preston (1995; p.69)

Stakeholder theory is built upon three foundational principles which have evolved with the discourse over the intervening thirty-years (Freeman, 1984; Evan and Freeman, 1993; Freeman, 2004);

1. *The stakeholder enabling principle* – Organisations should be managed in the interests of stakeholders; stakeholder's rights must be ensured and participation in decisions substantially affecting their welfare must be permitted
2. *The stakeholder fiduciary principle* – The management of organisations bear a fiduciary relationship to their stakeholders *and* to the organisation as an abstract entity; that is, management have a duty of care to its stakeholders - act

in accordance to that stakeholder-enabling principle - and to ensure the long-term survival of the organisation

3. *The principle of stakeholder recourse* – In the event of management failure to enact the stakeholder fiduciary principle, stakeholders may bring action against management

Within these three principles there are four premises of stakeholder thinking:

I. Organisations have relationships with many constituent groups or stakeholders
II. Stakeholder thinking is concerned with the nature of the relationships between organisations and stakeholders, in terms of both processes and outcomes (Jones and Wicks, 1999)
III. Stakeholder thinking is concerned with the decision making *and* actions of both the management of organisations and its stakeholders
IV. Legitimate stakeholders each have rights and an intrinsic value which need to be respected

The rights and interests of no one stakeholder group is set to have any greater intrinsic value than any other. It is this absence of predominance which sets stakeholder thinking apart from theoretical counterparts such as stockholder theory, which places shareholders as the fiduciary responsibility of management with dominant moral, legal and contractual standing. Additionally, premise III (above) highlights the proactive procedural nature of stakeholder thinking throughout the entire decision management process from conception to delivery.

The three foundational principles of stakeholder thinking are aligned with the four principles of sustainable development: satisfying basic human need, environmental protection, inter-generational equity and intra-generational equity as outlined in the previous chapter. The notion of the 'stakeholder' is engrained in the normative principles of sustainable development, both as the aim of development and the procedural nature of development: as an end and a means.

Though stakeholder theory and stakeholder management have become widely accepted in both organisational practice and academia, it remains a work in progress (Freeman, 1994; Wicks et al. 1994; Laplume *et al*., 2008).

One of the central issues within the development of stakeholder theory has been that of its nature and purpose (Donaldson and Preston, 1995). Though pitched originally as an alternative to the traditional view of the corporation, the input-output model, the

legitimacy of its normative basis has been questioned (Marcoux, 2003). In principle it is argued that managers have a fiduciary responsibility to shareholders (stockholders), with the corporate objective function to maximise shareholder value, not stakeholders. Stakeholder management is often portrayed as the antithesis of this 'stockholder view'. As Goodpaster et al. (2002) note the original term 'stakeholder', invented in the 1960s, was an intentional play on the word 'stockholder' (shareholder in the UK).

The crux of the divergence is the role of ethics in business, and hence management decision making. Central to the stockholder view is the role of business to maximise shareholder value, within legal confines *i.e.* the *fiduciary responsibility* of management. Within a stakeholder approach to management, the principles of which are outlined above, managerial salience is given to a range of actors whom, in a neo-classical sense, should have no salience due to a lack of legal or contractual status. Evan and Freeman (1993) argue that, rather than stakeholder thinking being the antithesis of a stockholder approach, maximising shareholder value is in fact a narrow interpretation of a stakeholder approach. Stockholders (shareholders) are a valid 'stakeholder', and hence worthy of management consideration.

The development of stakeholder theory has been taken along several strands of thought, the two most prominent being defined stakeholder analysis and stakeholder synthesis (Goodpaster, 1991). Though stakeholder thinking imbues ethics into business management, stakeholder thinking can be conducted in a number of ways. The two identified strands of development are a case in point. "Stakeholder analysis may give the initial appearance of a decision-making process, but in fact is only a *segment* [emphasis in the original] of a decision-making process. It represents the preparatory or opening phase that awaits the crucial application of the moral (or nonmoral) values of the decision maker" (Goodpaster, 1991; p.56). Whereas stakeholder synthesis proceeds further to include stakeholders in the *actual* decision making.

It is this moral legitimacy of the inclusion of stakeholders in the decision making of management where the two corporate theories (stakeholder theory and stockholder theory) can be seen to diverge.

Though much of the development of stakeholder theory has been focussed on large corporations, examples being Konrad et al. (2006), this "represents an unnecessary limitation on the scope of stakeholder theory" (Phillips et al. 2003; p.38). This traditional perspective is identified as 'corporate-centric', with the corporation being seen at the hub of stakeholder interactions. Two other perspectives of stakeholder

theory have developed: stakeholder-centric and concept-centric. In a stakeholder-centric perspective scholars seek to understand stakeholders, their claims and legitimacy with the corporate performance being negated. A concept-centric perspective explores ways in which a stakeholder "supports a certain concept or vice-versa" (Steurer *et al*. 2005; p. 267).

The development of the stakeholder literature and research can be divided into two distinct, however related, tracts (Andirof and Waddock, 2002). Firstly, one focussed on the normative basis and implication of the stakeholder concept, i.e. its legitimacy and moral authority as a management doctrine. And secondly, for a strategic management purpose i.e. identifying and classifying stakeholders to understand stakeholder relationships for a practical application. The preceding section has addressed the first strand of stakeholder theory and the subsequent sections shall deal with the latter.

An assessment based on stakeholder analysis consists of a three stage process (Andirof and Waddock, 2002; Wolfe and Putler, 2002; Konrad *et al*., 2006):

1. Identification of legitimate stakeholder groups of the organisation or concept
2. Determination of stakeholder interests
3. Evaluation of the type and level of stakeholder power

The following section further addresses the development and utilisation of stakeholder thinking. The subsequent section shall address the first two points of the identified three stage process.

3.3 Typology

In summary, rather than stakeholder theory being a cohesive management doctrine, it has evolved along multiple strands of thought; ethical and moral, through integration with corporate social responsibility (Carroll, 1991) and a pragmatic business strategy (Freeman, 1984). As such, stakeholder theory "can be, and has been presented and used in a number of ways that are quite distinct and involve very different methodologies, types of evidence, and criteria of appraisal" (Donaldson and Preston, 1995; p. 70). The multitude of applications and utilisation of stakeholder theory has led to "...confusion about its nature and purpose" (*ibid;* p.72).

Donaldson and Preston (1995) developed one of the most influential second-order theoretical developments of stakeholder thinking by differentiating between three

aspects of usage: descriptive, instrumental and normative. Descriptive stakeholder theory may be used to describe and explain corporate characteristics and behaviours in relation to its stakeholders. Instrumental usage may "...identify the connections, or lack of connections, between stakeholder management and the achievement of traditional corporate objectives" (*ibid*; p.71). A normative application identifies the moral or philosophical guidelines for the management of corporations.

The three developed aspects are not discrete entities, Donald and Preston (1995) admit, though they have split research developments along these three strands, the "theoretical approaches are often combined without acknowledgment" (*ibid;* p.72). Instead the three aspects should be considered nested within each other (Figure 12); at its heart is a normative core.

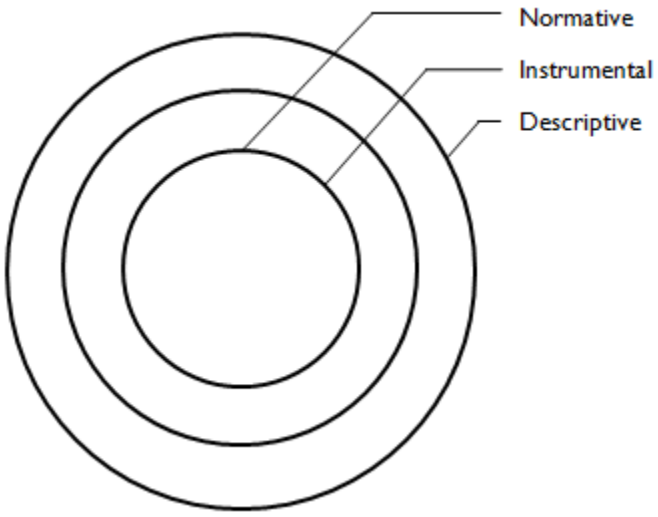


Figure 12 Adapted from Donaldson and Preston (1995) three aspects of stakeholder theory.

The development of the triple-taxonomy of stakeholder theory has been rooted in a corporate perspective (Steurer *et al.,* 2005; Steurer, 2006). The three identified aspects of stakeholder theory have customarily become distinguished as three distinct approaches (Hendry, 2001). With this in mind, each of the three aspects shall be reviewed in turn from the core outwards.

3.3.1 Normative

At the centre of the proposed stakeholder model is a normative core. As discussed in the previous sections, this normative core is a contested issue. Principally, the core is constructed of two ideals: "...stakeholders are identified by *their* [emphasis in the original] interest in the corporation and that the interests of *all* [emphasis added]

stakeholders have intrinsic value – can be viewed as axiomatic principles that require no further justification" (Donaldson and Preston, 1995; p.81).

One of the normative aspects of stakeholder theory, linked to the second axiomatic principle, highlighted by Donaldson and Preston (1995) above, is the intrinsic value of the stakeholder "...each group of stakeholders merits consideration for its own sake and not merely because of its ability to further the interests of some other groups, such as shareowners" (Donaldson and Preston, *ibid*; p.67). Thus, normative considerations interpret the function of the corporation and the relations between business and society. As such, "...each stakeholder has a right to be treated as an end in itself, and not solely, as a means to an end" (Shankman, 1999; p.323).

Normative stakeholder thinking recognises that, morally, management have no greater fiduciary responsibility to traditional financial stakeholders, such as shareholders (stockholders), than wider stakeholders with a *legitimate* claim. The identification of stakeholders, the determination of stake and the legitimacy of their claims is discussed in the next section (3.4). It is this basis which creates the link and the justification for considering stakeholder thinking as a method of operationalising sustainable development. Organisations have a "moral duty to protect the interests of stakeholders ... a responsibility to take into account the legitimate interests of stakeholders and to safeguard a fair distribution of benefits and burdens" (Hummels, 1998; p.1404).

The normative principles outlined above are highlighted in Section 3.2

3.3.2 Instrumental

An instrumental application of stakeholder thinking is used to "identify the connections, or lack of connections between stakeholder management and the achievement of traditional corporate objectives" (Donaldson and Preston, 1995; p.71). The premise of instrumental stakeholder thinking being that if a corporation manages its relations with a broad range of stakeholders it will better achieve the organisations' business objectives (e.g. revenue growth) (Wilson, 2003; Jones, 1995). These business objectives can be both traditional corporate objectives and alternative objectives including such as managing multiple stakeholder needs. Instrumental applications of stakeholder theory cannot be considered in isolation; defining the corporate objective is in itself a normative issue (Freeman *et al*., 2010). This broad range of objectives can be synonymous with those of the competing dimensions of sustainable development:

economic, social and environmental. With the dimensions of sustainable development being associated with the priorities and need of competing system stakeholders. Freeman *et al.* (2010) attest that the normative core of stakeholder theory is not singular, and as such socioeconomic challenges and interest can provide the normative basis for the stakeholder thinking (Schaltegger, 2013).

Though there exists a link between corporate social performance and company financial performance, the effect is small and current research lacks practical guidance to managers on the measurement of these positive impacts (Peloza, 2009). Examples in the literature of the implementation of stakeholder thinking and its effect on the achievement of corporate provide mixed conclusions. For example, Cochran and Wood (1984) found a positive relation between social and economic performance. However, Preston and O'Bannon (1997) found no conclusive causal link between the two. O'Toole (1991; p. 18-19) found neither a positive nor negative association between the two objectives and stressed the normative basis of social objectives as "the *sine quo non* [indispensable and essential action] of business virtue". Specifically within the aviation sector, Lee (2010) found a positive linear relationship between CSR, stakeholder management being embedded within this much broader management approach, and value creation within the airline industry.

3.3.3 Descriptive

Donaldson and Preston (1995) assert that stakeholder theory is fundamentally descriptive in nature. As previously highlighted, stakeholder thinking reinterprets the neo-classical view of business society relations. This fundamental reinterpretation is related to the purpose of the organisation's existence, its structure and governance (Letza *et al.,* 2004).

The neo-classical traditional view of the organisation perceives it as an economic input-output entity, transforming inputs into sellable products and services for the market for the purpose of generating profit for owners (Niskala and Näsi, 1995),

This simplified model of an organisation "as a mere 'resource-conversion entity' is no longer appropriate" (Friedman and Miles, 2006; p. 25) to account for internal changes within an organisation or external changes in the business environment. Examples of these external changes could be consumer movements, environmental movements, or the rise of individual and organisational special interest movements. The rise of sustainable development as a societal movement over the last thirty-years is a case in

point as an "event[s] or [and] issue[s] which cannot be readily understood" (Freeman, 1984; p.1984).

Organisations viewed as the nexus of stakeholders, stakeholder thinking undoubtedly presents a 'people-orientated' view of organisations. This orientation explicitly has people, or stakeholders as the essence of the matter, "whereas the neo-classical theory includes stakeholders at most implicitly or as a very general remark "organisations have stakeholders" (Niskala and Näsi, 1995; p.124). Consequently, organisations are "seen as a form of cooperation where people in different roles cooperate in order to attain their goals, satisfy their needs, or for some other reason...[and thus] can be defined operationally e.g. as "a goal-orientated social system" (*ibid*; p.124).

Two points are interesting in this statement; first the notion of cooperation to achieve multiple ends echoes the proposed method of operationalising sustainable development, and second the definition of organisations as 'goal-orientated social systems' appears to further extend the deemed purpose of organisations and the need to conduct research from the social systems within which they operate. Cochran (1994) identifies a number of theories; neo-classical theory, customer theory, worker theory, stockholder/worker theory and managerial theory that all purport to describe the 'objective function' of an organisation. Whilst all these theories hold that management should account for the objectives of one or two stakeholders above others, stakeholder thinking means that organisations should strive to deliver wider outputs to a whole range of stakeholders, rather than maximising the repayments to shareholders or legal owners as reflected in the production-orientated model (Letza *et al.,* 2004). This thought is embedded with the foundational principles of stakeholder theory established by Freeman and examined in the previous section. Evan and Freeman (1993) state "the very purpose of the firm is, in our view, to serve as a vehicle for coordinating stakeholder interests" (p.102). As a result, stakeholder thinking is perceived by some as an attempt to integrate all the theories of why organisations exist into a single unified theory (Brenner and Cochran, 1991).

In addition to describing the nature of organisations, the stakeholder thinking doctrine therefore can also be seen to direct management of organisations "to pursue outcomes that optimise the results for all involved stakeholders rather than maximise the results for one stakeholder group (i.e. shareholders)" (Jones, 1999; p.164). As stakeholder thinking professes that organisations should 'optimise the results for all stakeholders', it is thought that it inherently requires all organisations to implement sustainable

development, as this is thought to be the aim in everyone's long term benefit. Echoing the sustainable development literature, the achievement of this optimisation is thought to entail the balancing of the interests and rights of stakeholders (Hummel, 1998). This is also known as 'stakeholder management' which "involves allocating organisational resources in such a way as to take into account the impact of this allocations on various groups within and outside the firm" (Jones, 1999; p.164). Such an organisational resource allocation approach is a direct contrast to the neo-classical stockholder fiduciary principle "directed to maximise the welfare [return] of primary stakeholders such as owners and creditors" (*ibid*; p.164). The main principle of 'stakeholder management' can be seen to operationalise the concepts of sustainable development: stakeholders' participation in decision making, long-term contractual relationships between the organisation and its stakeholders, trust relationships and organisational ethics (Letza *et al.,* 2004).

3.4 The concept of the stakeholder

One of the central, and most contentious, strands in the development of stakeholder theory, since Freeman's seminal work, has been the notion of stakeholder identification; which groups *are* stakeholders, which *are not* and *why* (Starik, 1995; Mitchell *et al.,* 1997; Phillips, 1997). The original definition of "any group or individual that can affect, or is affected by" (Freeman, 1984; p53) has left the concept of whom a stakeholder is open to continuing criticism (Fassin, 2009), primarily as being too vague; "...it leaves the notion of stake and the field of stakeholders unambiguously open to include virtually anyone" (Mitchell *et al.,* 1997; p.856).

The three-stage process of stakeholder assessment, presented in the previous section, firstly involves the identification of relevant stakeholder groups. The identification of who, or what, stakeholders are, is based in the normative basis of stakeholder theory (Mitchell *et al.,* 1997). The term '*stakeholder*', can be broken down into two parts: the '*stake*' and the '*holder*': what claim do groups/individuals have; and which groups/individuals hold this claim? The previous section addressed the issue of the '*stake*' and surmised that stakeholders have a legitimate claim and saliency in management decision making. This following section addresses the second aspect, the identification of relevant stakeholder individuals or groups.

The development of stakeholder theory from CSR, can be seen to influence not only the normative basis of the theory, but also the notion of stakeholder "...corporations have an obligation to constituent groups in society beyond stockholders [shareholders]

and beyond that prescribed by law or union contract, indicating that a stake may go beyond mere ownership" (Mitchell *et al.,* 1997). Freeman's (1984) original definition of a stakeholder as "any group or individual that can affect, or it affected by" (p.53), still persists today. However, a range of stakeholder interpretations has developed; "the idea of a stake can range from simply an interest in an undertaking at one extreme to a legal claim of ownership at the other extreme" (Carroll and Buchholtz, 2004; p. 67). Consequently, a range of stakeholder interpretations has developed between the two extremes (Friedman and Miles, 2006).

Interpretations of stakeholders have been categorised into broad or narrow interpretations (Dricoll and Starik, 2004). Freeman's original conceptualisation of stakeholder is an expansive broad interpretation. "Expansive views of relevant "stakeholders" lend easily to become so broad as to be meaningless and so complex as to be useless" (Orts and Strudler, 2002; p.218). Narrow definitions of stakeholder status limit status to those stakeholder groups with an economic, legal, contractual obligation or assume a degree of risk in relation to the organisation in question (Friedman, 1970; Clarkson, 1995).

In applying stakeholder thinking to the concept of sustainable development in the aviation sector, a broad interpretation of stakeholder status is required. A broad definition of stakeholder status allows an inclusive participative framework to be constructed. The concept-centric nature of the application of stakeholder thinking allows flexibility in exploring both avenues of interests, and to capture the broad range of issues in trying to understand the dimensions of sustainable development: economic, social and environmental. In proposing a broad definition of stakeholder status, this does not address the issue of understanding the identity of the stakeholder nor determine the stake they hold in relation to the concept under exploration, it merely does not preclude any groups or individuals prior to investigation.

Though a broad interpretation is congruous with sustainable development, it in no way addresses the common criticism of stakeholder thinking; the discrimination of stakeholders and the ambiguity and vagueness in stakeholder identification (Sternberg, 1997; Fassin, 2009). Freeman's broad definition may "include virtually everyone, everything, everywhere" (Sternberg, *ibid*; p. 4).

Following the three stage process of stakeholder thinking, outlined in Section 3.2, stage one: 'Identification of legitimate stakeholder groups of the organisation or concept' requires greater expansion than merely classifying the concept of stakeholder status.

Stakeholder status "does not of itself, say what interest is, or even what type of interest is; and does not say how seriously or with what weight that interest should be regarded" (Cohen, 1997; p. 14). Development in the field of stakeholder thinking has focussed on identifying and prioritising potential stakeholders, primarily as a means of identifying legitimate and salient stakeholders.

Exploration into the classification of stakeholders has primarily been corporate centric. Carroll (1989) classified stakeholders as primary or secondary regarding their relationship to the organisation. Primary stakeholders have a direct contractual relationship e.g. employees, owners, shareholders and secondary stakeholders are those without contractual status e.g. local communities. Phillips (2003) distinguishes four classifications of stakeholders: normative, derivative, dangerous and dormant. Normative stakeholders are those that organisations have a moral obligation to; derivative stakeholders may influence the organisation but have no contractual relationship; dangerous stakeholders can detrimentally affect the organisation in pursuance of its objective; and dormant stakeholders have no legitimate relationship with the organisation but could affect the firm.

Central to the process of applying stakeholder thinking in stage one is the need to understand the saliency of stakeholder groups to either the management organisation or the concept in question. One of the axiomatic principles of stakeholder thinking, discussed in the previous section, is that all stakeholders have an equal and valid claim. However, the relative importance and potential to influence (the organisation or concept), as perceived by management (or researcher), by each stakeholder group will be different. Kochan and Rubinstein (2000) explored three components of a stakeholders' ability to influence:

I. The extent to which stakeholders contribute resources to the organisation
II. The degree of risk taken by the stakeholder in supplying these resources to the organisation
III. The power held by the stakeholder in relation to the organisation

One of the most influential developments in the characterisation of stakeholder groups was the framework established by Mitchell *et al.,* (1997) to assess stakeholder salience. The model to assess saliency is constructed of three determinants: power, legitimacy and urgency (see **Error! Reference source not found.**). Where power is "the extent it [a party] has or can gain access to coercive, utilitarian, or normative means, to impose its will in the relationship" (Mitchell *et al.,* 1997; p.865). Legitimacy of the

stakeholder claim is linked to the earlier discussion regarding the normative core of stakeholder theory and the interpretation of stakeholder status e.g. narrow vs. wide. Mitchell *et al.* adopt Suchman's (1995) definition of legitimacy; "a generalised perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs and definitions" (p. 574). Finally, urgency can be constructed of two components: the relationship or claim is time-sensitive in nature, or when the relationship or claim is critical to the stakeholder.

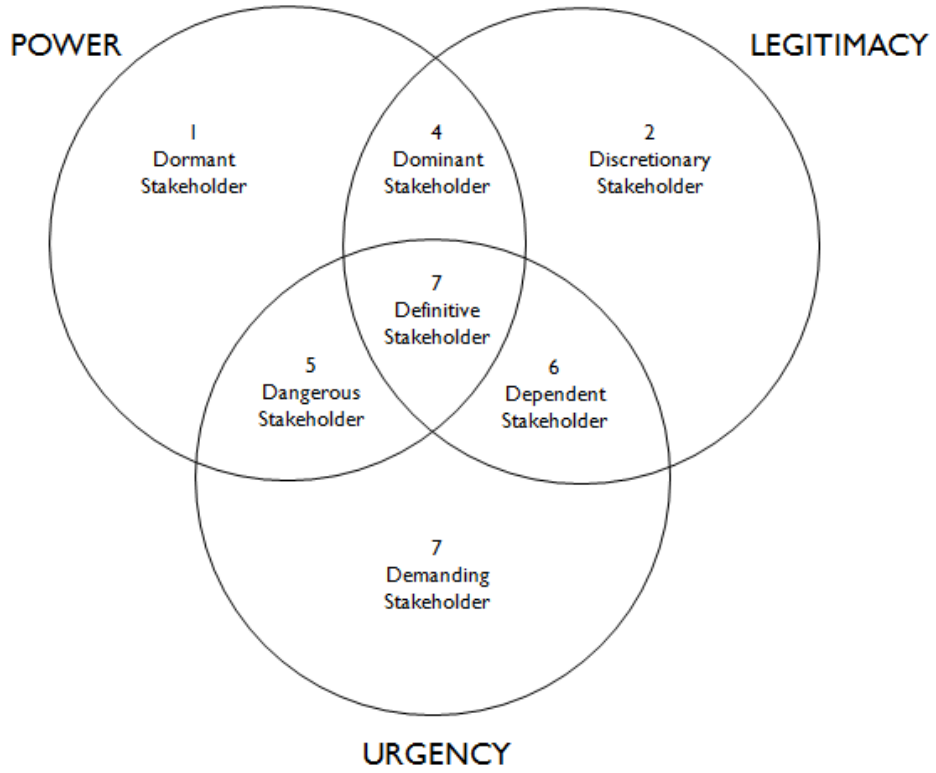


Figure 13 A stakeholder typology. Reproduced (Mitchell *et al.*, 1997)

It should be noted that the above, the possession of the listed attributes by organisation stakeholder, "are not static, rather, are in constant flux" (Mitchell *et al.*, 1997; p. 870). In part, this theoretical ability to recognise stakeholder-manager relations is critical of the hub-spoke of business-society relations as perceived by Freeman (see Figure 11). The more attributes possessed by a stakeholder the more salient it should be regarded by management (Parent and Deephouse, 2007).

The above exploration of the stakeholder concept; stakeholder characterisation, identification and saliency have primarily been developed from a corporate-centric perspective. This study is utilising stakeholder thinking from a concept-perspective, that of sustainable development in aviation. However, the application of the outlined model above can explore the stakeholders' saliency with regards to the concept of

sustainable development and the relationships between stakeholders. In this concept-centric application what becomes important is the perception of stakeholder typology from the perspectives of other stakeholders. Therefore, a stakeholder could be salient, if recognised as salient by other stakeholders legitimising their stakeholder status.

3.5 Nature as a stakeholder: part 1

A continuing debate throughout the thirty-year development of the stakeholder theory literature has been the representation, identification and role of nature within the stakeholder system. Most potently, should nature, or in Starik's (1995) claim "trees", be given stakeholder status? As this research takes sustainable development as the normative basis for the utilisation of stakeholder theory, the role of nature and the non-human environment must be considered and resolved when contemplating the balance between environmental, social and economic dimensions.

As previously discussed in Section 2.3, sustainable development is an anthropocentric concept, centred on human need; one of the central components of sustainable development is satisfying basic human *need*. Stakeholder theory, with a 'fairness-based' approach would only value nature and the natural environment as a result of the preferences of human stakeholders (Phillips, 2000). Orts and Strudler (2002) assert that the ethical principles, and basis of stakeholder theory, do not allow managers to include the non-human environment or nature as stakeholders in themselves.

The debate about the role of nature within stakeholder theory has centred on whether nature itself possesses the characteristics of stakeholder status, therefore warranting the attention of management as a 'salient stakeholder' (Starik, 1995; Driscoll, 2004), or alternatively the moral consideration of the environment (Phillips, 2000). Much of the debate has focussed on the interpretation of stakeholder status, as covered in the previous section.

Starik (1995) claims that nature itself should legitimately be awarded salient stakeholder status, not just as one stakeholder but many. He extends Wood's (1990) earlier work on the "business environment", and extends it beyond the social context in which businesses operate, as was Wood's initial intention, to literally include "the environment". Referring back to the previous discussion regarding the concept of the stakeholder, see above, using a classical definition of 'affect or be affected by' Starik could be deemed correct in assigning stakeholder status to the environment to "any naturally occurring entity which affects or is affected by organizational performance"

(Starik, 1994; p.92). However, by expanding stakeholder status to this level it makes stakeholder thinking inoperable by assigning stakeholder status to practically anything (Phillips, 2000).

Later work by Driscoll and Starik (2004) attempted to expand on Mitchell et al.'s (1997) stakeholder salience framework by making the addition of proximity to the existing three attributes: power, legitimacy and urgency. The addition is intended to bolster the claim for the inclusion of the non-human environment as a salient stakeholder.

The consideration of nature within this study has been influenced by the development of the sustainable development literature which has primarily been anthropocentric. As such, though the natural environment forms an important dimension of sustainable development it lacks the characteristics of stakeholder status in being able to communicate and vocalise their stake. As such, this study will seek to use a broad range of stakeholder proxies to understand the role of the environment.

The role and the identification of nature within the stakeholder system shall be investigated and analysed by this research and forms part of the later discussion in light of the empirical research findings.

3.6 Stakeholder representation in UK aviation

As previously described, significant attention and academic study has been devoted to the relationship between stakeholders and corporations; the stakeholder research tradition has overwhelmingly been corporate-centric (Steurer, 2005; Konrad, 2006). The pursuance of corporate-stakeholder relations has been presented on the basis of an ethical obligation (Freeman, 1984; Donaldson and Preston, 1995), or a method for achieving strategic objectives (Jawahar, 2001, Jones, 1995; Frooman, 1999). However, stakeholder representation within UK aviation preceded the rise of the stakeholder concept, within both the academic and corporate spheres, through the introduction of the Civil Aviation Act 1962.

Stakeholder representation within UK aviation has been a requirement at the airport-level as required by the Civil Aviation Act 1962, and superseded by Section 35 of the Civil Aviation Act 1982. Stakeholder representation is in the form of an airport consultative committee (ACC), which, as stated by the Act (s.35), is to be formed of:

a) Users of the aerodrome
b) Or any local authority (or, if the person having the management of the aerodrome is a local authority, for any other local authority) in whose the aerodrome or any part thereof is situated or whose area is in the neighbourhood of the aerodrome, and –
c) For any other organisation representing the interest of persons concerned with the locality in which the aerodrome is situated

Despite the outlined guidance for member inclusion, a criticism of Freeman's (1984) definition of 'stakeholder status', that "...it leaves the notion of stake and the field of stakeholders unambiguously open to include virtually anyone" (Mitchell *et al.,* 1997; p.856), was levied within the aviation context. The judgement of *Regina vs. Fairoaks Airoprt Ltd ex parte Richard Roads (November 1998)* has given clarification to those stakeholders in group (c). The ruling allowed any group to join the ACC as long as they conformed to the constitution of the ACC in question. The defendant (Fairoaks Airport Ltd) claimed "...to include members of all the category (c) organisations on the committee would result in a committee that was so large as to be unmanageable" (Regina vs. Fairoaks Airport Ltd, 1998).

The purpose of the ACC is outlined in the latest Department for Transport (2014) guidelines. These being:

- Enable an exchange of information and idea between members of the ACC
- Allow the concerns of the members of the ACC to be raised and taken into consideration by airport operators, with a genuine desire on all sides to resolve any issues that emerge
- To compliment the legal framework within which the airport operates

However the ACC is not intended:

- To detract from or constrain the responsibility of the airport owner and/or operator to manage the airport
- Nor, to prevent interested parties from raising concerns directly with the airport, or through other channels

The ACC could be perceived to fulfil the criteria of stakeholder thinking, as originally envisaged by Freeman in his work *Strategic Management: A stakeholder approach* (1984), and much of the theoretical development since has been grounded in the corporate

sphere. The interpretation and assignation of 'stakeholder status' is broad: "the idea of a stake can range from simply an interest in an undertaking at one extreme to a legal claim of ownership at the other extreme" (Carroll and Buchholtz, 2004; p. 67). The application of stakeholder thinking is very much defined in terms of the corporate-centric strand of development (Steurer *et al.,* 2005), the relationship between stakeholders and the focal corporation (the airport). Though this research project is investigating sustainable development in aviation from a concept-centric application of stakeholder thinking, the ACC is recognised as an important entity bringing together a broad range of aviation system stakeholders. As such, the ACCs are identified as an important gateway to accessing stakeholders and gaining participation in the research; a matter discussed further in the following chapter.

3.7 A stakeholder approach to sustainable development

The review of the literature surrounding stakeholder thinking presented in this chapter has outlined and investigated the links between stakeholder thinking and the conceptualisation of sustainable development. The following section brings together the strands of discussion, and their implications, into how stakeholder thinking can be leveraged to explore the issues of sustainable development, and answer the identified research questions.

Initially an overview of the stakeholder theory literature demonstrated that it has evolved from merely a corporate-centric view of the firm into an inclusive and broad discourse for exploring business-society relations. Two additional perspectives have evolved: the stakeholder-centric and the concept-centric. It is this concept-centric perspective of stakeholder thinking that this study shall utilise and leverage; the concept being that of sustainable development

Additionally, this chapter presented the triple-value taxonomy of stakeholder theory by Donaldson and Preston (1995): descriptive, instrumental and normative. Though these three aspects are deemed to be nested within each other, this study utilises both the normative and descriptive aspects. The normative aspect of stakeholder thinking links the three principles of the stakeholder approach with the four principles of sustainable development: public participation, environmental protection, inter-generational equity and intra-generational equity. The descriptive usage of stakeholder thinking shall be utilised to explore the concept of sustainable development in aviation.

The outlined three-stage process of stakeholder management (see Section 3.2), shall be undertaken to identify stakeholders, determine their stake and characterisation in relation to the 'affect or affected by' binomial and the perceived relationship between stakeholders within the context of sustainable development; in addition to exploring interpretations of sustainable development and the perceived impacts, both costs and benefits.

This research proposes that sustainable development provides the normative basis for stakeholder thinking, a basis that has been ill-developed to this point, which builds from the ethical foundations of CSR. Sustainable development is not just a vision of a future but is also procedural as defined in the second order dimensions of sustainable development of public participation, aspiration for satisfying human wants and wider issues of governance are aligned with the procedural nature of stakeholder thinking: "[s]takeholder theory is concerned with who has input in decision making as well as with who benefits from the outcomes of such decisions. Procedure is as important to stakeholder theory as the final distribution" (Phillips *et al.,* 2003, p.487).

Earlier examples of theoretical and empirical attempts to integrate sustainable development and stakeholder thinking can be found in both the management and business literature (Steurer, 2005; Konrad *et al.,* 2006) and transport studies (Amekudzi *et al.,* 2009; Castillo and Pitfield, 2010; Xenias and Whitmarsh, 2013).

In the management literature it is as explored through the concept-centric application of stakeholder management but their efficacy is limited as the studies and framework have remained corporate-centric, in this case multi-national corporations (MNCs), and how MNCs and stakeholder interests related to the dimensions of sustainable development (Steurer, 2005; Konrad *et al.,* 2006). The developed sustainable development-stakeholder relations management (SD-SRM) framework of Steurer (2005) made considerable progress in linking the evolving concept of sustainable development with the theoretical foundations of stakeholder theory. The framework gives tacit appreciation of the plurality of sustainable development positions (very weak to very strong), but is developed for instrumental value, reducing the descriptive strength of stakeholder thinking to a secondary consideration and overlooking the procedural nature of sustainable development (e.g. public participation). The application of the Steurer's (2005) SD-SRM framework by Konrad *et al.* (2006) was purely limited to MNCs, and explored the issues of sustainable development through a rigid framework of sustainable development 'dimensions' and 'issues'. MNCs, and likewise

their stakeholders, are treated as homogenous entities and groups such that the issues of a telecommunications business are the treated in the same manner as those of an energy company. The application of the framework does not take into consideration how the *specific context* of application can affect the sustainable development 'issues' or the constituent members of the stakeholder network.

The work of Xenias and Whitmarsh (2013) integrated 'stakeholder thinking' with the preference ordering of potential policy options in the attainment of sustainable development in transport. Within this study stakeholders were crudely delineated and limited to 'experts and non-experts'. Though concluding that participation within policy development by stakeholders (in this case the public) was an important procedure there was no appreciation of the wider, and more complex, network of stakeholder actors which, outlined previously in this chapter (see Section 3.2 through Section 3.4) could influence both policy and the public.

In a similar vein Castillo and Pitfield's (2010) study into developing sustainable development indicators from a stakeholder perspective, that reflects the context in which development is to occur, utilises stakeholder status in a very limited fashion. Despite explicit recognition that "the framework endeavours to be stakeholder-led" (p.21), stakeholder involvement in the development of output indicators is limited to just two stakeholder groups: academics and transport planners.

Though Amekudzi *et al.* (2009) appreciate that different stakeholders will hold differing priorities, wants and needs related to the concept of sustainable development, and even different interpretations of what sustainable development is and *who* valid stakeholders are is not defined.

Although sustainable development has a procedural characteristic, most issues regarding the concept are content-oriented in the sense that they specify economic, social and environmental principles or (minimum) requirements. Development can be regarded as sustainable only if these principles and requirements are satisfied. Stakeholder relations management (SRM), on the other hand, is the result of an interactive process rather than a conceptual principle. SRM serves the quest.

With this theoretical stakeholder-sustainable development framework developed, the following chapter utilises this and forms a method of investigation centred and built upon the Wolfe and Putler (2002) three-stage process of stakeholder thinking. The

theoretical stakeholder framework is flexible and context specific, that helps to explore the concept of sustainable development within that which it is applied.

3.8 Identified gaps in the extant stakeholder literature

The following section summarises the identified gaps within the extant stakeholder theory literature with relation to exploring the concept of sustainable development, and connects them to the stated aims and objectives of this research as outlined in Section 1.5

Stakeholder theory has evolved from a pure 'theory of the firm' into a much broader discourse for exploring business-society relations. However, much of the development of stakeholder thinking has remained in the 'corporate-centric' sphere; understanding business-stakeholders relations for the achievement or impediment of the corporate objective function. The value of stakeholder thinking from a concept-centric perspective remains an underdeveloped and growing avenue of research. In relation to this underdevelopment this research identifies three areas of development.

First, the majority of the previous literature of stakeholder thinking has remained within the corporate-sphere of thought and alternative applications of stakeholder thinking (concept-centric and stakeholder-centric) have remained under investigated. Prior applications of the concept-centric view of stakeholder thinking related to sustainable development, as in the case of this research, has been limited to individual 'small-scale' (at the local spatial-level) projects, rooted in investigations of multi-national corporations, and not at the national sectoral-scale. Consideration of sustainable development entails temporal consideration; stakeholders and their values may be non-static. As such, this gap spans both aims of this research (A1 and A2) and three objectives (O1, O2 and O3).

Second, the characteristics and identifiers of salient stakeholder status were developed in relation to 'the firm' and the perception of managers (Mitchell *et al.,* 1997) as to whether stakeholders possess power, legitimacy and urgency: the power of a stakeholder over the firm (or vice-versa), the urgency of a claim against the firm etc. Other scholars identify stakeholders' legitimacy using various definitions, often implicit, with little rationale. The boundary between legitimate and non-legitimate claims of stakeholder status is not clear-cut, evidenced by the quantity of publications related to those exact discussions. However, new thinking is required to explore stakeholder status within a concept, such as sustainable development, where the system boundaries

are blurred and open to a number of pluralistic and legitimate interpretations. Establishing who legitimate stakeholders are, or identifying the markers for such groups, is intrinsic to the first aim of this research (A1) and specific objectives (O1 and O2).

Third, the role of nature within stakeholder theory has remained a contentious, unresolved and on-going strand of debate within its development. Nature and the non-human environment are inherent within all modern interpretations of sustainable development (*long term environmental protection*). Areas of exploration needed include how the natural environment is perceived and valued by system stakeholders.

The proposed stakeholder-sustainable development framework is believed to be capable of providing insight into enacting sustainable development from a sectoral level. It provides understanding into epistemological interpretations of sustainable development, stakeholder-stakeholder relations within a concept, and the integration of stakeholder thinking into policy and scenario assessment and evaluation.

3.9 Chapter Summary

Identified in the previous chapter, Chapter Two – Sustainable Development, was the concept of the 'stakeholder' and its status as a core component within the development and attainment of sustainable development. Stakeholder theory did not develop within the sustainable development discourse, but in the field of strategic management. An exploration of stakeholder status has been the focus of this present chapter.

The roots of stakeholder theory are grounded in the corporate literature relating to the understanding of business-society relations. Though in the past thirty years stakeholder theory has become a mainstream discourse in investigating and conceptualising the modern corporation, two central elements were identified open to debate: who attains stakeholder status; and what does stakeholder thinking entail?

The identification of valid stakeholders, as in who *is* and who *is not*, is central to the application of stakeholder thinking. Freeman's original binomial (affect/affected by) is open to wide and narrow interpretations and assignations of stakeholder status. This research, discussed more fully in the following chapter, adopts an approach of a broad conceptualisation of stakeholder status, as not to preclude potential stakeholders, and shall be flexible and reflective in the identification of stakeholders as they emerge within the research process.

Though stakeholder thinking developed as a corporate-centric discourse, it has since been developed to explore business-society relations through two other perspectives: stakeholder-centric and concept-centric. It is this latter perspective that this research utilises to explore how stakeholder relations, perceptions and interpretations, relate to the phenomena (concept) under investigation, that of sustainable development in the UK aviation system.

Identified in the previous chapter, a central dimension to the concept of sustainable development was nature and the natural environment. The role and status of nature within stakeholder theory has been a developing and unresolved argument within the discourse, being linked to the prior thought on the assignation of stakeholder status. Similar to the identification of stakeholders, the role of nature is to be developed in the research process.

Subsequently, the links between stakeholder thinking and the concept of sustainable development are explicated. Sustainable development provides the normative basis for

the utilisation of stakeholder thinking. It is this normative aspect and the descriptive aspects of stakeholder theory that this study utilises in investigating the phenomena of sustainable development in UK aviation.

The following chapter builds from the theoretical development of a stakeholder-sustainable development framework. It outlines the philosophical stances of this piece of research and constructs an investigative methodology centred on the utilisation of a grounded theory method.

4. Research Design

4.1 Chapter overview

The proposed stakeholder-sustainable development theoretical framework presented over the previous two chapters has informed the data collection, data analysis and methodological structure of this research. The purpose of this chapter is twofold: firstly, it outlines the theoretical underpinnings of the research and how it has subsequently shaped the research process; secondly, the chapter presents the research process and the developed method of enquiry.

To start, the chapter outlines and explores the philosophical stances of the research and establishes the epistemological and ontological orientations of interpretivism and social constructionism respectively. The implications of these stances on the methodology of the research are discussed. A qualitative method of enquiry is identified as appropriate to explore the identified phenomenon of sustainable development, and answer the identified research questions, within the developed stakeholder and philosophical framework. Grounded theory is selected as an inductive approach to theory development and the most appropriate method of exploration of the nuances of sustainable development. In addition, the grounded theory method is argued to be aligned with the developed participative stakeholder framework.

Subsequently, the data collection phase is outlined. The developed stakeholder framework has highlighted the importance of a 'focal organisation' within its concept-centric application. As such, the research develops an 'airport typology' which is utilised as a means of directing the research enquiry and data collection phase. Semi-structured 'expert interviews' of stakeholders are outlined considering their limitations in exploring the concept of sustainable development.

Finally, the chapter tackles the analysis of the collected data. The process of interview and data coding is outlined, in light of the adopted grounded method research approach. The chapter is drawn together by a consideration of the limitations and impact of the research.

4.2 Ontological and epistemological considerations

The philosophical stances within social science research have oft been debated and it is not the intention of this research to present the full spectrum of researcher stances. Though deep reflection has been characterised by Patton (2002) as an unnecessary prerequisite for social research and even "can be a hindrance" (*ibid,* p.69), Schwandt (2000) positions philosophical reasoning as inescapable: "...acting and thinking, practice and theory, are linked in a continuous process of critical reflection and transformation" (p.191). It is possible to proceed in developing a research strategy without reflection by the researcher on their philosophical orientation, and the resultant implications on decisions made in the research process, "...working without an awareness of our underlying philosophical assumptions does not mean that we do not have such assumptions, only that we are conducting research that rests on unexamined and unrecognised assumptions" (Mertens, 2009; p.7). As such, the following section outlines the main ontological and epistemological considerations in designing this research with the aim of guiding the research towards the development of an effective and appropriate method of enquiry (Easterby-Smith *et al.,* 2002).

For clarification between the two terms, epistemological and ontological, definitions are presented. Epistemological issues concern assumptions made about the best way of inquiring into the natural world. Ontological stances are concerned with the assumptions made about the nature of reality. The result of the spectrum of philosophical stances is that "different observers may have different viewpoints and that 'what counts for the truth' can vary from place to place and from time to time" (Collins, 1983; p.88).

Within social research two epistemological stances pervade: positivism and interpretivism. Positivism is associated with the application of methods from the natural science to study social reality. As such, positivism is most closely associated with deductive hypothesis-lead research (Bryman, 2012). Positivists assume the existence of an independent reality which can be observed and made sense of. Therefore, theory should be scrutinised by value-free rigorous observation.

Interpretivism is the antithesis of positivism. Interpretivism separates the study of the social environment from that of the natural sciences. Von Wright (1971) depicts this as the difference between *explaining* human action and *understanding* human behaviour. This philosophical stance is highly influence by the works and reflections of Weber and his approach of *Verstehen: "*the interpretive understanding of social action in order to

arrive at the causal explanation of its course and effect" (Weber, 1947: p.88). As such, it is the role of the researcher to understand the causal explanations with reference to the social context. It is the role of the researcher to understand the acts of others within the context of the investigated phenomena, to interpret their actions, and "to see things from that person's point of view' (Bogdan and Taylor, 1975; p. 14).

As discussed in Chapter Two, within the sustainable development concept, not one singular definition or operational framework exists. Pearce (1993a) presented a spectrum of epistemological interpretations dependent upon the strands of development: from very weak to very strong. As such, an interpretivist philosophical stance would enable this legitimate spectrum of interpretations to be explored with preclusion by the researcher. Without a singular predefined definition of what sustainable development is *or* is not, it is impossible to develop testable hypotheses to investigate therefore negating the opportunity for a positivist method.

This research adopts the ontological philosophical position of social constructionism, accepting that the social actors shape the social phenomena under investigation (Bryman, 2012). Social constructionism is inextricably linked to the social constructivism which pervades in the psychological fields, often the terms are used interchangeably. This philosophical stance allows the research to explore the pluralism of stakeholder interpretations regarding sustainable development as: "social constructionist inquiry is principally concerned with explicating the process by which people come to describe, explain, or otherwise account for the world (including themselves) in which they live" (Gergen, 1985; p.266). Additionally, a social constructionist stance is supported by the earlier adoption of an interpretivist position.

Social constructionism originally posited by Berger and Luckmann (1966) is centred on the proposal that reality is socially constructed. Knowledge, and subsequently the perception of reality by actors in society, is entrenched by institutionalised reciprocal actions. As such, the phenomena under investigation are subject to changes in social interactions and subsequently in a constant state of revision: "the researcher always presents a specific version of social reality, rather than one that can be regarded as definitive" (Bryman, 2012; p.33). Thus, specific consideration within this research is given to the positioning of stakeholders within the aviation system, a matter further explored later in Section 4.6

Hess (1997) identifies two distinct interpretations of social constructionism: radical and moderate. Moderate constructionism states that "scientific theories are realistic maps

or explanations of a real world and at the same time vehicles that encode culture-bound linguistic categories and culture values...and/or are shaped by social interests and other social variables" (*ibid,* p.35). On the other hand, radical constructionism states: "scientists do not discover but impose a structure on it or in some sense 'make' the world" (*ibid,* p.35). Radical and moderate constructionism are therefore compatible with different epistemological stances: realism and antirealism respectively (e.g. interpretivism) (Bryman, 2012; Kwan and Tsang, 2001). Moderate social constructionism allows the existence of 'sustainable development' whilst accepting multiple interpretations of the concept influenced and shaped by the" social variables" of actors.

4.3 Qualitative research

The two identified research questions of this thesis: '*How can a stakeholder management framework be utilised as a means of understanding the sustainable development of aviation in the UK*?' and *'How can a stakeholder approach inform the assessment of sustainable development?',* and the philosophical stances of the researcher, support a qualitative strategy of enquiry. A qualitative research strategy is strongly aligned with inductive theory development. This research does not seek to 'test' hypotheses related to sustainable development, but instead immerses itself in *rich* data garnered from a variety of social actors and institutions within the UK aviation system, to understand and generate *new* theory related to the phenomena under investigation.

The following section outlines the main feature of a qualitative research strategy. How the research strategy relates to the philosophical stance of the researcher, and the implications for this research in designing a research process. And, how the defined research process is appropriate for achieving the stated aims and objectives, and in attempting to answer the identified research questions.

Qualitative research, despite its popularisation since the 1970s, lacks a distinct, defined and agreed research strategy, stemming in part from its emergence and development by different research traditions and philosophical stances (Bryman and Burgess, 1999). Rather than being one distinct research strategy it can take a number of forms (Silverman, 1993). Primarily qualitative research has three key features: inductive in the generation of theory from data, epistemologically interpretivist, and ontologically constructivist implying the need to examine participant views (Bryman, 2012; Gephart, 2004). Qualitative research is often defined in terms of what a quantitative research

strategy is not. However, the two research strategies have distinct properties and aligned with different philosophical stances (see

Table 9).

Table 9 Qualitative and quantitative research strategies (Bryman, 2012)

	Quantitative	**Qualitative**
Principle orientation to the role of theory in relation to research	Deductive; testing of theory	Inductive; generation of theory
Epistemological orientation	Natural science model, in particular positivism	Interpretivism
Ontological orientation	Objectivism	Constructionism

Qualitative research is seen to be aligned with interpretivism, the epistemological orientation of this research, and additionally to the ontological orientation of social constructionism. Thus, it is accepted that "reality is subjective and multiple as seen by the participants in the study" (Hussey and Hussey, 1997; p.48).

Several scholars claim that when studying the social world, unlike the natural sciences and the positivist stances, human beings are able to apply meaning to their environment (Bryman, 2012). Thus, for social researchers to understand the field of study, or to be able generate theory, qualitative research contains two central aspects "(1)...face-to-face interaction is the fullest condition of participating in the mind of another human being, and (2)...you must participate in the mind of another human being (in sociological terms, "take the role of the other") to acquire social knowledge" (Lofland and Lofland, 1995; p.16). As such, qualitative research utilises social actors, their interpretations and understandings, to study the phenomenon in their environment (Denzin and Lincoln, 1994). The differences in quantitative and qualitative research strategies go beyond 'numbers versus words' (Bryman, 2012), but affect all aspects of the research process (see Table 10).

Table 10 Research traditions. Reproduced from Gephart (2004; p.456) and expanded by Pizam and Mansfield (2009).

Tradition	Positivism and post-positivism	Interpretive Research
Assumptions about reality	Realism: objective reality that can be understood by mirror science: definitive/probabilistic	Relativism: local inter-subjective realities composed from subjective and objective meanings: represented with the concept of actors
Goal	Discover truth	Discover meanings and understanding
Tasks	Undertake explanation and control of variables: discern verified hypotheses or non-falsified hypotheses	Produce descriptions of members' meanings and definitions of situation: understand reality construction
Unit of analysis	Variable	Verbal or nonverbal action
Methods of focus	Uncover facts, compare these to hypotheses or propositions	Recover and understand situated meanings, systematic divergences in meaning
Subject/researcher relationship	Rigid separation	Interactive, cooperative and participative
Desired information	Quantity of people that think or do a specific thing, or a specific problem	What people think and do, their motivations and reasoning

A qualitative research strategy has been closely associated with a participative stakeholder methodology (Burgoyne, 1994). Qualitative research allows the researcher to more fully understand the context of the phenomena. This research is not seeking to subject theory to hypothesis validation, but seeks to develop an understanding of the nature of balance in sustainable development policy. The developed stakeholder framework seeks to guide the researcher and explore the concept of sustainable development in UK aviation in order to subsequently enable an understanding of the phenomena.

The researcher in the case of this study is external to the system where the phenomenon of sustainable development is to be investigated. As such, the research strategy needs to immerse the researcher within the field of study, creating the

necessitated 'face-to-face' contact to allow the worldview of participants to be approached and fully understood (Lofland and Lofland, 1995).

The following sections seek to outline the development of a methodical research process in order to tackle the identified research questions. But, the inductive nature of the research, later explained through the application of a grounded theory method of data generation and theory development, and the phenomena in question, means that the researcher must be flexible to respond to emerging themes and avenues of development. As such, the outlined methodology is "characteristically exploratory, fluid, flexible, data driven and context-sensitive" (Mason, 2002; p.24).

4.4 Grounded theory

As previously stated, this research is concerned with the inductive development of new theory regarding the enactment, and pursuance, of sustainable development in aviation. As previously highlighted in Chapter Two, sustainable development is not one fixed concept, or grand theory, but a balance of competing needs and ideals that are influenced by the context in which it is studied and applied (Holden *et al.,* 2013; Mebratu, 1998). As such, theory related to sustainable development needs to be anchored, or *grounded*, in the context in which it is to apply. The following section identifies the method utilised by this research in developing new theory from the context under study.

Grounded theory differs from the traditional linear-model of the hypothesis led research process. Instead, theories are not applied to the phenomena under investigation, but the theories are discovered and formulated from the study of the empirical data (Flick, 2006). Such that, rather than the linear model of research having discrete and independent stages, grounded theory advocates the mutual interdependence between the stages of the research process as advocated in the seminal work on grounded theory by Glaser and Strauss (1967).

Grounded theory is proposed as an interpretive process for conducting social research in order to understand "the actual production of meanings and concepts used by such social actors in real settings" (Gephart, 2004; p.457). Glaser and Strauss (1967) rejected positivist stances and proposed an organic interpretive process of theory emergence based on "how well data fit conceptual categories identified by an observer, by how well the categories explain or predict ongoing interpretations, and by how relevant the categories are to the core issues being observed" (Suddaby, 2006; p.634).

The purpose of grounded theory being that the researcher can develop new theories from the data, that reflects the realities of actors in the particular social setting under investigation.

Though grounded theory is synonymous with inductive research (Bryman, 2012), advocated by the adoption of the social constructionist philosophical stance of this researcher, often the application of grounded theory is inconsistent with the procedural developments central to the theory (Locke, 1996). Suddaby (2006) criticises the application of grounded theory by many social researchers as "often used as rhetorical sleight of hand by authors who are unfamiliar with qualitative research and who wish to avoid close description or illumination of their methods" (p.633). A view supported by Gephart (2004) "...references to grounded theory are more common than detailed application of grounded theory techniques" (p.456). With this is mind, the following section outlines the key processes within an application of grounded theory, and how they relate to the research process and the generation of theory from data.

The grounded theory procedure can be summarised as: theoretical sampling and data collection, coding of data and two linked phases of constant comparison and theoretical saturation. Though these steps are presented and discussed as discrete stages here, in practice they are linked (see Figure 14).

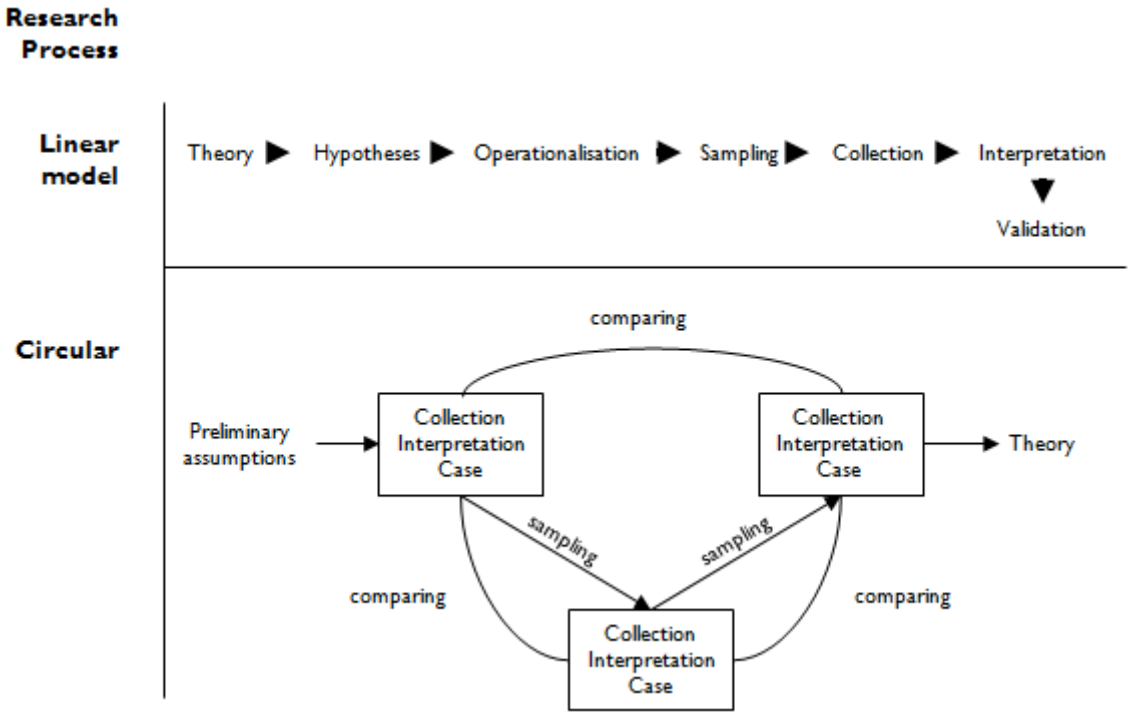


Figure 14 Overview of research process (reproduced: Flick, 2006)

Theoretical sampling

Theoretical sampling is 'the process of data collection for generating theory whereby the analyst jointly collects, codes, and analyses [their] data and decides what data to collect next and where to find them, in order to develop [their] theory as it emerges' (Glaser and Strauss, 1967; p.45). Charmaz (2000, 2002) defines this as the key principle of grounded theory, as the sampling and data collection is concerned with reaching the point of theoretical saturation of identified concepts and themes emergent within the coding and data analysis. Further sampling decisions are aimed at those individuals that promise greatest or new insights into emerging themes (Flick, 2006). The primary questions for selecting further participants become: "What groups or subgroups does one turn to next in data collection? And for what theoretical purpose? The possibilities of multiple comparisons are infinite, and so groups must be chosen according to theoretical criteria" (Glaser and Strauss, 1967; p.47).

4.4.1 Data collection

This stage is the process of obtaining the qualitative data to explore the phenomena under investigation. The data collection process for this project is discussed in subsequent sections below.

4.4.2 Coding

This is the process of analysing collected data. Coding is identified as the central process of grounded theory (Bryman, 2012; Charmaz, 2002; Strauss and Corbin, 1990). The purpose of coding is to conceptualise the raw data into categories: "codes are tags or labels for assigning units of meaning to the descriptive or inferential information compiled during a study. Codes are usually attached to 'chunks' of varying size – words, phrases, sentences or whole paragraphs" (Miles and Huberman, 1994; p.56). Though Strauss and Corbin (1990) identified three 'types' of coding practice (open coding, axial coding and selective coding), they should not be perceived as three distinct approaches to coding, but rather different levels and staging within the coding process (Bryman, 2012). Open coding identifies initial concepts and the categorising of data (Strauss and Corbin, 1990). Axial coding is "a set of procedures whereby data are put back together in new ways after open coding, by making connections between categories" (*ibid*, p.96).

In the initial open coding phase the intention is to apply valid and unique codes to the data, the intention is to apply and develop and exhaustive list of codes that captures all relevant data (Miles and Huberman, 1994).

4.4.3 Constant comparison and theoretical saturation

Constant comparison is linked to the subsequent step of theoretical saturation as the two are inexplicably linked and central to the grounded theory proposed by Glaser and Strauss (1967). Theoretical saturation is in itself not just linked to the stage of constant comparison to the previous steps as well: the coding of data (when there is no further point in reviewing your data), and data collection (a concept or category has been developed to a point where new data adds nothing of additional value).

A misassumption and misrepresentation of grounded theory research is the utilisation of the extant literature when approaching the phenomena under investigation, with some researchers entering the field of research with an absence of theory in understanding the phenomena in question (Suddaby, 2006). An extreme example of this would be the researcher entering the field of study with a blank mind (without knowledge) and without an agenda (without defined research questions). Obviously this is problematic, potentially producing random data and a "mass of descriptive material waiting for a theory, or a fire" (Coase, 1988; p. 230). As presented over the previous three chapters, this research has identified the phenomena of investigation that of sustainable development in aviation, explored the issues in the extant sustainable development literature, and subsequently identified stakeholder thinking as a means of exploring the research phenomena. The utilisation of grounded theory is thus to develop and design the research process which is addressed over the remaining sections of this chapter.

4.5 Research process: stage one

Research process links the ontological and epistemological stances of the researcher, outlined in the previous section, with the previously developed research questions. The philosophical positioning will influence how data is collected, analysed, and ultimately characterised and interpreted.

The proposed concept-centric stakeholder theoretical framework presented over the previous two chapters has informed the data collection, data analysis and methodological structure of exploring the phenomena of sustainable development in aviation.

The concept-centric application of stakeholder thinking as proposed by Steurer (2006) was outlined in the previous chapter. Steurer's model, developed from the foundations of Donaldson and Preston's (1995) oft cited triple-taxonomy of stakeholder thinking, can be utilised to explore a concept, and the interactions of stakeholders within this concept, from a normative, instrumental and descriptive basis. This research project utilises and develops the model to explore the concept of sustainable development, with particular application of the normative and descriptive aspects.

Though this research has adopted the epistemological and ontological stances of interpretivism and social constructionism respectively, it recognises that other researchers may have adopted and identified alternative stances to explore the identified phenomena. As Abbot (2004) argues: "the idea of heuristics is to open up new topics, to find new things. To do that, sometimes we need to invoke constructivism... sometimes we need a little realism" (p.191)

4.6 Developing an airport typology

As outlined in Chapter 2, sustainable development is context specific. Though this research is approaching the concept of sustainable development from a national UK perspective, the airport level or scale is seen as an important confluence of stakeholder interests, and the impacts of aviation activity are perceived to be concentrated here. Within the concept-centric application of stakeholder thinking the features of the focal organisation (Steurer *et al.,* 2005) is important, in this case the airport. As highlighted in the introductory chapter of this research, the UK possesses airports of various different scales, types of operation, ownership, geography and regulatory regime. Accordingly, this research proposes that airports should not be considered a homogenous group of institutions.

Jawahar (2001) posited a descriptive stakeholder theory where the stage of a company in its organisational lifecycle would influence the saliency of stakeholder claims, threats and opportunities, and therefore the nature of business-stakeholder relations. This development is very much positioned within the corporate-centric strand of the stakeholder paradigm.

The life cycle of the organisation is split into four identifiable stages: start-up, emerging growth, mature and decline/transition (Jawahar, 2001). These life cycle stages draw from the extensive literature of organisational lifecycle models (Miller and Friesen,

1984; Drazin and Kazajia, 1990). A firm's position in the lifecycle can be determined by a range characteristics and criteria: age, turnover, growth etc.

In approaching the research phenomena, the research process will seek to understand sustainable development in a broad range of contexts. Extrapolating Jawahar's (2001) findings to a concept-centric application of stakeholder thinking, the research first seeks to explore the issue of airport 'types' through an analysis of published data on airport operations.

4.6.1 Study airports

There are 48 airports and aerodromes on the mainland UK and Scottish Isles (see **Error! Reference source not found.**) that report activity to the DfT and their activity (ATMs, Pax etc.) is published in its statistics (DfT, 2013). Within this set of 48 there are airports of various scales, operations, ownership structures and regulatory regimes (see **Error! Reference source not found.**).

The primary physical variable between airports is their scale, measured either by ATMs or Pax, with airports such as Heathrow processing in excess of 60 million terminal passengers per annum to Blackpool Airport, approximately 200,000. In addition, the last decade has seen a dramatic change in the way in which people consume flight services, with the rise of low cost carriers (LCCs) and the demise of national flag carriers and legacy airlines (e.g. Pan Am, British Airways, Aer Lingus). This change in consumption saw dramatic growth in regional airports; utilising the same two examples of Heathrow and Blackpool Airport they experienced pax growth over the last decade (2002-2012) of 7.6% and 234.1% respectively. Incidentally, before the Great Recession of 2008, between 2002 and 2007, the recent peak of UK air activity, Blackpool Airport experienced growth of 692%. However, not all regional airports experienced such dramatic growth, with Manchester Airport experiencing growth more akin to that of Heathrow than Blackpool (see far right column Figure 15).

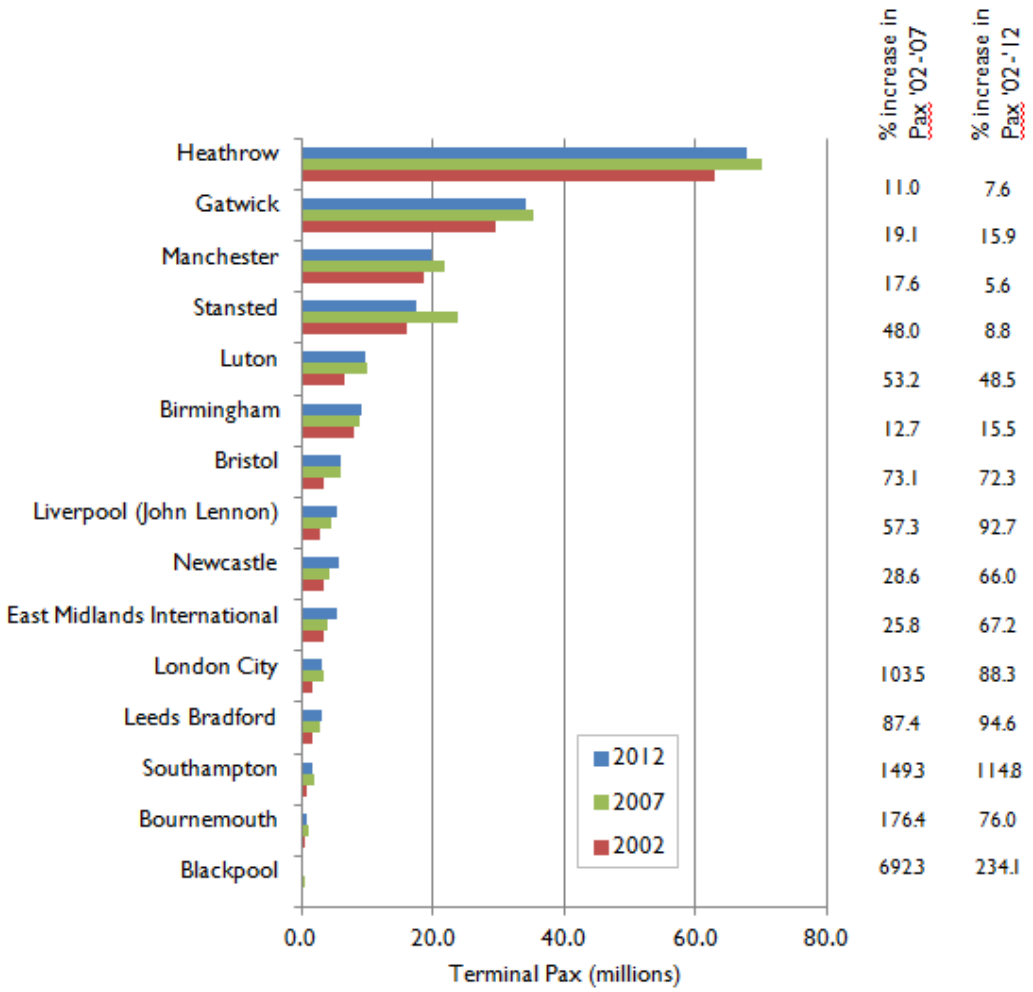


Figure 15 Annual terminal passenger numbers for *selected* UK airports and percentage increase in terminal passengers for 2002-2007 and 2002-2012 (Data source: DfT, 2013a)

Geography is additionally important with regards to UK aviation. **Error! Reference source not found.** depicted the even spread of airports and aerodromes across the UK. However, when taking into consideration aviation activity (see **Error! Reference source not found.**) this is concentrated heavily in the South East of England, primarily at three London airports: Heathrow, Gatwick and Stansted (in order of scale of activity, see **Error! Reference source not found.**).

Additionally, these three London airports are subject to a different regulatory regime than other airports in the UK. Under the Civil Aviation Act 2012, the CAA possesses the responsibility for regulating the activity of these three airports with the aim to promote competition, maintain their operation in the interests of passengers and control the dominant position of these airports, particularly Heathrow, in a capacity constrained environment (CAA, 2013). Furthermore, these three airports have been at the centre of an on-going debate regarding the future expansion of airport infrastructure capacity, as investigated by the Airports Commission (2012), with

Gatwick and Heathrow Airport's proposals both shortlisted for appraisal by the Commission (2013b).

With the above issues in mind, this research project splits airports into three groups: London regulated, large regional airports and small regional airports.

4.6.2 Airports by airport typology

The utility of this development, from Freeman's original stakeholder theory, is most suited to understanding stakeholder-firm relationships, from either a corporate-centric or stakeholder-centric application (Steurer, 2005). However, as outlined in Chapter 3, this research project utilises and applies stakeholder thinking from the concept perspective in understanding stakeholders within the sustainable development of aviation. As such, the purpose of the development of the airport typologies is to provide guidance to the investigative process. With existing stakeholder theory in mind, the interview process shall seek to explore emergent themes within these identified typologies. The developed interview process is discussed further in the following section.

Utilising the defined airport typologies (see Section 4.2 UK airports are thus categorised as follows (see Table 11).

Table 11 UK airports by airport typology.

London Regulated Airport (LRegA)	Large Regional Airport (LRA)	Small Regional Airport (SRA)
Gatwick	Birmingham	Blackpool
Heathrow	Luton	Bournemouth
Stansted	Manchester	Bristol
	Glasgow	East Midlands International
	Edinburgh	Leeds Bradford
	Aberdeen	Liverpool (John Lennon)
		London City
		Newcastle
		Southampton
		Belfast International
		Cardiff Wales
		Humberside
		Prestwick

Note: for presentation purposes not all small regional airports are shown. There are a significant number of airports and airfields with <10,000 ATMs per annum. A full list of airports is show in the DfT: Aviation Statistics (2013a).

4.7 Interviews

Interviews are deemed to be the most important and best method of data collection in a social setting (Easterby-Smith *et al.,* 2002; Yin, 2003). Stakeholder interviews, utilised within a grounded theory based methodology, allow the stakeholders to have an active participation in the research process. Stakeholder interviews allow the broad based inclusion of a range of stakeholder actors from the institutional-level to the individual. Though significant documentary evidence and data exists this tends to be from larger

institutional actors. Interviews allow the inclusion of the individual participants or stakeholder groups that have not widely published their views on sustainable development. In addition the interview method of enquiry allows the researcher to "probe deeply to uncover new clues, open up new dimensions of a problem and to secure vivid, accurate inclusive accounts that are based on personal experience" (Burgess, 1982; p. 107).

Interviews, as opposed to questionnaires, give the opportunity for the researcher to ask follow-up questions and probe the responses of participants. The advantages of interviews are numerous and well documented within the social research literature:

- They are well suited to explore attitudes, values and motives within or related to a specific context or concept (Smith. 1975).
- They have been demonstrated to deliver higher response rates than a similar questionnaire or survey (Bailey, 1987).

The qualitative interview technique is deemed well suited to grounded theory inductive research (Bryman, 2012; Flick, 2006; Suddaby, 2006; Easterby-Smith *et al.,* 2002), as the researcher can respond to emergent themes discovered during analysis (Burgess, 1982). Additionally, interviews give the researcher more direct control over the data collection and how the data is formed throughout the collection process e.g. the interviewer is more able to respond and adapt to the changing and emerging situation, essential to grounded theory analysis (Charmaz, 2002).

Due to the social constructionist philosophical stances of this research, interviews allow the researcher to understand and investigate the context in which a response is given, and this "...interaction is the fullest condition of participating in the mind of another human being" (Lofland and Lofland, 1995; p.16).

Semi-structured interviews give guidance to the interview process, but the interviewer retains leeway and flexibility to follow-up on emergent themes, an important component of a grounded theory based method.

Where possible all interviews were recorded. The purpose of audio recording was twofold: to enable accurate transcription of the interview data, which could then later be utilised in analysis, and secondly, to allow the interviewer to fully participate in the two-way interview process. Despite an attempt, and intention, to audio record all interviews additional note taking was conducted. The reason being three-fold (Bryman, 2012):

1. As an aid to the interviewer to ensure all questions are answered
2. To mitigate the impact of a malfunction in the recording equipment
3. To capture the instantaneous and context specific thoughts of the researcher at the time

The transcription of the interview audio recordings results in a highly accurate recording of the qualitative data which can thus be analysed: "transcription has the advantage of keeping intact the interviewee's (and interviewer's) words, it does so by piling up the amount of text to be analysed" (Bryman, 2012; p.484). As such, as soon as practicably possible following an interview, it was transcribed. The purpose of immediate transcription after the interview is in order to keep a manageable workload during the project (Lofland and Lofland, 1995), but also as advocated by the grounded theory method.

The interview questions, interview guide, participant information pack and recruitment process received ethical approval from the Sheffield University Management School Ethics Committee. Participation in the study by stakeholders was entirely voluntary. Participation, interview data and responses were to be kept anonymous. The maintenance of anonymity allowed the full participation of stakeholders and also allowed participants to answer the questions freely without fear of recrimination or reprisals. Data collected (interview recordings and transcripts) were to be kept confidential, and only available to the immediate research team. At the beginning of each interview, participants were requested to read and sign a *Participant Consent Form* which outlined the principle issues of data protection. Where the interviews were conducted over the telephone the researcher read the form to the participant. At the beginning of all interviews, participants were given the opportunity to ask any questions about the research or the interview process.

As previously discussed, the audio of the interviews was electronically recorded in order to capture the raw data for later analysis. However, in three instances this was not possible (highlighted in Table 12, denoted by *). The reasoning for no recording in these three cases were different. The first and second occurred due to a recording equipment failure and in the final instance the participant would not consent to the interview being recorded. In these instances it was immediately known that the recording of the audio had either failed or not been possible as such the researcher was able to immediately reflect on the interview and create notes. Despite note taking

not being able to fully replicate the advantages of complete audio recording, it can provide a satisfactory evidence base of the interview (King, 1994)

4.7.1 Interviewee selection

Participation in the interview process by aviation stakeholders was entirely voluntary. Therefore, to achieve maximum participation from a broad base of potential stakeholders, it was recognised that a degree of preparatory groundwork was needed. This foundational work shaped the interviewee recruitment process throughout the project.

As previously discussed, three airport 'types' had been defined with a range of physical characteristics and attributes. It was defined from the concept-centric application of stakeholder thinking the existence of a focal organisation within the phenomena under study. From the extant transport literature it was evident that the airport is the focal organisation where most stakeholder interests converge. As such, stakeholder recruitment was initially focussed at this level.

As previously outlined in Section 3.6 every UK airport is required to operate an airport consultative committee (ACC) for local stakeholders. The stakeholder make-up of each of the ACCs is different and influenced by a number of factors: the constitution of the group, geographical and historic qualities, the nature of operations conducted at the airport, ownership etc. However, ACCs bring together a range of stakeholders that are generally regarded as 'legitimate'.

The ACC operates independently of the airport operating company. Each ACC has varying rules on public-access and attendance at quarterly meetings ranging from free unfettered access, others require pre-registration and permission from the ACC chair, and others do not allow public attendance at specific meetings e.g. annual general meetings, or specialised sub-committee meetings. In all cases before initially distributing invitations to potential participants at least one ACC meeting was attended. The purpose of attendance was two-fold: firstly, to gain a degree of visibility and legitimacy as a researcher, and secondly to gain contextual understanding of local issues and background knowledge that may frame interview responses and provide illustration and detail.

The research aimed to attain participation and conduct stakeholder interviews at least one airport from each of the three defined airport types. In effect the airports outlined in Table 10 represent the population from which the sample of interviews is drawn

from. Invitations were sent to both ACCs and airport management for each airport within these three categories. Subsequently, participation and interviews were pursued and undertaken where agreement was attained. Due to high-levels of response from SRAs, interviews were conducted at two airports, this also allows the research to understand the homogeneity of airports and stakeholder views within the developed airport typologies.

Subsequently, and as part of the interview process, interviewees were asked to identify other stakeholders. This process of stakeholder identification was repeated until it was considered that the complete stakeholder network had been established. A full network of stakeholders occurred when no new stakeholders were being identified and the research had achieved theoretical saturation, no new emergent themes developed or there was repetition of identified stakeholders. A significant proportion of interviews occurred as a result of identification by previous participants. The research was unable to interview every stakeholder that had been identified, though every effort was made by the researcher to encourage participation by identified stakeholder groups. Non-participation by system stakeholders is discussed more fully in the following chapter.

Though interview participation was voluntary, the project sought to achieve participation from a broad range of stakeholder groups, and where possible participation from multiple individuals within the same stakeholder group to investigate stakeholder group homogeneity. As such, follow up invitations were distributed to stakeholder representatives where it was felt representation was not deemed sufficient, or from analysis of previous interviews a strand of enquiry had emerged that was deemed as being of interest.

In total, 29 stakeholder interviews were conducted. Participation in the research project is summarised below (see Table 12). The interviews typically lasted between 45 minutes and one hour and were digitally recorded (unless otherwise specified). The interviews were conducted over an 18-month period, the date of the interviews (month/year) are given in Table 12. Approximately three quarters of the interviews were conducted via telephone.

Where interviews were conducted with aviation organisations or institutions (e.g. airport operators, industry groups etc.) participation was encouraged from a representative in a 'thought leader' position with intimate knowledge of the activities and development of the organisation, and the concept of sustainable development.

Since this project covers a range of organisations of various scales and access to resources, it was recognised that not every organisation would have a sustainable development or environment unit; participation included environmental managers but also policy and regulatory advisors, community affairs and public affairs experts.

Table 12 Summary of stakeholder participants in project and date of interview

Small Regional Airport 1	Small Regional Airport 2	Large Regional Airport
Local community representative 1 (*Mar-13*)	Local community representative 1* (*May-13*)	Local community representative 1 (*Sep-13*)
Local community representative 2 (*May-13*)	Local community representative 2 (*May-13*)	Local community representative 2 (*Sep-13*)
Local community representative 3 (*Oct-13*)	Airport management representative (*May-13*)	Local community representative 3 (*Oct-13*)
Local business group+ (*May-13*)	Aviation advocacy group (*Aug-13*)	Local community representative 4 (*Nov-13*)
ACC chair (*Mar-13*)	Local business group (*Jun-13*)	Airport management representative (*Sep-13*)
Local community representative 4 (*Apr-13*)	ACC secretary (*Jul-13*)	
London Regulated Airport	**National Representatives**	
Local community representative 1 (*Mar-14*)	Non-governmental organisation 1 (*Oct-13*)	
Local community representative 2* (*May-14*)	Non-governmental organisation 2 (*Feb-14*)	
Airport management representative (*Apr-14*)	Industry trade body (*Aug-13*)	
Local business group (*Apr-14*)	Manufacturing trade body (*Sep-13)*	
Local pressure group (*Apr-14*)	Original equipment manufacturer (*Mar-14*)	
Airline representative (*Mar-14*)	Tier one OEM supplier (*Mar-14*)	
	Aviation regulator (*Nov-13*)	

+ denotes interviews where the audio was not electronically recorded

4.7.2 Interview guide

The interview guide, as used in the research process, is presented in full in Appendix A. The questions have been designed in light of the literature review, the stakeholder analysis required, the identified gaps in the extant literature and the stated aims and objectives of this research project. The interview guide is not just a means of directing avenues of discussion and research but as a "directive function with regard to excluding unproductive topics" (Flick, 2006; p. 165).

Considering the grounded theory based methodology of this research project, the interview guide provides a framework for the interview, but the interviewer is able to ask follow-up questions and questions of interest in consideration of emergent themes that have been developed from prior interviews.

The interview guide is split into three distinct, if not discrete, sections: role of stakeholder, impacts of aviation and other stakeholders, and sustainable development and aviation. The questions outlined in the presented interview guide and the overarching 'themed' sections, were prepared based upon the extant literature and the literature review presented over the previous two chapters.

The questions were formulated with the research questions, aims and objectives in mind. They were intentionally 'open-ended', with the interviewee free to 'go off at a tangent' this could give an insight into what the interviewee deems to be important or of relevance from their perspective (Bryman, 2012). Questions were grouped within identified themes to ensure a logical flow to the interview, with the language used deemed suitable to stakeholders within the aviation system.

Section A – Role of stakeholder

These two questions (and four sub-questions) give an insight into whom the participant in the study is, how they relate to the aviation system and their motivations (primary interest). Lofland and Lofland (1995) describe this as participating in the mind of another and to understand the sociological context of data generated in further questioning.

Section B – Impacts of aviation and other stakeholders

This section of questioning gives an insight into the perceived 'world view' of the participants: how do they see the network of stakeholders within the system,

understanding of the impacts of aviation and their distributions and the purpose of development within UK aviation.

These questions serve a second function linked to the grounded theory method of knowledge development. The questions relating to the stakeholder network offer a participatory role for interviewees to shape the direction of future interview participants.

Section C – Sustainable development and aviation

Intentionally, references to sustainable development were left to the end of the interview process. This section explores the epistemological interpretations of sustainable development. Firstly, from the abstract (what does sustainable development mean in general), and secondly, practically to the development of UK aviation.

At the beginning of each interview an overview of the study was presented and a factsheet completed compiling information about the participant (the top of Page 1 of the Interview Guide). Additionally, interviewees were invited to ask any questions prior to the commencement of the interview. At the end of the interview an opportunity was given to the interviewee to reflect on their previous answers, in light of subsequent questions, responses, thoughts and discussions. The interviewee was also invited to stay in contact with the researcher in the future to maintain an open dialogue and provide additional insight if required.

4.8 Limitations

The following section outlines the limitations identified in the developed research process. Where limitations have been identified mitigation strategies are proposed in light of the extant literature.

The success of interviews, especially semi-structured ones, can be dependent on the competency of the interviewer in responding to the specific circumstances and challenges of each individual interview on an ad-hoc basis (Flick, 2006). In addition, despite preparation, such as the construction of an interview guide, the depth and range of answers to enquiries is variable, cannot be realised in advance, and out of the control of the interviewer (Merton and Kendall, 1946).

The research methodology developed proposes a mixture of one-on-one 'face-to-face' and telephone interviews. The reasoning and benefits for such a mix are outlined previously. However, telephone interviewing has been characterised in the social research literature to limit data collection and be inferior in comparison to face-to-face interviewing techniques. Limitations include:

- Telephone interviewing cannot engage in visual observation of the respondent
- Visual aids cannot be utilised by the interviewer (Bryman, 2012)
- Telephone interview response rates tend to be lower than face-to-face interviewing techniques (Frey, 2004)

Visual cues and observations of the interviews are not being considered by this research, or recorded during face-to-face interviews. As such, the first limitation identified is not perceived to be an issue.

Visual aids are not utilised in the interview process. The ranking question (question 8) could be identified as an issue if the interviewee did not have the interview guide or questions at hand at the time of the interview. This is not deemed to be an issue as the researcher can repeat the list several times if needed and if requested by the participant.

The semi-structured interviews undertaken in this research project can be considered as expert interviews, in that the participants have specialised 'expert' knowledge, specific insight into an organisation, have managerial or a strategic role within in an organisation, or represent a specific group of individuals. Expert interviews can fail for a range of issues (Flick, 2006):

- The interviewee may not be an expert as previously assumed
- The participant can change between the role of expert and private individual giving a mixed insight
- A rhetoric interview: the expert may give a lecture on his or her knowledge rather than staying within the confines of the topic of the interview

The primary means of tackling the above issues is through the skill of the interviewer maintaining the focus of the interview and the interview guide to frame its direction.

By maintaining an open dialogue and regular contact with participants prior to the interview, issues potentially limiting participation (e.g. more pressing time

commitments, cancellations) could be addressed and mitigated. If needed the interviewer was fully flexible in the timing of when an interview could be undertaken.

4.9 Interview analysis: the process

The procedures for interview analysis followed the grounded theory approach of Glaser and Strauss (1967), outlined earlier in this chapter. Thus, analysis is undertaken concurrently with the on-going interview process, in that the analysis of an interview shall be used to identify further research interviews, which stakeholders to approach, and identify avenues of investigation and theoretical concepts to pursue in the following interviews. As a result, a channel of communication was maintained with all participant interviewees to enable the investigation of emerging themes around the phenomenon under investigation.

This concurrent analysis and on-going data collection, necessitated by the grounded theory approach, is most evident as the main driver for participant identification, and subsequent interviews. In addition, concurrent analysis allows emergent themes and avenues of discussion to be identified and pursued in later interviews, thus supporting the semi-structured interviewing technique (Glaser and Strauss, 1964; Lofland and Lofland, 1995; Bryman, 2012).

The interview analysis, in part, followed the three stage process of stakeholder thinking: stakeholder identification, determination of stakeholder interests and the evaluation of the type, and level, of stakeholder power. This three step process is in turn addressed below (see Table 13):

Table 13 A summary of analysis steps of participant interviews in relation to the three-step process of stakeholder analysis

Stakeholder thinking process step	Analysis
Stakeholder identification	• Utilised to identify perceived stakeholders in the overall aviation system • The roles of identified stakeholders were additionally identified
Determination of stakeholder interests	• Determine the homogeneity of stakeholder groups with regard of relevant interests, in order to determine the validity of generic-role based stakeholder groups; Wolfe and Putler (2002) identify this is a failing in both previous empirical and theoretical studies applying stakeholder analysis
Evaluation of the type and level of stakeholder power	• To determine the nature of stakeholder identity, as outlined by the Mitchell's et al (1997) model of stakeholder typology, in relation to sustainable development in aviation

4.10 Chapter Summary

This chapter introduced and outlined the methodological process to be followed in conducting this research. The epistemological and ontological positions adopted by this research of interpretivism and social constructionism respectively were identified. Sustainable development involves concepts of ethics and values which are determined by both societies at large, and in the case of this research the stakeholders within the aviation system. The views and perspectives of these system stakeholders are integral to the phenomena under investigation: their perceptions of impacts, distributions of identified impacts and ultimately their epistemological interpretations of sustainable development.

A grounded theory approach has been developed to investigate interpretations and the role of sustainable development in the future development of the UK aviation system. Semi-structured stakeholder interviews were developed as a means of following this grounded theory approach. The interview process allows the interviewer to explore emerging concepts as they arise both within the interview and in shaping future interviews, both their participation but also the content and lines of enquiry. As entailed within the grounded theory methodology concurrent data collection (conducting of stakeholder interviews) and data analysis were undertaken. The ultimate aim of the interviews is to reach theoretical saturation in identifying emerging themes and lines of enquiry but also of the identified themes.

From the stakeholder theory literature, presented in the previous chapter, and due to the social constructionist ontological stance adopted, 'three types' of airports were identified in the UK aviation sector: small regional airports, large regional airports and London regulated airports. The primary differentiating characteristic of these airports are their size, relative recent historic growth and the nature of their operations. The study aimed to undertake representative participant interviews from each of the three types of airport.

Participation in the interview process was to be guided not only by the developed airport typologies, but also future interviews were targeted at stakeholders identified from previous interviews.

The following chapter, Chapter Five, presents in detail the findings of the data collection interviews and the development of substantive grounded theory.

5. Research Process: Stage 1 - Interview Analysis

5.1 Chapter overview

The aim of Chapter Five is to present the findings and the analysis of the stakeholder interviews as outlined in the previous chapter. Subsequently, the chapter is split into three parts.

The first part, Section 5.2 outlines the development of the stakeholder interviews and participation. As outlined in the previous chapter participant responses were to be kept anonymous. This section develops the participant identifying code to aid in the presentation of research findings. Additional insight in to stakeholder participation is presented later in the chapter (Section 5.5).

The second part, Sections 5.3 through 5.4, outlines the analysis of the stakeholder interviews utilising the outlined grounded theory method. Initially, the open coding process is presented, which in turn was utilised to develop the focused coding. It is from the focussed coding, and subsequent analysis and reflection, that the four grounded theory categories of sustainable development can be developed: Balance and 'trade off', context and process, power and influence, and responsibility. The development of the four categories is presented with additional detail, rationale and evidence.

The final part of this chapter (Sections 5.5 through 5.7) draws together and summarises the stakeholder analysis aspects of the research. Further reflection of the epistemological stances of participants in relation to sustainable development is presented on the 'sustainability spectrum'. Analysis of stakeholder interests are summarised and commonality and potential conflict between stakeholder groups is developed.

The following chapter, Chapter Six - Research Process: Part 2, presents the assessment of the identified impact of noise, within the outlined stakeholder framework and in light of the emergent theory established from the interview process. Following this, Chapter 7 (Discussion) draws together this present chapter and the results of Chapter 6 and discusses the findings in light of the extant and relevant academic literature, policy and industry stances.

5.2 Stakeholder participation

As outlined in the previous chapter, participation in the interview process, and the research in general, was entirely voluntary. The identity of the participants was to be kept anonymous in order to facilitate full participation without the danger of participants withholding information for fear of recrimination upon publication of the study findings.

The identification of participants in the study was driven by the grounded theory method of attaining theoretical saturation. Though the researcher sought to achieve a representative balance of stakeholder representation and interests this was not to be achieved through equal numeric representation of stakeholder groups. The ACCs had earlier been identified as the point of confluence of stakeholder groups, interests and aviation impacts. Within the interview process participants were asked to identify the network of salient stakeholders within the aviation system. This process of identification was the primary method of identifying system stakeholders, and future interview participants, at the national scale i.e. beyond the airport and ACC level.

Participation within the study varied by the selected study airport, reflective of the specific utilisation of the airport, geography, stakeholder groups represented and the spectrum of interests identified in the research process. A case in point would be the scale of involvement of local community groups, with the interests of these groups having greater precedent at larger airports or where the geography of the airport exposed larger populations to its impacts and activities. As the scale of the airport increased from small regional airport, to large regional airport and London regulated airport there was proportional increase in the representation of community groups, both local and at the regional scale.

To aid in the analysis process, and the presentation of the findings and discussion of this research project, participant stakeholders were assigned an identifying code. The participant code identifies characteristics of the interview participant: the stakeholder group represented and the airport affiliation e.g. LRA_LCR (large regional airport local community representative). A full list of participant identity codes are summarised in Appendix B (Table 30). Stakeholder identity and the stakeholder grouping to which the participant is grouped was self-assigned by the participant and an explicit aim of Section One of the Interview Guide.

5.3 Development of the interview coding process

This present section gives an overview of the process of interview analysis undertaken by the researcher to understand and make sense of the interview data collected. The general methodological approach of grounded theory was outlined in the previous chapter. The main stages of analysis being theoretical sampling (identification and recruitment of participants), data collection (conducting the interview), initial open coding, focussed coding category development, focussed coding, grounded theory category development, constant comparison and theoretical saturation. The stage of theoretical saturation is all an encompassing term to summarise the iterative process of the grounded theory method. Within the coding processes, and category development process, constant comparison is made with the existing data: what new ideas are emerging from the latest interviews; what new stakeholders have been identified? This stage leads the researcher to identify new participants for the researcher and to unlock and identify new avenues of enquiry. In the following sections it is attempted by the author to convey this iterative process in seeking theoretical saturation regarding sustainable development in UK aviation.

5.3.1 Initial open coding

After each interview had been conducted it was immediately transcribed and coded, as per the grounded theory methodology outlined in Chapter Four. Prior to the initial coding the researcher undertook a process of data reduction, as recommended by Miles and Huberman (1994). This data reduction process included the identification and removal of irrelevant data from the interview transcript, otherwise known as dross. Such dross included where the interviewee strayed off topic, general conversation etc. Irrelevant data was particularly prevalent at the end of the interview where the participant was invited to retrospectively contribute any further information they would like to provide in relation to a previous question, or to reflect on the interview as a whole. An example is presented below.

> *You get a lady comes on with a wheeled affair, which she can't possibly lift, and so has to ask somebody else, and holds things up, whilst finding an obliging male who will stick it up into the thing. And, then it is a struggle to get it in at all.* (SRA_ACCC)

During the initial open coding process the intention was to begin to make sense of *all* the data. Though a preliminary process of data reduction was undertaken prior to coding.

The continual coding and interview analysis allowed emergent themes and findings to be identified, which could then in turn influence subsequent interviews, the identification of future participants and guide areas of enquiry (examples of which are presented in the following sections). The summary of initial codes was constantly updated throughout the interview and coding process. The initial open coding process assigned a word or phrase to each interview line (where relevant) to summarise the data. Table 14 presents extracts from three interview transcripts to highlight this process.

Table 14 Three example extracts highlighting the initial open coding framework

Interview transcript	Initial codes
SRA1_LCR1	
But, the local authority then has to balance, I suppose	Balance – local gov responsibility
the economic and financial aspirations of the	Economic (business aims) - profit
company with the general effect of having something	Off-setting –ve against +ve
like that [an airport] *quite near to centres of*	Local geographic context: impacts
population...it is a difficult balancing act I think the	Balance
airport and the local authority have to...have to well	Multi-actor responsible "have to"
try and balance. It is not always easy, but there we	Balance - not easy
are.	Resignation to reality
LRA_AMR	
So obviously the effect of that [airport	
operations] *is it brings in economic and social value*	Multi-dimensional benefits
of the airport. We obviously have to balance that	Balance – airport responsible
then against the environmental impacts and	Environmental costs off-set

community impacts, that most industries have, and in	inter-sector comparison
particular an airport, with the biggest being noise.	Noise – biggest impact -ve

LRegA_LPG

It is the local community which tends to be the odd	Local community bears costs
one out, where they suffer the downside: night flights,	Impacts - reductionist
early morning flights, or just the general noise of	Range of impacts – connected
flying. Whether you have double glazing you can	
mitigate it up to a point. But, you can't double-glaze	Mitigation – limitations
someone's garden; you can't double-glaze the [local	Impacts on household/property
woodland] *which is one of our pristine assets in*	Value of nature/natural env.
terms of countryside. If you have got aeroplanes flying	
overhead, besides the visual aspect of it, the noise	Multiple causes of impacts
aspect of it spoils the enjoyment of peoples' ability to	Impact on personal utility of asset
enjoy the countryside.	

The initial open coding process produced an extensive and exhaustive list of codes (see Table 15). These initial codes were constantly collated from analysed interview transcripts into a separate document. As can be appreciated, the open coding process produces an extensive list of codes.

Table 15 Example of initial codes from the open coding process

Codes	
• Specific geographic challenges	• Aesthetic impact
• Profit	• Disturbance
• "Victim" status – representation	• Total costs
• Business vs. Environment	• Convenience
• Whole journey perspective	• Airport in locality
• Reward-cost	• Level of taxation
• Power	• Collective responsibility
• Influence	• Media 'spin' and PR
• Social aspiration	• Stakeholder claim
• Debate	• Trade-off

Using the list of initial codes, these were then categorised. Where duplications of codes were identified these were noted and then eliminated, though frequency is not tallied within the coding process of the grounded theory methodology, it was noted. The initial codes were then analysed to identify commonality and overlap between them. Through this process, and utilising theoretical ideas generated throughout the interview process, the initial codes were grouped into four focussed code categories. These focussed codes represented a cluster of linked and related ideas (summarised in Table 16), from which the grounded theory concepts would be developed.

Table 16 Focussed codes

I - Balance and 'trade-off'	**II – Context and process**

• Impacts
  ○ Environmental
  ▪ Noise
  ▪ Emissions (LAP)
  ▪ Emissions (GHG)
  ▪ Resources
  ▪ Visual/aesthetic
  ○ Social
  ▪ Aspiration
  ▪ Convenience
  ▪ Employment
  ▪ Cultural exchange
  ▪ Vacations
  ▪ Pleasure
  ○ Economic
  ▪ Jobs and training
  ▪ Direct
  ▪ Facilitation
  ▪ Important
  ▪ Connectivity
• Scale
  ○ Local, national, international
• Distribution
  ○ 'Off-set', 'trade-off', 'balance'
	• Development
	  ○ Temporal (past, present future)
	  ○ Infrastructure
	  ▪ Airport
	  ▪ Non-airport
	• Scale
	• Accessibility
	• Type of development
	  ○ Leisure
	  ○ Business
	• Participation
	  ○ Oversight
	• Distribution
	  ○ Compensation
	  ○ Costs
	  ○ Benefits
	• 'Special case' (transport mode)

III – Power and influence	**IV – Responsibility**

• Resources
  ○ Financial
  ○ Skills
  ○ Knowledge
  ○ Time
• Politics – debate and policy
  ○ Media
• Legitimacy
	• Who? (stakeholder group/s)
	  ○ Power
	  ○ Resources
	• Trust
	• Governance
	• Distribution
	• Process
	• Balance

○ Perception ○ Governance ○ Democracy	• Morality ○ Fairness ○ Equality • Taxation ○ Who? ○ How? (form) • 'Special case' (transport mode)
V – Other*	
• National pride • Strategic role (military)	
*This group of codes are those that do sufficiently fit within a particular group or theme of other focussed codes	

The focussed codes presented above were developed from the list of codes identified in the initial opening coding stage of assessment. From this list of focussed codes four emergent themes could be developed (**Error! Reference source not found.**) in relation to sustainable development and aviation.

Table 17 Developed themes with description

Theme	Description
I. **Balance and 'trade-off'**	• Impact category (environmental, social and economic) • Impact (positive or negative) • Scale of impacts (geographic and on stakeholder groups) • Distribution of impacts (burdens and rewards) • How the impacts are 'valued' and perceived
II. **Context and process**	• Development over *time* (past, present or future) of aviation or non-aviation (e.g. commercial) infrastructure • The process and formulation of development plans and fulfilment • Participant perceptions of stakeholder involvement in the process development • Geography of impacts and development
III. Power and influence	• Possession of resources (financial and non-financial (e.g. knowledge)) • Political influence, lobbying (policy and regulation) • The nature of development, challenges to the 'status quo' • Alignment of interests between stakeholder groups

Theme	Description
IV. Responsibility	• Possession of resources (financial and non-financial) • Governance, trust in 'the system', accountability • Distribution of impacts, equality, meritocratic, balance • Scales of responsibility (business, personal, global citizen, future generations)

Subsequently, the participant interviews were re-coded utilising the newly formulated focussed codes. Each of the four codes was designated a colour, and the interview transcript reanalysed utilising this new coding system. Data related to a particular category or code, was marked or highlighted with the corresponding coloured marker. Upon completion, all data pertaining to a particular code was collated. This process of focussed coding was a useful exercise in not only collating relevant data, but to reaffirm and refine the developed categories. Through this process the category of 'V-Other' was developed. This category brings together ideas and data that did not fit within one of the established codes, but did not in themselves represent a significant emergent theme to specify a new code. Rather than discard this data, in a similar manner to the removal of dross at the initial open-coding stage, they were archived and reviewed later in the analysis process.

Though the focussed codes are presented as discrete topic areas they are inter-related and connected. These connections and linkages are discussed later in this chapter (see Section 5.5).

5.3.2 Validation of developed codes

As noted in the previous chapter, validation is an important aspect of qualitative research. Validation in qualitative research can take many forms, dependant on the specific developed methodology and the chosen method of enquiry. This research is particularly concerned with credibility (how credible is the research and its interpretations as a representation of the participant's perspective), and objectivity (the degree to which the findings corroborate).

Due to the maintenance of open channels of communication post-interview, the researcher was able to seek clarification form participants about meanings, definitions and gain additional insight. It should be noted that no secondary interviews were conducted with past participants. However, as the researcher was engaged with the airports, airports communities and stakeholder through attendance at the ACCs, informal questions could be asked to seek clarification. This was utilised primarily early on in the interview process at SRA1 and SRA2, examples of the type of clarifications are presented in Table 18. The grounded method approach and the semi-structured nature of the interview process meant that proceeding interviews could also be used to seek clarification. As the researcher became more immersed in the data as the research proceeded and developed issues and clarification could be pre-empted and integrated into the interview itself.

Table 18 Examples of follow-up clarification with past participants

Participant	Clarification
SRA1_ACC	*How the relationship between the ACC and the airport changed with time?*
SRA1_LCR1	*Are other local communities affected by the car parking issue that you identified?*
SRA2_AMR	*What is the function of SRA2_AAG* [stakeholder group identified in the interview] *and how does it relate to the function of the airport?*

The iterative nature of the coding process, and the continual generation of new interview data and subsequent codes, meant it is vital to maintain rigour in the coding process. As such, upon the completion of the open coding stage, and the development of the focussed codes (see Table 16), a random sample of four anonymised transcripts were exchanged with a fellow researcher, independent of the research and institution,

but with experience of interviewing techniques and analysis in social research. They undertook the open coding process and the initial development of more focussed codes. During a feedback session the developed codes were compared and justified. This reaffirmed the four developed themes and focussed categories.

5.3.3 The coding process and developing concepts

The process of connecting the developed codes from the open coding stage to the secondary focussed stage was far from straight forward. The open coding stage produced an exhaustive list of codes (only a sample is presented above in Table 15) and creating the connections between them was an iterative process. The focussed codes used and developed by this research were themselves the result of several stages of development.

Initially, six focussed codes were developed: *balance, process, context, power, influence* and *responsibility*. However, due to interviews being transcribed and coded immediately after they had been conducted additional and new insight was being gained. Indeed, additional connections were being created between the initial focussed codes to the point where combing four categories into two, rather than detracting from any understanding of sustainable development, gave greater and broader understanding of the concept. For example the *process* of development (i.e. how, in what way, and over what period) is inextricably controlled and dependant on the specific *context* of such development. The *power* held by stakeholder groups most notably knowledge, resources (time and finance) and existing stakeholder relationships could not be separated from their ability to *influence* the process of development.

The on-going and continual interview analysis and coding also shaped the questions of proceeding interviews. As new ideas and themes emerged additional questions were developed for participants (an example of this is shown in Section 5.4.1.1).

5.4 Emergent themes

The following sections expand on each of the four developed themes (**Error! Reference source not found.**) from the coding process, providing insight, justification, and context from the interview transcripts. Though presented as separate sections, the categories cannot be considered as abstract and discrete entities, but inter-related in various forms. This notion is expanded upon in the following sections, highlighting the links and interdependencies between the categories (also see Section 5.5).

5.4.1 Balance and trade-off (core category)

Theme summary:

Theme	Description
I. **Balance and 'trade-off'**	• Impact category (environmental, social and economic) • Impact (positive or negative) • Scale of impacts (geographic and on stakeholder groups) • Distribution of impacts (burdens and rewards) • How the impacts are 'valued' and perceived

A recurrent theme from an early stage in the interview process was the notion of balance and 'trade-off'. All participants reflected and highlighted the need to weigh the negative and positive impacts of aviation against each other. Balance was initially the first category to be identified and developed during the interview analysis. Not because the identification of impacts chronologically is linked to early questions in the semi-structured interview, but that it occurred throughout participants' responses, with balance being related to both the impacts of aviation operations, and also later in reflection of stakeholder interests.

Balance was identified as a core category very early in the analysis process from the initial interviews and continued to be explored throughout the interview process. Section 5.4.1.1 provides evidence of how the researcher utilised the grounded theory method to develop and explore emergent themes in the analysis process, in this case ideas of balance and 'trade-off'.

This present section demonstrates how the category of *balance and 'trade off'* was developed throughout the coding and interview analysis process as an example of the grounded theory methodology (outlined in Sections 4.4 and 4.9).

Balance and trade-off encapsulates the benefits and costs of flying and what stakeholders viewed as the active trading of costs and burdens against the benefits of flight. As such, the following issues were raised by stakeholder participants:

- **What** form do the impacts take?
- The **distribution** of the costs and benefits within the system.
- At what **scale** are the impacts felt?

It was widely recognised by *all* stakeholder participants that the aviation sector makes direct economic contributions nationally, regionally and locally. Participants repeatedly prescribed 'balance' or a 'balanced strategy' to the development of aviation whereby the economic and social benefits of air travel mitigate the localised and global environmental and social burdens/costs. This balanced approach is used to enable and justify a growth in the overall activity of aviation from present levels, as NR_ITB reflects: "*it is about dealing with the environmental impacts in ways that enable the business to grow and for those companies to continue to be making profits and providing jobs*". Positions of balance are closely aligned to interpretations of sustainable development, within the sustainability spectrum of very weak to very strong (Pearce, 1993a). Epistemological stances of sustainable development are summarised and analysed in a following section (see Section 5.7

Stakeholder perceptions of balance are closely aligned with their relative position within the wider aviation system. 'Balance' is often used by 'industry' (airport operators, airlines, OEMs) to justify the expansion of airports and their aviation operations. LRegA_AMR, LRegA_AR, LRA_AMR and SRA_AMR use the term balance repetitively in their responses to justify and almost 'close the debate' about the impact of the airports or their activities:

> *"this is where the balance comes in, economic development and international connectivity, but you have got to make sure that you are running a sustainable business and that you not unfairly impacting on, or taking into consideration some of the local impacts"* [LRegA_AMR]

> *"...so obviously the effect of that* [aviation activity] *is it brings in economic, social value of the airport. We have to obviously balance that then against the environmental impacts and community impacts that most industries have"* [LRA_AMR]

In these instances there is a tacit appreciation of the detrimental environmental and social impacts have limits, but little detail as to what these limits mean in practice is provided. Uncertainty of environmental and social limits is perceived by NR_NGO1 and NR_NGO2 to be actively used by industry to intentionally create ambiguity:

> *"... this idea that it is good for the economy to fly more, just almost for the sake of it, is a ludicrous argument. Nobody would*

> *use that argument to say we should drive cars more because it is good for the economy, or we should use electricity more because it is good for the economy"* [NR_NGO1]

Balance is perceived to be used as a rhetorical tool by industry and position to overcome any criticism of aviation activity [LRegA_LPG]. Balance and trade-off is not just a concept linked with the distribution of impacts within the aviation system, but more broadly in that aviation activity must be judged and balanced relative to other global industries. This broader conception of balance is used by the industry as a means of justifying extreme intervention that may be seen to be damaging to future growth prospects: "*On the global level there is a concern about carbon emissions and global warming ... aviation contributes relatively minor amounts of carbon compared to other*[s] *... I don't think people have always got reality and perception aligned.*" [NR_ITB]. For NR_NGO1 this line of argument is utilised by industry as a way of diverting the need for action from industrial stakeholders to government and policy makers, stakeholders whom industry try and influence (see Section 5.4.3). The effects of impacts such as global warming are at a global scale and the result of GHG emissions from a range of industries.

However, the benefits of aviation extend beyond pure economic gains and encapsulate social value. Flying was seen as an aspirational right within society [SRA1_ACCC], with the ascribed social value being equal to the market price of the service. For the participants of the study it is important that the *balance* of these costs and benefits is "*net positive*" [LRegA_AR]. The benefits of which are national in scale:

> *-because of the very competitive nature of the what airlines do then I think there is a very broad and wide ranging economic benefit, not only to...well it depends on who you class as stakeholders, but it flow[s] not only up and down the supply chain, but also from the nodes of the transport system – so out of the airports.* [LRegA_AR]

The primary benefit of aviation was the role and support it provided for both direct economic activity and support of other sectors within the economy. However, even members of society who do not fly derive indirect benefits through forms of economic activity it facilitates as NR_ITB reflects "*the benefits are quite wide I think they are not as tangible as they should be and I don't think that people necessarily relate the things that they*

value to how does that get there and therefore they do not perceive the link between aviation and the benefits to them personally."

Even amongst those stakeholder groups whom it would be thought of as being 'anti-aviation' (e.g. NGOs, LCRs, LPG) have a pragmatic view of the role of aviation as being an important and relatively unique piece of transport infrastructure. Aviation activity is widely perceived as supporting business and economic activity at the local, regional and national scale. However, the needs of business are subordinate to the limits and carrying capacity of the environment.

Most often, balance is used in relation to future expansion and as a means of justifying the expansion and growth. However, balance is as important a consideration of present activity, or more precisely the *imbalance* of impacts. Many LCRs expressed that the rhetoric of aviation industry regarding balance is used to unduly influence and restrict the debate about aviation activity and development. Benefits are seen to accrue to industry and shareholders without bearing much of the downsides experienced by local communities: "*I don't think the shareholders bear much cost because without fail they don't live locally*" [LRA_LCR1]. Though profit motive is not incompatible with sustainable development as SRA_LCR1 attests "*And the airport company is in conflict with everyone as their main criterion is to make money. There is nothing wrong with that basic rationale ... you need to balance these things*". LRegA_AR advocates this shareholder fiduciary responsibility "*we want to maximise profits by running a safe commercial airline*". Local communities bear a range of detrimental impacts:

> *People close to an airport do suffer a lot from noise, and they can suffer from air pollution, they probably suffer from congestion and generally an ugly place. They suffer a lot. They gain few direct benefits, unless they actually work for an airport ... Ok, being near an airport may be useful if you want to fly abroad but, as I said, most people are only flying every year or so. The benefit in reduced time to get to the airport is not great* ***compared*** *with the impacts every day of the year.*
> [NR_NGO1]

NR_NGO1 makes a *comparison* between the scales of impacts i.e. the benefits vs. the costs. LRegA_LCR2 reflects that balancing the costs of noise against economic benefits or jobs is "very crude ... and it is like comparing apples and oranges". Direct impacts in the local community but benefits are less direct, unless employed:

> *... when you see these Ryanair flights to X, Y and Z, you have to ask how does that* ***benefit*** *the British economy when an Irish airline buys American planes to transport British people to spend their money overseas. Clearly it creates jobs [on] the beaches of France and the bars of Brussels and Prague, but there is an economic cost to the rest of the UK...there is an artificially low price in relation to other forms of transport...there is no tax, there is no excise duty on aviation fuel, and there is no VAT.* [LRegA_LPG]

The ticket price paid by passengers was widely seen as being artificially low both in comparison to other forms of transport e.g., rail [SRA1_LCR1, SRA2_LCR2]. Broadly, aviation perceived to be "subsidised" by society in relation to other forms of transport through preferential regulatory and tax regimes, most notably, the exemption of VAT from tickets and the lack of fuel duty by aviation fuel. With the price of tickets being artificially low this creates false demand signals and consumption that would be greater than if the market price reflected total costs to society and the environment: "*putting up prices will have a downward pressure on traffic volumes that is just an inescapable fact"* [LRegA_AR]. The market and market forces are viewed as the best method for the sector to balance competing needs, if priced correctly:

> *If the market is functioning properly then passengers and airlines have pretty complementary interests. They are ruthlessly opportunistic – most airlines are ... they simply make money by providing passengers with what they want. And, if they get that wrong passengers will simply fly with somebody else and then the market drives them to fix that.* [LRA_AMR]

Taxes such as Air Passenger Duty (APD) was broadly perceived by all participants as being ineffective and not suitable. NR_NGO1, NR_NGO2, LRegA_LPG reflect that the present level does not truly reflect the total costs. Whereas LRegA_AR, SRA2_AMR, LRegA_AMR view APD as being ineffective, "punitive", and not rewarding innovation. Where imbalance exists the market should be priced and reformed in such to support movement in the required direction, but reform is needed not from a sector perspective, but where impacts are common to other industries e.g. GHGs there should be a broad economy-wide (on an international scale) transition for the pricing of impacts. With regards to CO_2 emissions the "*carbon cost can be mitigated by*

the airframe manufacturers and the engine manufacturers, but ultimately there is still a carbon cost to be paid, and really society needs to make that choice" [LRegA_AR]. Addressing imbalance requires actions not just from an individual stakeholder but broad societal action.

5.4.1.1 Evolving ideas of balance during the research process

Central to the grounded theory method is that the researcher is free to follow emergent themes of enquiry. Thus, as an example, this section presents and describes how the category of '*balance and trade-off*' evolved, the process by which the researcher explored this theme and developed additional insight.

The interview process at each of the study airports did not proceed in a linear serial-manner, i.e. as discrete phases of enquiry, but were conducted on an ad-hoc basis as and when agreement was attained from identified stakeholders. However, engagement at SRA1 happened early in the research process.

From these initial interviews a prevalent weak interpretation of sustainable development emerged, and with it a reductionist stance on environmental impacts. Impacts (costs and benefits) were identified to be substitutable between impact categories (environmental, economic and social) and stances regarding development taken:

> *Well I suppose something that is effect neutral, something that I would regard as sustainable, i.e. we don't put more into it than we get out...what are we* [the council] *going to do to* ***mitigate*** *against the effects of what you are proposing and if we can get that down to nothing.* [SRA1_LCR1]

Noise was highlighted by all the initial participants as a negative impact of aviation with particular emphasis on noise nuisance, and its impact on the welfare and utility of the local community. But, even here, the idea of local residents 'trading' the negative impact of noise against property prices was prevalent:

> *Those that complain that about the fact that they can hear engines running at night, but* [they] *were quite happy to* ***accept the discount*** *on their house that was sufficiently close to the airport for them to hear the engine noises.*
> [SRA1_ACCC]

*People living near the airport obviously **accept** there will be noise but they want to see the benefits too.* [SRA1_LCR3]

This trade and balance between the impacts was perceived to be a conscious and rational decision by local residents. Linking this to other identified themes and developing thoughts around context (geographic references to impacts), the researcher explored in later interviews this issue of balance, trade-off and noise. As highlighted in the extracted quotes above there was a view of trading utility loss (tranquillity) for financial gain (reduced property price), or alternatively expressed, residents sought the maximum level of tranquillity given budgetary constraints.

Figure 16 outlines how the interpretations of '*balance and trade-off*' evolved with the progression of the interview process. Highlighted is how the grounded theory method was utilised to form an understanding of the emerging concept in the progression of interviews, e.g. dimensions of the concept in previous interviews were explored in subsequent interviews.

Levels of noise around airports are a function of the frequency of flights, operational functions of the airport, the types of aircraft utilising the airport etc. (Thomas, 2003; Smith, 1989). Explored in a later section (5.4.2), intrinsic to aviation development and that of sustainable development, is a temporal function; the operations of the airport, the relationship between stakeholders changes and the relative importance and stance on impacts. The researcher thus explored the ideas of financial compensation for those affected by aircraft noise.

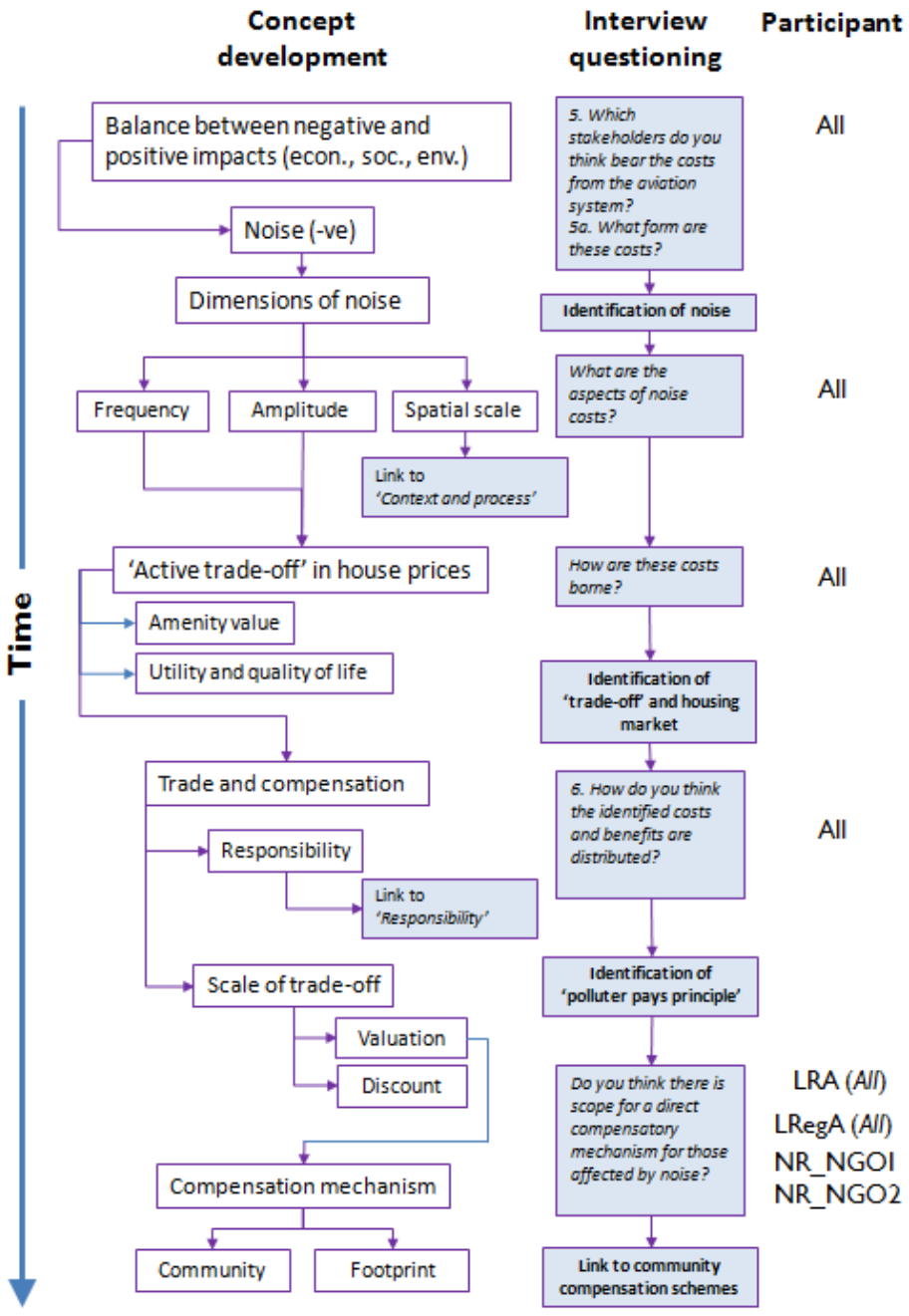


Figure 16 Demonstration of how the dimension of noise was explored in the progression of the interview process by the application of the grounded theory method through to theoretical saturation

The idea of a direct compensatory mechanism for noise was developed due to several themes that emerged regarding sustainable development: a prevalent weak interpretation of sustainable development, a reductionist approach to impacts, the rational decisions of local communities to balance noise against house prices, and the degree of substitutability of capital.

Local community residents at the LRA and LRegA and both NGO participants were asked questions related to the concept of direct compensatory payments to local households, within the noise footprint of the airport for noise impacts:

> *...do you think there is scope for a direct compensatory mechanism for those affected by noise?*

The researcher intentionally avoided making references to any particular affected groups, any type of compensation mechanism, organisations that would disburse compensation or the payee.

LRA_LCR1, though recognising that people living under a flight path, or in the noise footprint of the airport, "pay massively more cost than the rest of us do", in this case the social cost of noise annoyance, when asked about direct compensatory payment to individual households:

> *...a top down automatic compensatory process is un-auditable...top-down...it is claiming there is a problem, and who is going to judge there is a problem to make the compensation to. I mean, if I am Joe Bloggs living under the flight path, are you going to write to me and my six neighbours and offer us £25 for the year or is it going to go to a local group who you don't know and you don't know their constitution.* [LRA_LCR1]

Another local community representative [LRA_LCR3] at the same airport valued the contributions of the airport's noise penalties (charges levied on airlines that break the airport noise guidelines) in 'offsetting' some of the social burdens placed on local neighbourhoods.

NR_NGO1 echoed the views of LRA_LCR1 in that a compensation payment recognised a problem and that financial compensation could be used a means of not having to technically address issues of aircraft design, usage and be a means of justifying exposing greater populations to noise. Local community investment funds provided by the airports were well perceived and recognised by participants, providing notable value and support to the local community in projects that were locally important and valued. As such, there was a limit to the degree to the substitution of capital for environmental and social utility loss, which in part supports the wider prevalence of weak interpretations of sustainable development amongst participants (see Section 5.7

5.4.1.2 Perceptions of impacts and scale (environment)

As discussed in Section 5.4.1 the impacts of aviation occur at various scales: local, national and international. The consideration and perception of the environment within the stakeholder framework offers an interesting example of how stakeholders' relative position in the aviation system affected their interpretations, and highlighted a potential limitation of the framework.

In the majority of participant responses there was a clear identification of different types of impacts, primarily differentiated by the scale at which they occur: for example NR_ITB identified "*local costs and more global costs*", LRA_LCR3 "*a threat to local wildlife*", SRA2_LBG "*local noise impacts*".

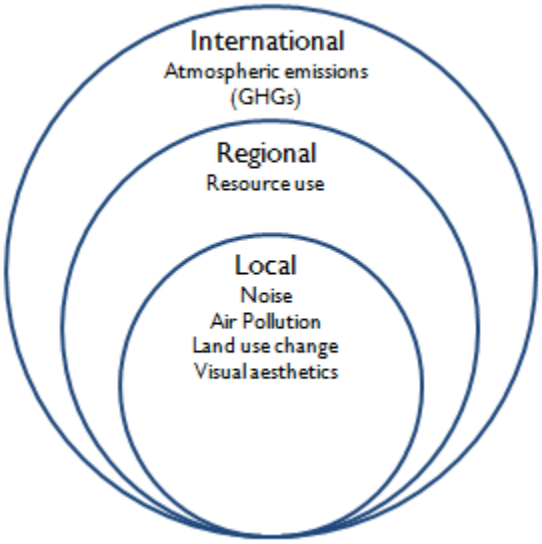


Figure 17 Perceptions of environmental impacts by scale

Broadly impacts were classified and differentiated between categories: international, regional (national) and local (see Figure 17). Local community representatives placed great emphasis on local impacts as they readily perceived these impacts on their day-to-day lives (most notably) noise nuisance. Though there is a tacit appreciation of the impact of aviation on the global atmosphere, GHG emissions were not given as great an emphasis. This was for two reasons: first, local community representatives do not perceive the costs or impacts of GHG emissions due to the global nature of the impact as NR_ITB reflects "*global impacts* [related to GHGs] *are obviously very important, local impacts related to carbon are obviously less important but if we are talking about noise, then local impacts would be first"*. Secondly, global impacts are not caused solely by direct aviation activity, unlike noise. As such, within the stakeholder framework the emphasis

of impacts is skewed by the perceptions of participants. Global impacts are therefore "championed" by stakeholder groups for whom the environment is highly valued (NGOs).

5.4.1.3 Consciousness of trade-off

As presented over the previous sections participants posited that the negative impacts of aviation activity to the environment (gaseous emissions etc.) and local community social impacts (noise) were traded for economic gain and the social value of employment and the ability to travel. Noise, due to aircraft, became the most prominent and contentious issue regarding aviation activity. All respondents highlighted the issue of noise nuisance and its impact on local communities in the vicinity of the airport. Section 5.4.1.1 discussed how the interpretation of balance was explored by the researcher. Residents in the local community who live within the noise footprint of an airport are viewed to have made an active, rational and conscious trade between loss of welfare (due to noise) and the valuation of property. As such, there is a broad conception that active substitution between impact categories is possible.

5.4.2 Context and process

Theme summary:

Theme	Description
II. **Context and process**	• Development over *time* (past, present or future) of aviation or non-aviation (e.g. commercial) infrastructure • The process and formulation of development plans and fulfilment • Participant perceptions of stakeholder involvement in the process development • Geography of impacts and development

Context and process are presented and developed as one grounded theory concept, though they can be viewed as two concepts that are intrinsically linked. Context was developed as reference to the specific geographical and operational qualities of an airport. Process aspects capture the matters of time and change that were perceived by participants, changes that would ultimately be reflected in the specific characteristics of the *context*.

Linked to the core category of balance and trade-off is the scale of impacts (costs and benefits), i.e. at what scale to the benefits accrue, at what scale are the impacts

imposed properties which are unique to the context in which an airport is situated. Following this, it is argued by many participants that as an airport grows, or changes scale (in the case of this project it may mean moving from one 'airport typology' to another), the benefits *may* be diluted and the relationship between the distribution of costs and benefits changes. As NR_AvR reflects:

> *As it gets bigger* [the airport] *and starts drawing on expertise and skill base from a wider area, the benefits become diluted due to expansion. As it grows bigger and the transport connections improve it is easier to facilitate bringing in the required skill base from a wider area.*

This example highlights two aspects: one, *change* related to the development and growth of the airport (linked to scale), and the second being *time*, development being a process. As such the impacts, both positive and negative, and their distribution are non-static, i.e. they can change with time. This change with time can be linked to the core category of *balance and 'trade off'* consider the example highlighted by NR_NGO1 and LRA_LCR2:

> *People accept the situation at present, but what really annoys people – and this is always reflected by public protests – is when things are likely to get worse. People are generally pretty tolerant of what the situation is now.* [NR_NGO1]

> *[local village] and [local village] are quite old communities. Those people who bought their houses in those communities years ago quite clearly are more disturbed by an increase in noise than those who bought recently and therefore expected the noise.* [LRA_LCR2]

In both cases, linked to the previous category of balance and trade off, residents were viewed to make an active and rational trade between social welfare and property values. What they also highlight is the non-static nature of the distribution of the impacts. Development is a process of change that may alter the scale, spatial distribution and magnitude of impacts on different stakeholder groups. As such, central to sustainable development and development in general is the need for temporal considerations. Development is not static in time and may affect the balance of impacts and their distribution.

LRegA_AR provides an alternative example of this temporal element to the aviation sector:

> *What we have done is taken a chunk of business away from the incumbents over the last 15-years to 20-years, be that pre-existing business, or business they would have had if we had not been there, who knows.* [LRegA_AR]

5.4.3 Power and influence

Theme summary:

Theme	Description
III. Power and influence	• Possession of resources (financial and non-financial (e.g. knowledge)) • Political influence, lobbying (policy and regulation) • The nature of development, challenges to the 'status quo' • Alignment of interests between stakeholder groups

Power and influence developed around thoughts of who *has* power and influence, not just to enact change within the aviation system's development, but also which stakeholder groups *does not* possess the resources to enact power and change.

> *The aviation industry has this power. It has managed over the years to produce this 'motherhood and apple pie' image that aviation has to be good for the economy because how could it be otherwise?* [NR_NGO2]

> *The difficulty is, of course, that the industry generally does not, if one is honest, it does not want to know and necessarily do anything about it, whereas of course government are – or can be – all powerful.* [NR_NGO1]

The aviation industry is perceived to influence the debate about climate change pushing for action from an individual sector responsibility, and the need for an international agreement, this influence being self-serving and self-protection to minimise adverse risk [NR_NGO1]. LRA_AMR highlighted the specific function of a team within the airport

for political engagement and "*promoting the vision of the airport*". NR_ITB and NR_MTB also saw their role as being to influence policy development, whether that is in the self-interest of their members, or to provide technical and industrial insight. In these cases direct stakeholders (industry) have unique resources at hand, be that knowledge, finance or personnel time to control and influence the debate. NR_NGO2 saw the danger of industrial stakeholder groups unfairly influencing and gaining "*preferential treatment*", with the work of the NGO being similar to "*David against Goliath"* or "*a bit like a gnat on the back of an elephant*".

Influence and power are also linked to context (linked to category II). SRA2_AMR highlights that the power to influence stakeholders is of instrumental value to corporate objectives but limited by a 'sphere of influence'.

Stakeholder engagement is seen at the airport-level through ACC an important conduit for both airports to influence stakeholders, but also stakeholders to influence the works of the airport. SRA2_AMR highlighted that the ACC was to "*demonstrate and sell the role of the airport in the community*" on an on-going basis, rather than engagement being a reactionary response to criticism on ad-hoc or issue-by-issue basis. LRA_AMR and LReg_AMR concurred and stakeholder engagement was as much part of being a "*good neighbour*" as much as instrumentally valuable to the business.

As LRegA_AR reflects some stakeholder groups do not have a "voice" within the debate:

> *The airlines cater to human demand... consumers tend not to be in a good position to represent their interests to...consumers can affect what airlines do by their purchasing behaviour but they find it difficult to affect what NATs or Heathrow does because they have no vehicle to do that. And then, they are probably not experts either.* [LRegA_AR]

As such, certain stakeholders are perceived to be responsible to take on the role of proxy representation of those groups that lack a coordinated voice or conduit for engagement. With NGOs and LCRs having the responsibility to represent the concerns of the environment at the local level and of wider society.

5.4.4 Responsibility

Theme summary:

Theme	Description
IV. Responsibility	• Possession of resources (financial and non-financial) • Governance, trust in 'the system', accountability • Distribution of impacts, equality, meritocratic, balance • Scales of responsibility (business, personal, global citizen, future generations)

Responsibility was identified as one of the key grounded theory categories after the preliminary development of the core category *'Balance and trade-off'*. Initially, responsibility was thought to nest within the category of '*power and influence'*. However, it was developed as its own independent category. Responsibility can be considered to have two dimensions: first, responsibility for the impacts of *current* aviation activity, and second, responsibility for the *future* development of aviation, linked to the process of development.

Sustainable development, as highlighted over the previous sections, is not one homogenous concept, but involves multiple impacts, scales, actors and processes. Responsibility is thus not singular, in that not one form of responsibility is borne for the sustainable development of aviation. Responsibility takes various forms, linked in part to the previous category of *'power and influence*': which stakeholders have the power to mitigate impacts; the costs of aviation should be borne by whom; what is the responsibility of an individual stakeholder? Thus, the category of responsibility is explored in three parts: responsibility for mitigation, responsibility for costs, and responsibility in the process of development.

5.4.4.1 Responsibility for mitigation

The negative impacts of aviation were widely perceived by all participants within the study (see Section 5.4.1). Perceptions of responsibility can crudely be divided into three spheres: those participants operating actively within the aviation system (airlines, airports, passengers, and manufacturers), those external to the system (local communities, non-governmental organisations) and government.

Market forces were identified as the key catalyst for dictating the shape and development of aviation. However,

> *Climate change fairly obviously affects everybody, and of course, it is an odd one isn't it? Because, it affects people on the other side of the world just as much as it does us, which of course is why it is in some ways the most difficult thing because nobody will take* ***responsibility*** *for it. They will say 'well it is not us* [industry]*, it is China'.* [NR_NG01]

NR_NGO1's depiction of responsibility summarises other interviewee's descriptions of how industry responsibility is subverted by references to the global context of aviation activity. As discussed in Section 5.4.2, the sustainable development is dependent on the context within which it is being is being attained: the local, national and international. Due to the relationships between impacts e.g. CO_2 emissions and NO_x (as discussed in Section 2.7) there was a perception amongst participants for inaction by industry.

> *They are legally obliged to do that* [maximising shareholder value]. *So taking the social and environmental* ***responsibility****, it is hard to lay that with them* [the aviation industry] *and clearly they will not accept it. Which is why it is so important to have governments that are in a sense controlling their impacts.* [NR_NGO2]

LRegA_AR though critical of the current industry regulations for not encouraging competition at capacity constrained airports, sees *fair* industry regulation as key to the adoption of the required technologies to tackle and reduce the environmental impact of flight.

5.4.4.2 Responsibility for the costs of aviation

Amongst participants there was a general consensus that the costs of aviation should be borne by those stakeholders that derive the greatest benefit, in this case passengers.

> *It* [carbon pricing] *will have to find its way down to the end user. What will it do? It will put up prices. Putting up prices will have a downward pressure on traffic volumes that is just an inescapable fact ... ultimately you know airlines pay the bills and passengers ultimately pick up the cost* [LRegA_AR]

Taxation was viewed as the most appropriate means of reforming the market system to better reflect the total costs of aviation and "*you can also pay a cost through airport*

taxation, but I accept that that is an important way of supporting and doing environmental work" [LRA_LCR2].

5.4.4.3 Responsibility in the process of development

Perceptions of responsibility in the process of aviation development mirror those discussed prior, when understanding perceptions of responsibility for the mitigation of aviation impacts. Broadly it was agreed that '*the market*' should be the guiding force in the development of aviation; both in terms of route development, operations and infrastructure. In an idealistic scenario this would be the case. However, in reality this is not; the role of the Airports Commission was used time and again as a case in point. The Government, and its various departments (DfT, DCLG, DEFRA) were identified as responsible in the process of new infrastructure development; therefore supportive of a top-down approach. It was identified that the development of new runways is a special case where the role of the market is key, but cannot be separated from politics.

At the local-level (airport scale) roles within the development of airports it is recognised that airport operators have a unique role in the process of development by providing a focal point and conduit for a broad cross section of sector stakeholders, as the airport is seen as the confluence of various stakeholder interests. The airport consultative committees are therefore critical to attainment of integrating this broad spectrum of views. As one LCR notes, this process of engagement is vitally important for local communities to accept some of the detrimental impacts of aviation activity:

> *In the end I think it works* [sustainable development] *if everybody feels they have* ***had an opportunity to say something*** *and they understand the other person's point of view and there is a balance. In the end I suppose we all have to know that we all can't get our own way all the time* [SRAI_LCRI]

Indirect stakeholders are viewed to have an important role in acting as a counter balance to industry demands for growth. NR_ITB notes that the industry is dependent on "*being able to maintain a licence to operate and to achieve a licence to grow whilst addressing the concerns of that continued operation and growth may bring".*

5.5 Linking the grounded theory categories

As discussed at the very start of this analysis section, the developed grounded theory categories cannot be considered in isolation as discrete entities, but interrelated and often mutually self-supporting concepts. This present section brings together the analysis of the categories and explicates the links between them. The developed grounded theory categories are:

I. Balance and 'trade-off'
II. Process and context
III. Power and influence
IV. Responsibility

Category I (Balance and 'trade-off) was developed as the core category, as such all other categories connect to this in some way (see **Error! Reference source not found.**). Balance within sustainable development was identified as two-fold: the balance and distribution of costs and benefits amongst system stakeholders, and the balance of stakeholder interests in development. Broadly, *balance* can be interpreted as the weighing-up of the potential benefits of flight (both social and economic value) against the disadvantages of social and environmental costs (noise, gaseous emissions and resource use).

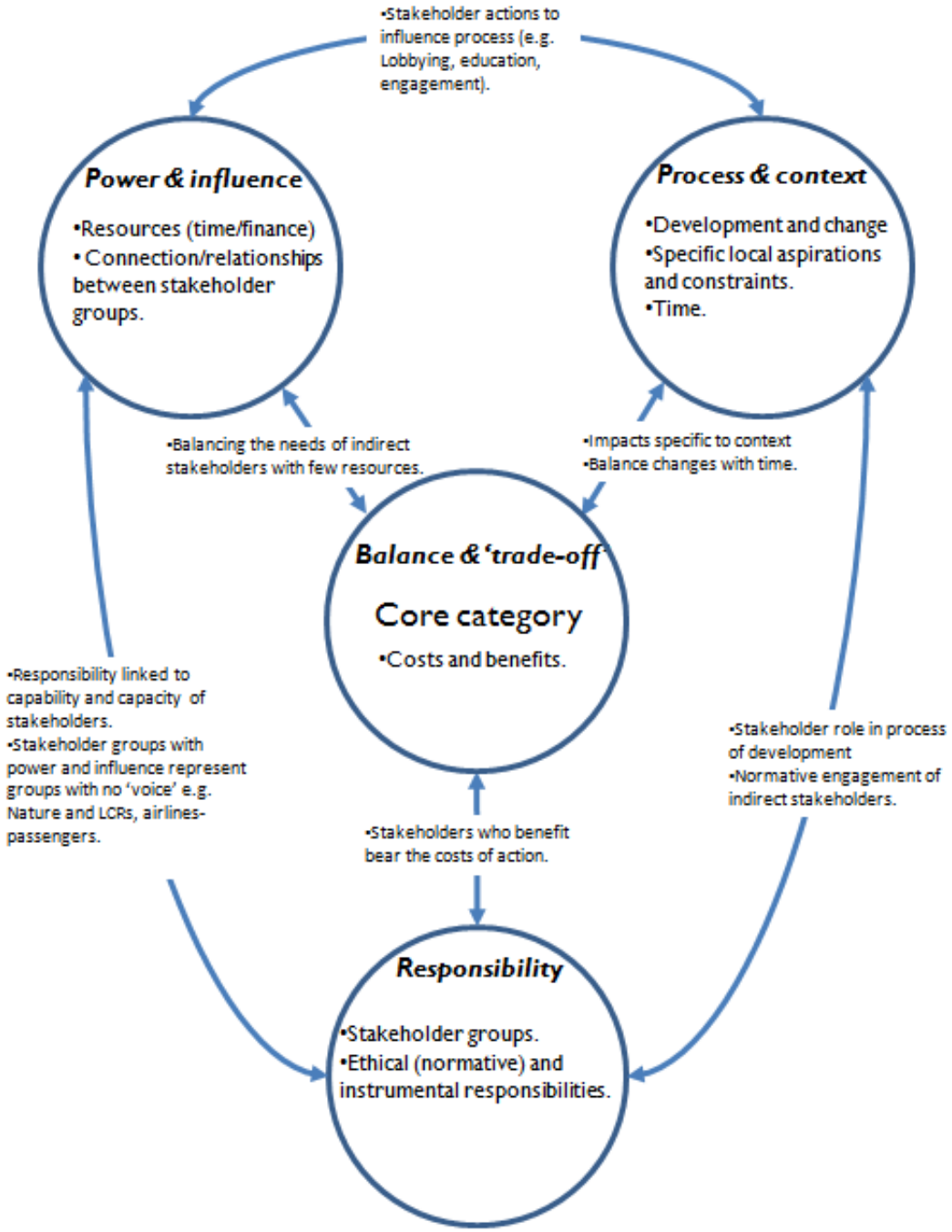


Figure 18 Schematic of links between the developed grounded theory categories

The identification and distribution of impacts is dependent on the 'worldview', perspective and *the context* (Category II) of the respondent. Thus, the balance of impacts will require actions specific to the context within which balance is being analysed. In this case, the actions required at individual airports will be unique and reflect the local sustainability aspirations of stakeholders. The nature of impacts, their magnitude and source are viewed non-static, in that they may change (Category II: *process)* with time, such that the *balance* of impacts may change over a time-period.

Category III (*power and influence*) relates to the core category of balance (Category I), in that the stakeholders *with power* were deemed to posses the ability to influence the balance of impacts in their self-interest. Direct stakeholders (airlines, airports, passengers) are viewed as being resistant to changes in the *balance* of impacts and utilise their resources (money, knowledge, personnel) to *influence* the process (Category II) of policy development.

Respondents to this study viewed *responsibility* (Category IV) to have multiple facets. As such, these varying 'types of responsibility' fit within the concept of sustainable development and the other grounded theory categories in different ways. Responsibility was defined by moral and ethical obligations between stakeholders and the concept of development. With those deriving the greatest benefit from aviation (passengers) being the ultimate party responsible for paying taxes and charges relative to impose environmental and social burdens. Central within this notion of financial costs reflecting the broader 'total' costs on society, and connecting it to the core category of balance is the ability to substitute between various forms of capital. Responsibility also connects to Category III (*power and influence*) and Category II (*process and context*) primarily for normative considerations. All valid stakeholders should have a contribution to the development process at the local level, a responsibility placed on the airport management to facilitate. There is no responsibility to ensure an equal distribution of benefits or costs amongst stakeholders, as the primary value derived by local communities in the process is the ability and opportunity to voice their interests. Those stakeholders with *power* were also given the moral duty to provide a voice by proxy to those stakeholders with no voice and little influence, a case in point being the representation of passengers by airlines due to the close alignment of interests. Additionally, *all* stakeholders were deemed to have a responsibility to the natural environment and future generations in all aspects of sustainable development, not just NGOs community representatives. Ethical motivations for responsibility were not seen sufficient to address all the challenges of sustainable development, and governmental stakeholders hold a unique role to enact legislation to engender sustainable development within market reforms.

5.6 Stakeholder identification

Central to the stakeholder-sustainable development framework developed by this research is the concept of stakeholder status: who are system stakeholders? What are their respective stakes? Are they affected by or can they affect the aviation system and its development? How do their interests relate to the implementation of sustainable development? The following section brings together these aspects of stakeholder analysis.

In many senses, the debate about stakeholder status ranged within the 'affect-affected by' stakeholder binomial: "*anybody who lives near an airport and is* ***affected by*** *airport noise is most certainly a stakeholder*" [NR_NGO1]. Participants provided expansive views on stakeholder status with several classifying potentially the entire population of the Earth as being a stakeholder if the "affected by" label were applied to the global impacts of Climate Change. SRA1_LCR1 reflects: "*we all at some point or other, actually nowadays everyone at some point or other have accessed the aviation industry in one way or another. I suppose if you have asked me that question thirty-years ago I wouldn't have said that".* And, NR_MTB adds: "*Everyone, I would have thought in the UK certainly is touched by aviation in one way or* another". Additionally of note in this example is the temporal component to their definition of stakeholder: stakeholder status may well change with time (linked to the Category II: Context and Process).

LRegA_AR represented stakeholders as being *direct* stakeholders who held a commercial or contractual right to stakeholder status (airport operators, airlines, passengers) and *indirect* stakeholders who were "impacted" by aviation activity. This secondary group included local communities affected by noise and the "global community" affected by carbon emissions. Generally with other participants stakeholders were classified into these two broad categories, often with direct stakeholders being directly substituted for "industry". These direct and indirect stakeholder classifications are synonymous with broad and narrow interpretations of stakeholder status from the literature (see Section 3.4 and Table 19).

Table 19 Summary of identified stakeholders within the aviation system

Direct	Indirect

• Airport operators
• Airlines
• Airframe and engine manufacturers (OEMs)
  ○ Suppliers (wider supply chain)
• Passengers
• Travel industry
• Government
  ○ National
  ○ Local
	• Local communities
	• Local and regional business
	• Regional and national community
	• NGOs

5.6.1 Non-participating stakeholders/stakeholder groups

As noted in Chapter Four, which set out the research method employed by this project, participation was voluntary, identification of future participants was driven by previous participants in interviews, and interviewees were sought to reflect the cross-section of valid stakeholders. Despite the 12-month preparatory work undertaken prior to the commencement of the first interviews, and the interviewing process proceeding over the following 18-months, there was significant difficulty in attaining participation of representatives from all identified stakeholder groups. Identified stakeholder groups that did not partake, example organisations have been included to aid the reader in understanding the terms of reference, included: international aviation trade groups (International Air Transport Association), tourism organisations (Association of British Travel Agents), various national governmental departments (DECC, DEFRA, DCLG, DfT) and national business organisations (Confederation of British Industry, Engineering Employers Federation).

The researcher respected the rights of all stakeholder groups that declined offers of participation within this project. The reasons for non-participation varied:

- The stakeholder group/s felt that their position/s regarding the development of aviation and sustainable development was already well publicised; in these cases the researcher was directed to previous publications or websites
- Several stakeholder groups recognised the value of the project and were keen to engage in discussion informally about the project outputs, but for various reasons were unwillingly to commit to an interview: time resources, felt uncomfortable representing the view of their organisations

- Several stakeholder groups did not respond to speculative enquiries regarding participation

Despite the preparatory work undertaken in engagement of stakeholders at ACC meetings, national aviation events and industry conferences there remained barriers to full involvement and participation that could not be overcome. The research strategy is deemed successful on reflection, due to the broad range of stakeholder groups that did participate and the depth of participation in the interview process achieved.

5.6.2 Stakeholder holder needs and interests

The interests of stakeholders and their relation to the aviation system varied between the contexts of the airports (Table 20). Broadly, there is consensus amongst direct stakeholders' primary interest that being industry growth and profit maximisation. Indirect stakeholders are more interested in the burdens placed on their respective groups by aviation activity. This bifurcation of stakeholders actually belies a broad consensus amongst stakeholders regarding sustainable development and aviation (see Section 5.7

Table 20 Summary of participant primary interests in the UK aviation system

Stakeholder		Primary Interest
Small Regional Airport (SRA1)	LCR1	Noise nuisance
	LCR2	Local employment
	LCR3	Noise nuisance
	LBG	Maximising local business links and activity
	ACCC	Airport growth
Small Regional Airport (SRA2)	LCR1	Local employment
	LCR2	Airport supporting regional economic activity
	AMR	Providing return on investment through service provision
	AAG	Supporting airport growth
	LBG	Maximising local business links and activity
	ACCS	Local community engagement
Large Regional Airport (LRA)	LCR1	Local employment and skills
	LCR2	Minimisation of environmental impacts on the community
	LCR3	Noise nuisance
	LCR4	Noise nuisance

Stakeholder		Primary Interest
	AMR	Defending and increasing market share
London Regulated Airport (LRegA)	LCR1	Connectivity and local access to airport
	LCR2	Local employment
	AMR	Defending and increasing market share
	LBG	Improving local economic activity
	LPG	Containing and challenging airport expansion
	AR	Profit maximisation and growth
National Representatives (NR)	NGO1	Environmental protection. Focus on international impacts
	NGO2	Local environmental protection and preservation
	ITB	Industry facilitation and representation
	MTB	Supporting industry growth
	OEM	Maintaining and increasing market share
	TIS	Revenue growth and market share
	AvR	Consumer representation and protection

5.7 Epistemological interpretations of sustainable development

There is little evidence of an agreed and consistent interpretation of sustainable development: neither broadly speaking, for example when asked to define sustainable development in a non-specific context (Question 9), nor a consistent vision of what sustainable development is with specific consideration of the aviation sector (follow-up: Question 9b).

Individuals' descriptions of sustainable development varied depending on the context of their position within the aviation system. Perceptions of sustainable development were based on stakeholders' 'world-view' and relative position within the aviation system.

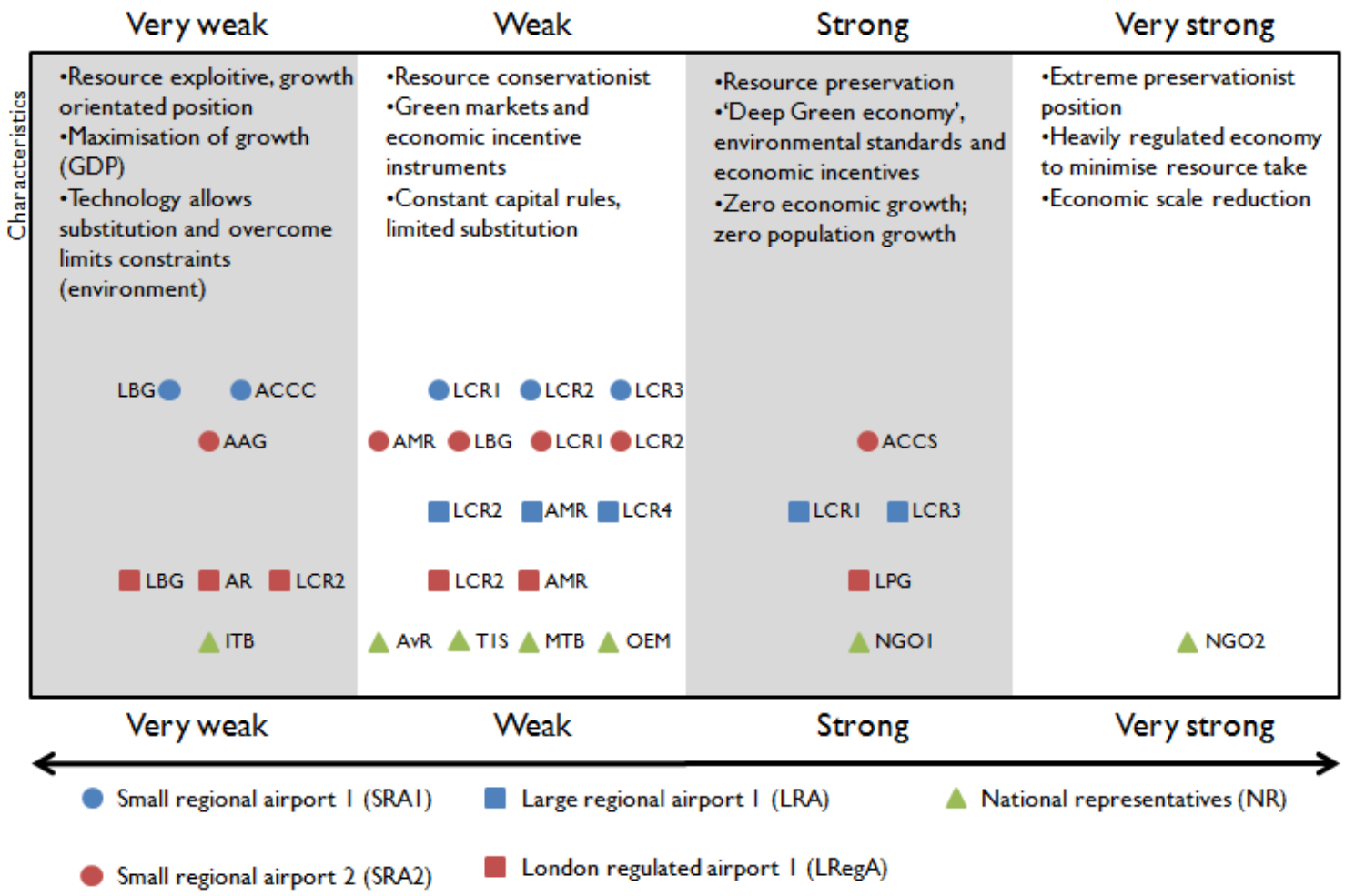
Definitions of sustainable development varied between almost verbatim quotes of the oft cited *Brundtland Report* definition (see Chapter 2), financially sustainability of corporate entities and definitions synonymous with sustainable growth, to classically strong definitions referencing limitations of resource use and the carrying capacity of ecosystems (e.g. the atmosphere).

With this identified variation in mind, the relative epistemological interpretations of sustainable development have been analysed with reference to the 'sustainability spectrum' developed by Pearce (1993a; presented in Chapter 2). The result of the analysis is plotted on a representation of the 'sustainability spectrum' (see Figure 19). Table 21 provides supporting quotes, relevant information and appropriate comments to establish and justify the categorisation of stakeholders within a particular epistemological stance.

Table 21 A summary of participant epistemological stances on sustainable development

Stakeholder		Interpretation of sustainable development	Comment
Small Regional Airport (SRA1)	LCR1	Weak	"...something that is effect neutral" Mitigation and impact offsetting. Substitution.
	LCR2	Weak	Growth and development essential but must be environmental limits.
	LCR3	Weak	Economic growth whilst recognising the limits of local environmental constraints.
	LBG	Very weak	Businesses need to grow to support the economy. Market and technological development will address resource scarcity and environmental constraints.
	ACCC	Very weak	"The business of business is business". Free market liberalism with minimal regulation.
Small Regional Airport (SRA2)	LCR1	Weak	Environmental impacts offset by social value.
	LCR2	Weak	Economic growth within environmental constraints. Intergenerational considerations 200-300yr timeframe.
	AMR	Weak	"balance of environmental, economic and social impacts" Substitution of between capital.
	AAG	Very weak	Business and aviation growth essential for the survival of the airport.
	LBG	Weak	Economic and social development offset environmental damage. Need to constrain environmental damage.
	ACCS	Strong	Social constraints to development. Preservation of local ecosystems over expansion and growth.
Large Regional Airport (LRA)	LCR1	Strong	"long term improvement for all stakeholder groups". No substitution between forms of capital
	LCR2	Weak	Development that is "net positive". Substitution between forms of capital.
	LCR3	Strong	Preservation of environment and social capital. Thresholds to environmental impacts.
	LCR4	Weak	Growth for social and economic contributions. Regulation to "encourage" needed efficiency improvements.
	AMR	Weak	Growth whilst trying to reduce the environmental impact per unit of growth.

	Stakeholder	Interpretation of sustainable development	Comment
London Regulated Airport (LRegA)	LCR1	Weak	Economic development through reducing environmental impact if it delivers real social improvement.
	LCR2	Very weak	Growth market driven. Offsetting of environmental impacts.
	AMR	Weak	Should be able to respond to the needs of the market. Valuable and irreplaceable contribution to local economy, infrastructure and community. Facilitates social improvement.
	LBG	Very weak	Growth dictated by market need. Technological improvements can overcome "concerns about the impact of aviation on the environment".
	LPG	Strong	Industry growth acceptable within environmental limits and carrying capabilities. No further expansion of infrastructure.
	AR	Very weak	Eco-efficiency. Economic gain offset environmental burdens/impacts. Environmental damage contingent on social acceptance.
.National Representatives (NR)	NGO1	Strong	Carrying capacities of environmental systems cannot be exceeded. Natural resource limitations. Inter-generational timeframes. Decoupling resources use and economic growth.
	NGO2	Very strong	Environmental limitations. "...development which is not damaging to the environment in the long g term" Decoupling resources use and economic growth. Rationing of flights. Reducing scale of aviation.
	ITB	Weak	Eco-efficiency. Technological solutions to environmental constraints: "sustainable growth".
	MTB	Weak	Meeting present and future needs within environmental bounds. Technology key to improving resource efficiency.
	OEM	Weak	Technology key to improving resource efficiency. Limited substitution between impact categories.
	TIS	Weak	Technology key to improving resource efficiency. Limited substitution between impact categories.
	AvR	Weak	Sector growth within environmental constraints. Net positive impact of development.



Notes to reader: The relative position (on x-axis) within each epistemological stance is irrelevant. Further detail of each stance is presented in Section 2.3

Figure 19 Participant interpretations of sustainable development plotted on a 'sustainability spectrum'. Supporting information presented in Table 21.

5.8 Chapter summary

This chapter outlines the empirical findings of the research from the application of the stakeholder-sustainable development framework developed through the previous literature review. The methodological process involved the application of a grounded theory and semi-structured participant interviews, drawn from stakeholders within the UK aviation system.

The chapter can be viewed to contain three sections. The first part, Sections 5.2 and 5.3 outlined the participation of stakeholders within the research and an overview of the application of the grounded theory method. The methodical development of the grounded theory codes is presented and how the coding process developed insight from which the overall grounded theory categories were established.

The second part of the chapter explicated the developed grounded theory categories: *balance and 'trade-off', process and context, power and influence* and *responsibility*. Each of the categories is expanded upon in turn and evidence is drawn from the rich empirical data to establish a strong narrative and the justification for its inclusion. *Balance and 'trade-off'* was established as the core category linking others within the concept of sustainable development; Section 5.5 provides additional detail.

Lastly, the chapter presents an analysis of stakeholder interests and interpretations of sustainable development. Amongst participants there is a prevalent weak interpretation of sustainable development, with emphasis on technological fixes in addressing and overcoming environmental and social constraints to development.

The subsequent chapter utilises the empirical findings developed from the implementation of developed stakeholder-sustainable development and applies them to the assessment of the impacts of noise. Noise was identified and considered due to the prominence of the impact as identified by *all* participants within this study. A review of available assessment techniques is undertaken, in light of the developed stakeholder centric understanding of sustainable development. And, thus the most appropriate assessment technique applied to aviation noise. Later, Chapter Seven- Discussion, reviews the results of the quantitative assessment of noise impacts in conjunction with the empirical findings, presented in this chapter, relative to the extant literature.

6. Research Process: Stage 2 – Valuation of Noise Impact

6.1 Chapter overview

Chapter Five presented the findings and analysis of the stakeholder interviews and the empirical data they garnered. In light of the grounded method theory applied by this research, four emergent themes were identified related to sustainable development in aviation: balance and trade-off (core category), context and process, power and influence and responsibility.

The focus of this chapter is to present a method of assessment of non-market impacts within the developed stakeholder-sustainable development framework. In light of stakeholders' reductionist stance regarding environmental impacts, the most identified detrimental impact is assessed, that of aviation noise.

Section 6.2 initially provides an overview of the underlying theory of policy assessment, and its focus on utility assessment and the 'Kaldor-Hicks compensation principle'. This initial review is then expanded to include non-market impact assessment and valuation. Identified are the two most commonly applied methods: stated preference and revealed preference techniques. An overview of the theory for each assessment technique is presented and critiqued for their methodological advantages and disadvantages.

Section 6.3, takes the identified impact of noise and appraises the two assessment methods with respect to the developed understanding of sustainable development formed by the interview stage of the research and the developed stakeholder-sustainable development framework. Identified as the most appropriate method satisfying the developed stakeholder-sustainable development framework is the hedonic pricing method (HPM). Within the hedonic pricing method there is clear geographic constraint to stakeholder status, the impact of aviation activity and the notion of 'trade-off'.

Subsequently, Section 6.3.2 presents an assessment of the noise social cost in the UK for the year 2013. An HPM assessment is undertaken at UK airports for which noise maps are created by DEFRA in accordance with the EU END. The total noise social cost for the modelled year is £102.2 million; the impact of noise at Heathrow Airport

accounting for 82% of the total. The average noise cost per passenger and ATM is £0.55 and £68.39 respectively

Section 6.4 undertakes a sensitivity analysis of two key assumptions within the HPM: long term interest rate and the noise depreciation index. The greatest influence was identified as the assumed noise depreciation index.

The following chapter (Chapter Seven: Discussion) brings together the findings of the interview process and the outputs of the HPM assessment and discusses both in light of the extant literature.

6.2 Valuing non-market goods and services

The following sections outline the economic theory behind the valuation of utility. These grounding principles shall be utilised in subsequent sections and chapters in the discussion and evaluation of assessment techniques of impacts.

Economists seek to estimate the monetised impact of a policy by analysing what impact the proposed intervention or investment has on utility. The premise of neo-classical economic theory is that individuals have preferences for both market and non-marketable goods (items not actively traded e.g. vistas, tranquillity) (Champ, 2003). An individual is assumed to prefer options or scenarios that maximise their personal utility. This preference order of non-market commodities (Q) can be considered a vector, $Q=(q_1, q_2 ..., q_k)$. Additionally, market commodities (C) can be considered as a similar vector, $C=(c_1, c_2, ..., c_n)$. The degree of utility extracted can be expressed for each bundle of goods (C,Q) as:

$$u(C, Q)$$

The procedure for social cost benefit analysis is the Kaldor-Hicks compensation principle (Hicks, 1939; Kaldor, 1939), this being; under project evaluation, a project is considered more efficient, and therefore more desirable, if the overall project costs are outweighed by the positive impacts that a project would entail. This efficiency can be achieved through the payment of compensation from stakeholders that stand to be 'net winners' to stakeholder groups that experience an overall loss of utility. No actual compensation or payment has to be exchanged between stakeholder groups. Thus, the issue becomes how should utility be measured and valued for a given range of non-market impacts?

Firstly, every individual, regardless of personal income, is assumed to be able to preference order a series of bundled goods. Money, being a finite resource, is used to obtain market goods or services that deliver the highest level of utility (Fujiwara, 2011; Champ, 2003). The price (P) of market goods (C) can be expressed in vector form, where $P=(p_1, p_2, ..., p_n)$. Utilising an individual's income (M), the indirect utility function (*v*) gives the maximised level of utility given income constraints to purchase market goods:

$$v(p, Q, M)$$

Non-market goods can be considered rationed, as they cannot be directly bought or traded by an individual. Each marketable good has a level of non-market goods associated with it. An individual is assumed to choose the marketable good which yields the highest level of utility, where the utility is derived as a combination of both the market good *and* non-market goods associated with it.

The provision of utility (the level of goods, both marketable and non-market goods in existence), the valuation of non-market goods, or the functioning of the market can be influenced by policy. Two methods of assessment are available to understand the impact of policy on utility: equivalent variation (EV) and compensating variation (CV) (Champ, 2003).

Equivalent variation is the amount of additional income that an individual would require to obtain the same level of utility given a change in the observed non-market good (Q). Thus:

$$v(p_0, Q_1, M_0) = v(p_0, Q_0, M_0 + EV)$$

Where *0* represents the original conditions of the system and *1* represents the situation after the policy intervention.

Compensating variation on the other hand is the amount of income an individual would lose as a result of a policy intervention due to a reduction in utility (Hicks, 1942):

$$v(p_0, Q_0, M_0) = v(p_0, Q_1, M_0 - CV)$$

Equivalent and compensating variation differ in the way property rights are assigned to an individual, and as such the level of utility used as the basis for comparison (Champ, 2003). The equivalent valuation method uses the *ex post* level of utility (after the policy

intervention) as the basis for the valuation of the non-market good. Compensating variation uses the *ex ante* level of utility.

In either scenario, without reference to the method of evaluation, an individual is assumed to seek to maximise their utility gain given budgetary constraints (personal or household income). In addition, it is assumed that an individual is never fully satisfied and places a positive value on the ever greater consumption of the non-market good, thus providing increased utility (Fujiwara, 2011).

The two measures introduced above, equivalent variation and compensating variation are often used interchangeably with two other labels (Freeman, 1993), depending on the explicit aim of the study: willingness to pay (WTP) and willingness to accept (WTA) (summarised in Table 22).

Table 22 Summary of welfare measurement methods

Welfare measure	Price increase	Price decrease
Equivalent variation (EV) – implied property right in the change	WTP – to avoid	WTA – to forgo
Compensating variation (CV) – implied property right in the status quo	WTA – to accept	WTP – to obtain

In cases where the policy change is unambiguously positive or negative the WTP/WTA terminology works well (Flores, 2003). In both cases, WTP and WTA, it is important to be explicit about what is being paid for and what is being compensated for respectively. And typically, WTP is often associated with a desirable change and WTA the opposite.

In whichever method is applied, changes in utility are measured as the degree to which an individual's preferences have been satisfied. The Axioms of Revealed Preference form the basis of preference techniques in valuing non-market goods (Houthaker, 1950; Pollak, 1990). They stipulate that an individual's preferences are rational. In this case, rationality, with regards to preference choice, must comply with the following three rules:

1. *Complete* – individuals are able to express a preference for any good or be indifferent between any pair of goods

II. *Transitive* – individuals who prefer (or are indifferent to) good *x* over good *y*, and who prefer (or are indifferent to) good *y* over good *z*, must also prefer (or be indifferent to) *x* over *z*; and

III. *Reflexive* – individuals are indifferent between *x* and *x*

Outlined above was the fundamental economic theory that underpins and relates utility and preference. Ideally the effectiveness and impact of policy would be analysed utilising real markets to understand its impacts on utility, but more often than not this is not possible (Blumenschein, 2008). The next stage is to understand how individuals exercise these preferences in the valuation of non-market goods and services. Two standard preference techniques have been developed to recover these values, where real markets do not exist: stated preference and revealed preference.

Stated preference techniques utilise surveys to elicit an individual's WTP (or WTA) an observable change in the provision of a non-market good. Revealed preference techniques infer an individual's WTP (or WTA) for a non-market good through the observation of behaviour in an existing, and related, functioning market. The following sections outline the two preference based valuation techniques and the methods available.

6.2.1 Stated preference methods

Stated preference methods utilise constructed surveys to elicit estimates of an individual's WTP or WTA a particular change in the provision of a non-market good, as the result of a policy intervention (Bateman *et al.* 2002). WTP is the *maximum* amount of money that an individual is willing to exchange for the proposed change in non-market good or service. WTA is the *minimum* amount of money that an individual is willing to receive in compensation for the change of a non-market good or service that entails a reduction in utility. The equivalent and compensation variation equations can be estimated using the stated preference methods WTP and WTA:

$$v(p_0, Q_1, M_0) = v(p_0, Q_0, M_0 + WTP_{SP})$$

Where $WTP_{SP} = EV$

$$v(p_0, Q_0, M_0) = v(p_0, Q_1, M_0 - WTA_{SP})$$

Where $WTA_{SP} = CV$

Two categories of stated preference methods exist: the contingent valuation method (CVM), which values the non-market good as a whole; and, the attribute-based methods, which seeks the valuation of specific attributes of a non-market good or service.

6.2.2 Revealed preference methods

Revealed preference methods estimate the value of non-market goods and services by analysing the behaviour of individuals in a real functioning market (Samuelson, 1938). The inference value, from a functioning market, is called the hedonic method. The underlying assumption of the hedonic method is that the level of provision of the non-market good or service affects the price of the market good being analysed (Rosen, 1974). Therefore, price differentials in the market good, caused by the level of non-market good associated with it, can be used to estimate the WTP and WTA. Considering again the non-market good as a vector, Q, where $Q=(q_1, q_2 ..., q_k)$, the EV can be estimated for marginal changes in Q:

$$v(p_0, Q_1, M_0) = v(p_0 - p_1(EV), Q_0, M_0)$$

Where p_0 a price vector for market goods before the provision of the non-market good and $p_1(EV)$ is an identical price vector except for the changed provision in non-market good.

The CV can be estimated as such:

$$v(p_0, Q_0, M_0) = v(p_0 + p_1(CV), Q_1, M_0)$$

The hedonic pricing method

The hedonic price method (HPM) can be used to estimate the value associated with characteristics of a market good. The most common application of the HPM is within the housing market to value the effects of environmental characteristics (Dekkers, 2009; Bateman, 2001; Rosen, 1974). Heterogeneous products, in this case houses, have variable characteristics making them distinct products even though they are traded in the same market. The variation in product, due to its unique characteristics leads to a variation in the price of the product. The underlying theory is that the variation in prices, between two otherwise identical products, save that they vary in one characteristic (e.g. exposure to noise pollution, proximity to a railway line, crime etc.). It is possible to infer the value, or trade-off, an individual is willing to pay for that change in characteristic, and ultimately utility.

As previously highlighted, the most common application of the HPM is within the housing market. The application seeks to estimate a hedonic regression function to estimate the effect of a non-market good on prices. The value of a residential property, much like any good, is a function of its characteristics (Rosen, 1974), in the case of a house: the number of bedrooms, the proximity amenities, the physical dimensions of the property etc. Hence, a house price (P_H) can be considered to be a function of a number of variables:

$$P_H = f(S_{il}, \ldots., S_{ij}, N_{il}, \ldots, N_{ik}, Q_{il}, \ldots, Q_{in})$$

Where, S, N, Q are vectors of structural, neighbourhood and environmental variables respectively. The above equation represents the hedonic function for housing, allowing an estimation of the implicit price of a characteristic to be established, e.g. S_k, a structural variable:

$$\frac{\delta P_h}{\delta S_k} = P_{Nk}(S_k)$$

Thus, from the partial derivative, the change in value of a property with one greater unit of S_k can be calculated. An amenity is represented by a positive partial derivative, where as a dis-amenity would be demonstrated by a negative partial derivative.

6.2.3 The strengths and weaknesses of preference based valuation

Outlined above were the theoretical foundations of utility and the two most common methods of valuing non-market goods: stated and revealed preferences. The following sections review the strengths and weaknesses of the two processes in light of the extant literature, and with specific reference to the analysis of the stakeholder interviews and findings of stage one of this research project. Finally the proposed method for the analysis of noise is outlined.

All preference based methods assume that individuals can predict and understand the effect of a non-market good on their utility and that the researcher can infer utility on people's decisions on the assumption that: "what is best for someone is what would best fulfil all his desires" (Parfit, 1984; p.494).

Numerous studies have demonstrated that individuals cannot accurately measure predicted utility due to the change in the provision of a non-market good (Kaheman, 2000). The observed utility mis-prediction is observed in studies of even a large sample size (Kahenam and Snell, 1992). This inability to predict with accuracy future changes

in utility is attributed to presentism heuristics, whereby future preferences are grounded in present demands (Gilbert, 2007).

Adaption, or more accurately an inability to predict adaption, and focussing illusions are other reasons why utility can be mis-predicted by individuals. It has been demonstrated that individuals consistently fail, or underestimate, their ability to adapt to a change in their environment. Generally, this misconception of adaption results in an over estimation and valuation of utility gain (or loss) (Kahneman and Thaler, 2006; Lowenstein, 1995). An example of focussing illusions is proportion dominance (Slovic, 2007). Respondents treat information presented in proportional form (percentages and probabilities) as more significant due to the fact that the outcome can be better perceived, as individuals are presented with a bounded option, i.e. scenarios that allow a participant to better understand the upper and lower bounds of options (Friedrich *et al.,* 1999).

The following sections build on the general review of preference based valuation above and in turn outlines the specific strengths and weaknesses of stated and revealed preference methods. Subsequently, a method is identified related to the outcome of the stage one interview analysis for the measurement of noise.

6.2.3.1 Stated preference methods

Stated preference techniques were outlined in Section 6.2.1, the following review focuses on CVM as the most popular and developed method.

Advantages

Wide application

In theory a revealed preference technique could be utilised to develop a valuation of practically *any* non-market good. There exists a wide body literature regarding the utilisation of contingent valuation techniques (Bateman, 2002), and its many issues and the credibility of the methods have been debated and tested (Brown, 1999; Carson, 1996).

Explore reasons behind preferences

Stated preference questionnaires may be constructed in such a way as to include questions exploring the reasoning for a participant's choice or answer to a WTP or WTA scenario. Additionally, characteristics of the participants can be gathered and

attitudes related to the non-market good can be explored. Winners and losers can be identified, particularly important in a stakeholder analysis and the distribution of benefits (Hummels, 1998; Bateman, 2002).

Furthermore, questionnaires allow the researcher to explore what aspects of a non-market good are being valued by participants, something which a HPM cannot (Smith and Huang, 1995). For example, with the issues of noise as considered here, is it the absolute level of noise or the frequency of disturbance that causes the participant's valuation?

Ex-ante application

Stated preference techniques allow hypothetical scenarios to be tested, which can be important to inform public policy or development and investment at an early stage in the process (Fujiwara, 2011).

Disadvantages

Hypothetical bias

The hypothetical nature of the scenario under investigation, and the proposed payment mechanism, can lead to inflated and inaccurate estimations of respondent's true willingness to pay and hypothetical bias (Neill *et al.,* 1994). Though hypothetical bias was demonstrated in Bohn's (1972) seminal work, the causes of bias are not well understood (Fujiwara, 2011). Hypothetical bias can include and result in non-commitment bias, strategic bias or be the result of the nature of the non-market good under investigation. Contingent valuation studies have demonstrated an overstatement of hypothetical WTP in comparison to real WTP (Brown, 1999; Neill *et al.,* 1994). Individuals have been demonstrated to overstate their valuation by a factor of two to three, when comparing hypothetical valuations against actual payments (Murphy *et al.,* 2005).

Protest valuations

Within a CVM survey procedure it is necessary for the researcher to eliminate protest valuations, these being responses that are either too large to reflect a true willingness to pay or 'protest zeros'. Protest zeros are where it is identified that respondents value a change in the non-market good, through responses to other survey questions, but is unwilling to pay and ascribes a zero valuation response (Diamond, 1994).

WTA-WTP disparity

As summarised in the previous section, WTP is the *maximum* monetary amount that an individual would be willing to spend to obtain a non-market good. On the other hand, WTA is the *minimum* amount of financial compensation an individual would accept for the loss of a non-market good. A vast body of evidence from the economic literature has demonstrated a WTA-WTP disparity, and little equivalency between loss and gain valuations (Cummings, 1986; Brown, 1999), this comes despite an expectation that "we shall normally expect the result to be so close together that it would not matter which [measure] we choose" (Henderson, 1941).

Methodological format and process

This disadvantage is broad and ranges from the practicality of undertaking a stated preference study to disadvantages of *all* survey-based methods. The most important consideration for this study is who should be the participants in the assessment, i.e. how do participants fit within the stakeholder framework. Additionally, the valuation method is resource intensive, both financially and temporally, requiring potentially extensive surveying at all fifteen of the study airports.

6.2.3.2 Revealed preference methods

Revealed preference techniques were outlined in Section 6.2.2, the following review focuses on HPM as the most popular and developed method, specifically in the analysis of housing markets.

Advantages

Estimates based on real economic choices

The outcome of any revealed preference technique is based on a functioning and real market; hence, the valuation is based on the real economic choice of individuals within the observed market.

Methodological format and process

A revealed preference technique, such as HPM, can utilise readily available public records and secondary data of housing, census output data, property transactions history, GIS and mapping programmes and data.

Disadvantages

Market imperfections

The validity and applicability of the HPM is dependent on their being in existence a relevant market where changes in the marginal provision of a non-market good can be observed (Freeman, 2003). Additionally, individuals have to not only comply with the *Axioms of Revealed Preference* (outlined in Section 6.2), also certain conditions about the availability of information must be satisfied; zero transaction and moving costs; and market prices must adjust to equilibrium with supply and demand changes.

Measuring WTP for non-marginal changes

Revealed preference techniques are well suited to measuring the welfare effects of marginal changes of non-market goods, i.e. a slight change in an existing non-market good (Boyle, 2003). Significant changes in the availability of a non-market good would represent a non-marginal change and applying a revealed preference technique is inappropriate (Freeman, 2003).

6.3 Noise social cost

Noise was highlighted throughout the stakeholder interview process as being the most important issue regarding the impact of aviation, both presently and in the future.

6.3.1 Choosing an assessment method

Mis-prediction of utility, whether through adaption or focussing illusions, is related to the familiarity of the individual respondent to the stimuli, or non-market good in question (Slovic, 2007; Gilbert, 2007). As previously identified in Chapter Five, the issue of noise is of a particular focus to this research and this chapter. Noise, or more specifically noise-nuisance, has tangible and perceived impacts on utility (quality of life etc. see Section 2.6). A clear dose-response relationship to aviation noise is observable (Jones, 2010a; 2009) and measured levels of exposure are readily available (DEFRA, 2006).

The stakeholder-sustainable development framework developed by this research is a two-stage process. The initial interview stage developed an understanding of the aviation system and sustainable development. It is with this understanding that the research project is to assess identified impacts, with an appropriate assessment technique.

This analysis stage developed four thematic concepts central to interpretations of sustainable development: balance (trade-off), context and process, power and influence and responsibility. As such, the two identified methods of stated and revealed preference techniques are reviewed, and an appropriate technique selected. This review of assessment methods is presented in Table 23.

Table 23 Assessment matrix of stated and revealed preference techniques with developed criteria

Criteria	Revealed preference (HPM)	Stated Preference (CVM)
Geographic confinement to assessment	Yes. Analysis limited to the noise footprint of the airport above background noise 55 dB(A)	No.
Clear identification of stakeholder identity	Yes/No. Stakeholders are identified as those within the noise footprint.	No/Yes. Stakeholder identification dependant on aspects of noise being investigated. Identification of participants subject to researcher preference
Role of stakeholder participation in the process	Participation in assessment is passive, as analysis if based on retrospective analysis of past choices	Participation is active in the survey stage of investigation
Implied effects of noise	Noise nuisance and its impact on welfare and utility. Expressed in valuation and preference for properties	Open to decision by investigator whether to investigate WTA or WTP and the quality of noise to measure
Participant understanding of noise	Individuals are assumed to make fully rational decisions, within budgetary constraints, to value noise impact on utility	Influenced by question formulation and presentation
Integration of notional 'trade-off'	Trade-off between noise impact on utility/welfare and actual house transaction price	Hypothetical trade of money
Insight into the distribution of costs	Geographic breakdown of costs at the household level	Dependant on the structure and formulation of the research method

A hedonic price method fulfils the criteria developed through the stage-one research process more fully than a revealed preference technique such as CVM. There is a

clearly defined impact area (within the noise footprint), where legitimate stakeholders are impacted; stakeholder saliency is gained from geographic proximity to the focal organisation (the airport). The HPM allows the 'trade-off' made by individual households to be established, the value of which is represented in actual real transactions.

6.3.2 An assessment of UK aviation noise social cost

The fifteen airports that form the basis of this study were chosen for a number of reasons, primarily data consistency and research practicality (see Figure 20). The fifteen airports considered within this report were only those within England and Wales deemed large enough (>50000 ATMs per annum) to warrant the creation of noise maps under the EU END (DEFRA, 2006). As such, data availability has limited the research to these fifteen airports. The fifteen study airports represent the vast majority of UK aviation activity; 92.5% of terminal pax and 82.4% of total ATMs (DfT, 2013a).

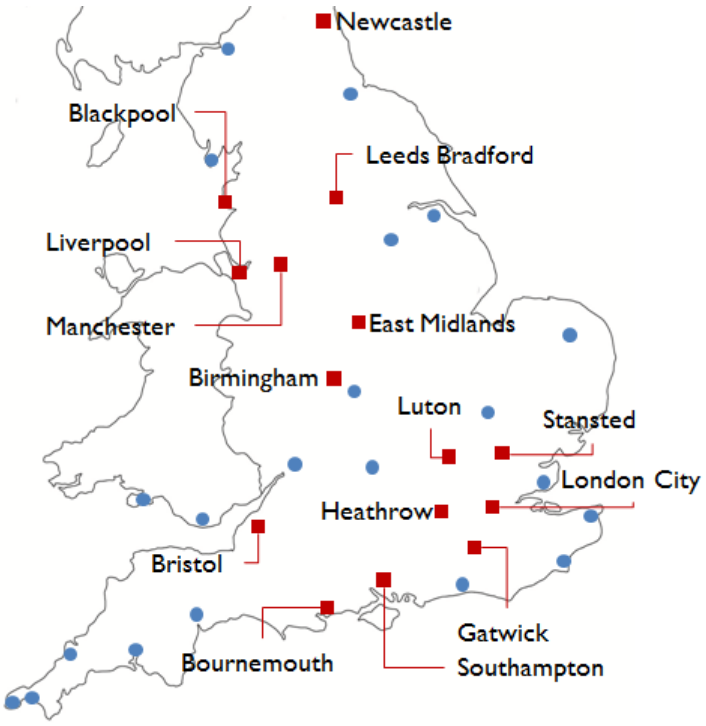


Figure 20 Map of study airports (red squares)

Section 6.2.2 outlined the theoretical grounding for the HPM. This section advances the method from theory to application. Subsequently an assessment of the cost of UK aviation noise is presented for the year 2013.

Outlined in the previous sections was the development of a partial derivative relating the change in property value with a change in the provision of a characteristic (in this

case noise). Most commonly this relationship within noise studies is summarized as the Noise Depreciation Index (NDI), which is percentage rate of price depreciation per dB(A) (Walters, 1975). NDI can be used to express the depreciation in property values between two identical houses bar their exposure to noise and can be defined as:

$$D = \frac{\Delta P}{\Delta N}$$

Where ΔP is the reduction in property value and ΔN is the difference in noise exposure. Thus:

$$NDI = \frac{D}{P} \times 100$$

Where P is the property value.

The HPM allows the total annual noise social cost to be estimated at a given airport (C_n):

$$C_n = \sum_{i}^{M} I_{NDI} P_v (N_{ai} - N_0) H_i$$

Where I_{NDI} is the noise depreciation index (NDI) expressed as a percentage, P_v is the average annual house rent within the locality of the airport. Therefore, $I_{NDI}P_v$ is the annual noise social cost per residence per A-weighted decibel (dB(A)). N_a—N_0 is the noise level above ambient, where N_{ai} is the average noise level for the i-th section of the noise contour and N_0 is the ambient background noise (55dB(A)). H_i is the total number of residencies within the i-th noise contour, and M is the total number of noise contours mapped.

P_v, the average house annual house rent, can be calculated utilising the average home value in the locality of the study airport. The value of a durable asset such as a property represents the discounted sum of all future rents (Taylor, 2003). When a market such as the property market is in equilibrium rental prices are proportional to the capital prices of the property (Freeman, 2003), as such a change in the property value results in a proportional change in the rental price of the property. The following capital recovery equation uses the house value (P), the assumed mortgage interest rate (r), and the average house lifetime in years (n):

$$P_v = P\left(\frac{r(1+r)^n}{(1+r)^n - 1}\right)$$

By combining the above two equations the total annual noise social cost at an airport can be calculated given appropriate input data, see below (Table 24).

Table 24 Summary of input data for noise social cost assessment

Input Data	Value	Data Source	Notes
Noise maps and population noise exposure	Various	DEFRA (2006)	Total population exposed to different noise levels around study airports (see Appendix B)
Census output data	Various	ONS (2013)	Middle Super Output Area data of number of households and populations. Calculate average household occupancy. Utilised in calculating number of residencies in noise contours (see Appendix B)
2013 property values	Various	Land Registry (2013)	Property values used within HPM (see Appendix B)
Noise Depreciation Index, I_{NDI}	0.62	Nelson (2004)	Utilised in HPM
Mortgage rate (%)	4.27	BoE (2013)	Average standard variable mortgage rate (SVR) (November '11-October '13)
Average house lifespan, *n*	100	RIBA(2010)	Average turnover of housing stock ~1% per annum

6.3.3 Results

The annual noise social cost of aviation noise across the 15 study airports is marginally in excess of £102.2 million per annum. Heathrow Airport has, by some considerable margin, the greatest contribution to the total (82%) of all of the study airports to the overall welfare impact (see Figure 21).

Though Heathrow is by far the biggest UK airport in terms of activity (Pax and ATMs), there is no clear demonstrable link between overall levels of aviation activity and welfare impact. Clearly, those airports with more ATMs will have a larger noise footprint as measured by area, but the impact on welfare and utility is dictated by local geographical and contextual factors: population exposure, property prices, layout of

airport and surrounding communities. Gatwick Airport in 2013 despite having triple the number of ATMs relative to Birmingham International Airport, 240,447 and 84,062 respectively, the social cost of noise at Birmingham International was more than quadruple that of Gatwick, £4.8 million and £1.0 million respectively (see Table 25).

Table 25 Calculated noise social cost of study airports (2013)

Airport	Noise social cost (2013)£ '000s	Airport	Noise social cost (2013) £ '000s
Heathrow	83,809	Gatwick	1007
Manchester	7008	London City	749
Birmingham	4830	Southampton	710
Stansted	1090	East Midlands	709
Luton	484	Liverpool John Lennon	359
Leeds Bradford	441	Bournemouth	201
Newcastle	376	Blackpool	41
Bristol	375		

Taking into account the relative activity at each of the study airports the annual noise social cost can be calculated per ATM and per terminal passenger. Unlike air passenger duty which is calculated only on an outbound (take-off) ticket, this calculation is for both outbound and inbound flights.

The average noise cost per passenger and ATM is £0.55 and £68.39 respectively. Besides Heathrow Airport, Birmingham is the only airport to have a social welfare cost on per passenger basis above average. No airport other than Heathrow has an above average social welfare cost on a per ATM basis. This result highlights both the high-level of activity at Heathrow and also the total social welfare cost which significantly affects the mean.

The results of this analysis are discussed at length in the following chapter (Chapter 7 – Discussion).

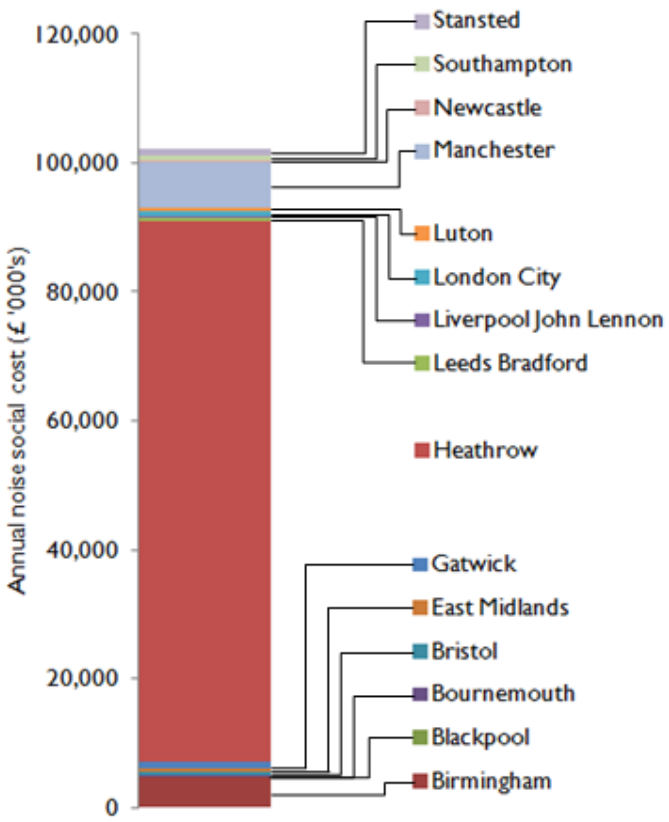


Figure 21 Calculated annual (2013) noise social cost at study airports

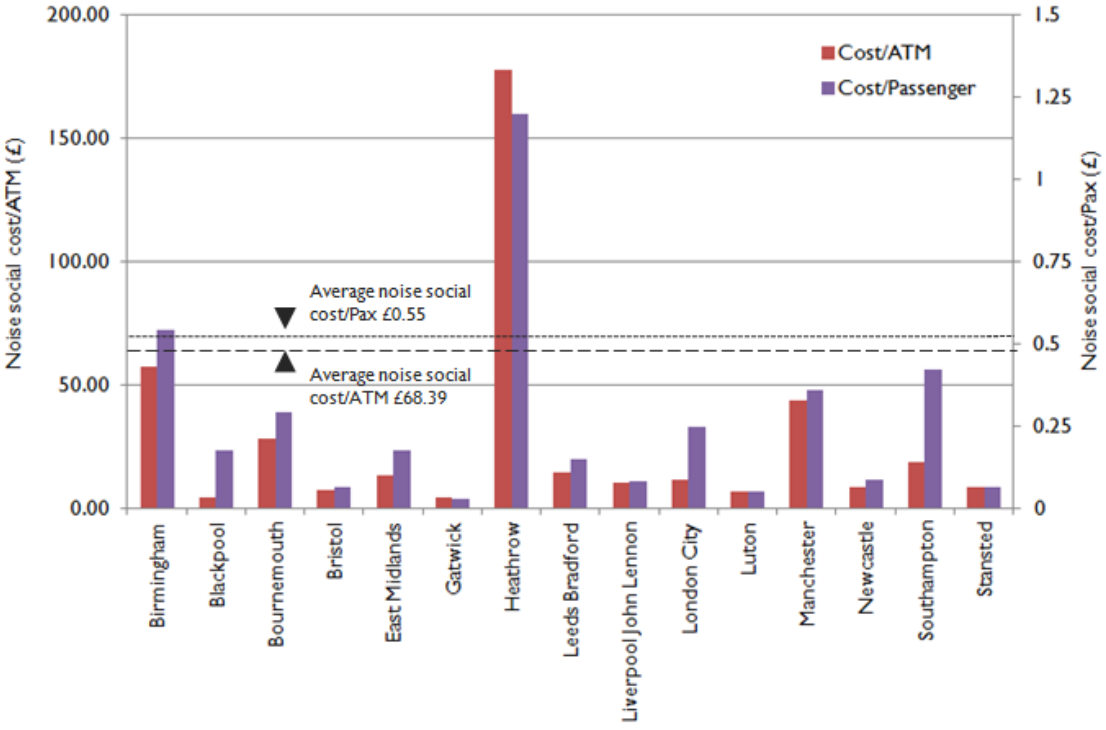


Figure 22 Calculated annual (2013) noise social at study airports per ATM and Pax

6.4 Sensitivity analysis

The application of the HPM has involved the assumption of certain values most notably the noise depreciation index (I_{NDI}) and the long term interest rate utilised in the capital recovery equation. As such, the research explores the implications of these assumptions.

6.4.1.1 Noise depreciation index

The chosen value of the noise depreciation index was chosen as 0.62% as the median value of HPM studies surrounding airports calculated from a meta-analysis of studies (Nelson, 2004). However, the meta-analysis and more contemporary studies demonstrate considerable range within the NDI utilised in HPM studies (see Table 26).

Table 26 Summary of NDI values in air transport studies

Study	NDI	Period	Study area
Dekkers (2009)	0.77	1999-2003	The Netherlands (Amsterdam Schipoll Airport)
Nelson (2004)	0.5-0.9	1969-1993	Canada, US, UK
Bateman *et al.* (2001)	0.29-2.3	1960-1996	Austrailia, Canada, US, UK

The values for NDI presented above are from a range of international and national studies. Specific UK studies have been limited, but the NDI is consistent within the range of published results: Pennington's (1990) study at Manchester International Airport estimated an NDI of 0.47%; and, Gautrin's (1975) study at Heathrow estimated an NDI of 0.62%. The preferences of individuals regarding noise and hence noise disturbance valuation and subsequently the NDI have been demonstrated to be consistent with time (Nelson, 2004).

With the above variance of the NDI in mind, two scenarios are constructed to show the upper and lower bound: 0.29% and 2.3% respectively.

The effect of changing the NDI is a change in the absolute value of the social welfare cost of noise with changes in the NDI of 0.29% and 2.3% resulting in an annual cost of £47.8 million (53% decrease on the modelled scenario) and £379.1 million (270% on the modelled scenario) respectively (see Figure 23). The proportional contribution of each study airport to the overall total remains consistent with the original modelling results, e.g. Heathrow Airport remains 82% of total.

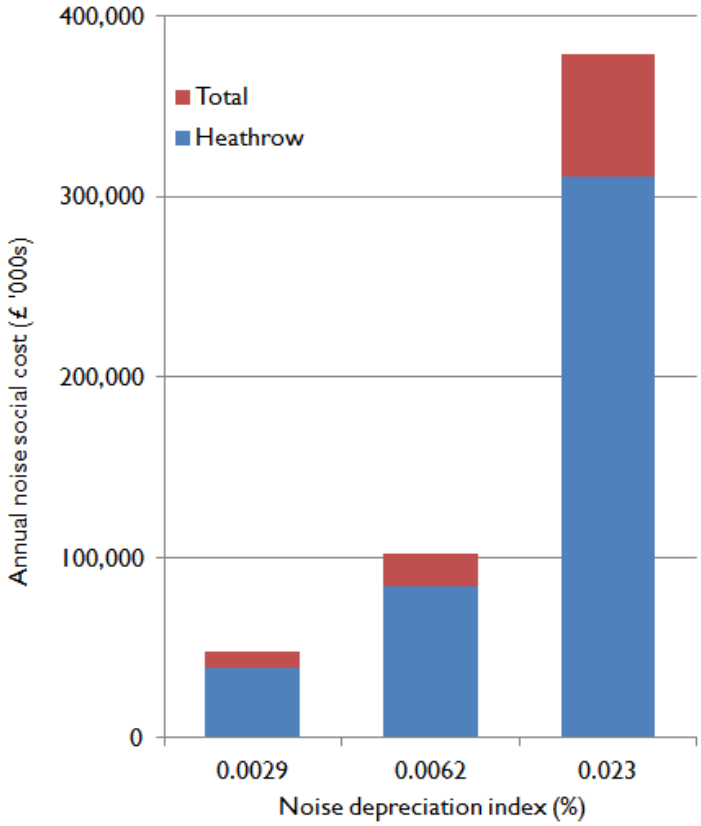


Figure 23 Annual noise social cost for various noise depreciation index scenarios

6.4.1.2 Interest rates

Within the capital recovery equation (see Section 6.2) assumptions of the long term interest rate have been made. Utilised in this study was the average standard variable mortgage rate as reported by the Bank of England for the previous 24 months. As demonstrated by Figure 24 current interest rates on SVR mortgages are low by contemporary historic comparisons. With this in mind, a scenario is constructed where the interest rate utilised in the capital recovery equation is equal to the 12-month average before the start of the current financial crisis, this date is chosen as pre-31/10/2008 (5.15%), when co-ordinated global action was taken by central banks to lower interest rates.

An increase in the interest rate utilised in the capital recovery equation leads to an increase in the social welfare cost of noise at the 15 study airports (see Figure 25). The total cost of noise is in excess of £122 million (for 2013), a 19.5% increase on the modelled scenario.

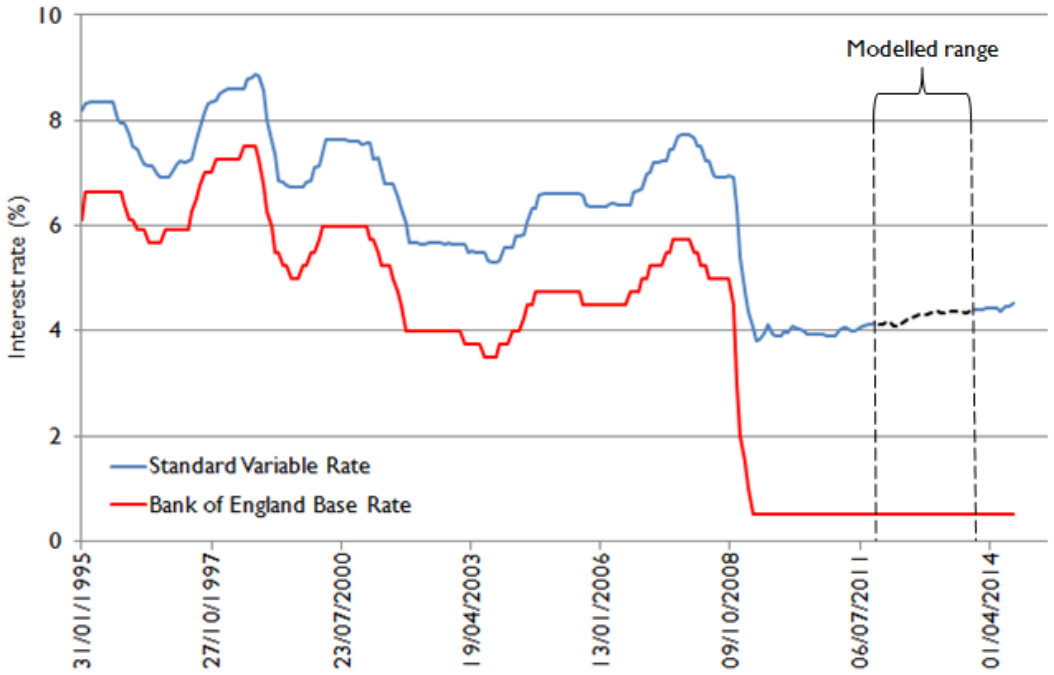


Figure 24 Standard variable rate mortgage interest rate and Bank of England base rate from 1995 to 2014 (November). Data Source: (Bank of England, 2014a; 2014b)

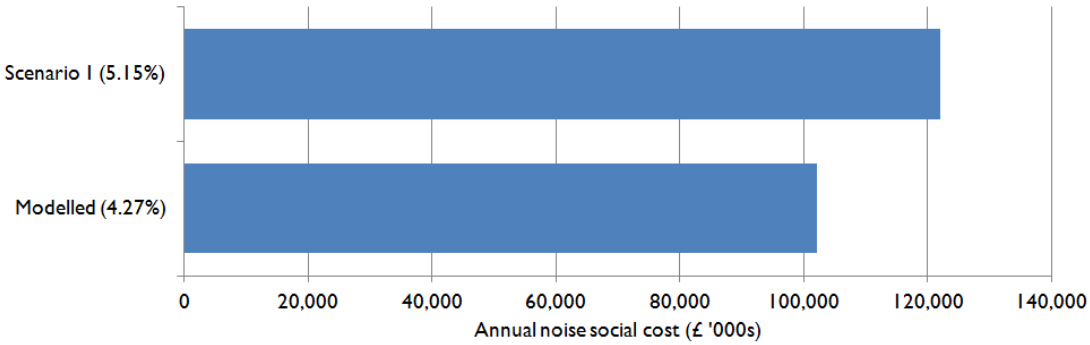


Figure 25 Noise social cost for two interest rate scenarios

6.5 Chapter summary

The assessment of different policy scenarios regarding aviation development can involve the trade-off between different impact categories and considerations of the absolute scale of impacts. As highlighted over previous chapters, sustainable development is a multi-dimensional concept involving a range of market and non-market impacts.

Traditionally policy scenarios have been assessed by a social cost benefit analysis, and the effects of non-market impacts on utility. However, as highlighted throughout this chapter a range of assessment techniques exist for measuring non-market effects: stated and revealed preference techniques. The choice of technique is a value-laden decision made by the assessor, containing biases, assumptions regarding distributions and participation etc.

Developed in the previous chapter as a result of the interview process is a contextual understanding of sustainable development in aviation. Noise nuisance was highlighted by each of the participant stakeholders as being one of the most important and widely perceived impacts of aviation activity. Utilising the developed thematic categories from the interview process (balance and context) the HPM was applied to the 15 study airports to quantify a monetary value of noise impacts for the year 2013.

The modelled social welfare cost of aviation activity at the study airports was calculated as £102.2 million (2013). Heathrow Airport constituted the greatest contribution to the overall impact (82%). The results highlighted how specific geospatial factors (runway positioning, location of local populations) influenced the results, with airports of similar levels of activity having different annual noise social costs. The sensitivity analysis highlighted how some input data assumptions could significantly affect the overall result, specifically the noise depreciation index.

The following chapter draws together the results from this present chapter, and that of the stage-one interview process, and discusses the results in light of the extant literature on sustainable development, stakeholder theory and transport research.

7. Discussion

7.1 Chapter overview

This discussion section relates the findings of this research project with the extant literature of sustainable development and stakeholder theory. As such, given the interdisciplinary nature of the study, and the methodology developed to enquire and research the phenomena of sustainable development in aviation, it is split into four parts. These four sections broadly follow the narrative of the study presented over the previous chapters.

The first part (Section 7.2) expands and reflects on the developed stakeholder-sustainable development framework. Broadly the framework is capable of exploring the concept of sustainable development in aviation from a multi-stakeholder perspective. However, a limitation is identified in the appreciation of global environmental impacts; a limitation of stakeholder theory itself.

The second part explicates the connections and links between the grounded theory categories developed as a result of the stakeholder participant interviews, as presented in Chapter Five. It explicitly links each of the four categories and how the core category of 'balance and trade-off' is central to sustainable development in aviation. The core categories are related and compared to the extant literature, to contextualise, strengthen and verify the findings.

Section 7.4 part three of this chapter, builds from the development of the first stage of the research and discusses the quantitative assessment and valuation of noise. The adoption of the hedonic price method via the empirically based framework established via the interview process is discussed in light of the literature of policy assessment and sustainability assessment. The subsequent valuation of noise impact is related and compared to previous published studies on the topic.

Finally, Section 7.6 relates the findings of the study and the developed stakeholder-sustainable development framework with the wider literature of stakeholder theory concerning stakeholder status and the role and consideration of nature.

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To aid the reader the grounded theory categories, developed as a result of the empirical investigation, are summarised below (Table 27).

Table 27 Summary of grounded theory categories

Grounded theory category	Comment
I. Balance and trade-off	*Impacts, impact categories, scale, distribution*
II. Context and process	*Scale, time factors, change*
III. Power and influence	*Image, politics, relationships*
IV. Responsibility	*Cost, burden, fairness, distribution*

7.2 The stakeholder-sustainable development framework

Sustainable development entails the attainment of simultaneous goals: social, environmental and economic improvement; managing and more importantly *measuring* this paradox causes challenges (Epstein, 2014). The developed stakeholder based framework aimed to address both these challenges.

Stakeholder theory has become one of the dominant approaches within business and government for understanding the interactions of business and society (Hasnas, 2012). Freeman (2002) attests that the strength of stakeholder theory is the flexibility of the concept:

> *"[t]he stakeholder theory" can be unpacked into a number of stakeholder theories each of which has a "normative core," inextricably linked to the way that corporations should be governed and the way that managers should act. So, attempts to more fully define, or more carefully define, a stakeholder theory are misguided.*

(*ibid, p.44).*

Stakeholder thinking and the application of stakeholder theory have previously been identified as means of conceptualising sustainable development in the strategic management of operations (Hörisch, 2014; Starik and Kanashiro, 2013; Konrad *et al.,* 2006, Steurer *et al.,* 2005). Central to these developments has been how and why

nature should be included in stakeholder management. Nature has either been depicted as a legitimate stakeholder in itself (Starik, 1995), or by stakeholder proxy (Phillips, 2000; Orts and Strudler, 2002). This research supports the latter consideration, a matter discussed in greater detail in Section 7.6.1. Where the developed framework advances the concept and integration of stakeholder thinking and sustainable development by extending the connection from a means of exploring stakeholder relationships, identities and the paradoxes of stakeholder interests, and embedding the stakeholder concept into quantitative assessment of impacts.

The prevalence of weak and very weak interpretations of sustainable development amongst the vast majority of system stakeholders (discussed in greater detail in the following section), reductionist interpretations of environmental impacts and the degree of substitutability (highlighted by the core category of balance and 'trade-off') between impact categories has led this research to pursue assessment of impacts through the application of methods consistent with the continuation of the neoclassical values and economic models. Such a development would seem at odds with the very purpose of stakeholder theory; advancing the purpose of business beyond traditional shareholder value maximisation (Freeman, 1984). Indeed the intention of stakeholder theory is to advance strategic management beyond the conceptualisation of value purely in monetary terms, and into broader interpretations of quality of life and stakeholder value (Hörisch *et al.,* 2014; Jones, 2013; Evan & Freeman, 1993).

It is argued that the proposed application of stakeholder thinking and monetary based assessments of impacts is not in violation of the normative foundational principles of stakeholder thinking: the stakeholder enabling principle, the stakeholder fiduciary principle, and the principle of stakeholder recourse (Freeman, 1984; Evan and Freeman, 1993; Freeman 2004) (see Section 3.2). For the example of aviation noise, that is examined in this research, the calculated sum total is not intended to be a figure equal to compensation disbursed to affected stakeholders within the noise footprint of an airport, a notion flatly rejected by stakeholder participants, but can be used a means of understanding the social impacts of business and the ethical responsibilities related to those affected stakeholders. Though, financial compensation commensurate to the size of the impact contributed to a local community fund was welcomed. Here the emphasis is less on direct financial compensation due to lost utility and welfare impacts but on broader quality of life values, central to stakeholder management (Freeman, *et al*., 2010).

Critics of stakeholder theory and a stakeholder approach to management argue that it leaves management with no framework for effective management, unlike a singular objective function of profit maximisation. Though this critique is focussed on the corporate-centric applications of stakeholder management, it could be envisioned to transcend to all applications in alternative perspectives.

The understanding of sustainable development garnered from this research highlights a fundamental shift in business society relations if it is to be attained. Considering the four grounded theory themes developed (balance and 'trade-off', power and influence, process and context and responsibility) they require new functions and purposes of stakeholders individually, as institutions and companies. As understood from the participants in this research the purpose of the aviation system is to transport passengers in order to support the wider economy and society, not to maximise profits. Thus, stakeholder relations become more cooperative and participative in decision-making. The proposed stakeholder framework, like other proposed sustainability management theories "would likely not include efforts to micromanage solutions to these catastrophes [e.g. anthropogenic climate change, environmental degradation], it would likely provide a framework for developing and implementing broad sustainability solutions" (Starik and Kanashiro, 2013; p.17). These solutions have to be linked to societal demand (Hawken, Lovins and Lovins, 1999), i.e. the reflection of social, environmental and economic costs in the market pricing of services. As reflected on above, the results of this research highlight a continuation of neo-classical economic structures, with suitable regulation to account for the environmental and social costs not currently reflected in the market.

Resultant interpretations of sustainable development, from the application of the stakeholder thinking based framework, reflect the values, judgements and interpretations of participants. These value propositions are the result of wider interactions with society and other stakeholders; stakeholders do not exist in a moral vacuum (Freeman, *et al*., 2000). Therefore central to the successful application of the developed stakeholder framework is the need for sustainable development to be one of these values (Hörisch, 2014). Thus, there are three core challenges in its application:

I. Sustainability must be an *interest* or value of stakeholders
II. Creation of mutual sustainability interests between stakeholders
III. Ensure adequate consideration of nature through stakeholder proxies *with* inter-generational thinking

As highlighted in Section 5.6.2 an analysis of stakeholder interests in the aviation system highlighted that sustainable development is an integrated concept (i.e. covering social, environmental and economic dimensions) and was not identified as the *primary* interest of most stakeholders, with the exception of the two environmental NGOs. Self-identified stakeholder interests in aviation usually related to one of the competing dimensions of sustainable development, with the interest defined by the specific context (geographic location) of the stakeholder position in the aviation system (e.g. a LCR concerned with local noise impacts of flights surrounding the airport, LBG interested in the business facilitation or investment engendered by the proximity of a local airport).

As such, though a stakeholder approach can support the procedural aspects of sustainable development due consideration and weighting of global environmental impacts and considerations was potentially inadequate given the magnitude of the scale of the challenge (further discussed in Section 7.6.1).

7.3 Perspectives of sustainable development

Within the concept of sustainable development there were identified to be four emergent themes: balance and trade-off, context and process, power and influence and responsibility. Though these seem rather abstract notions in comparison to the tripartite conceptions of sustainable development considered in Chapter 2, the author would argue that the empirical findings of this study do not reject such notions as balance between economic, social and environmental dimensions, but instead they form just one aspect of sustainable development. The findings of this research see this tripartite balance nested within the central and key theme of 'balance and trade-off', but of equal merit is the *process* of sustainable development, the latter three grounded theory categories emphasise the qualitative strengths and aspects of sustainable development.

Popular analogies of sustainable development, such as Elkington's (1998) triple bottom line concept, reduce sustainable development to a line in an accountant's ledger. The popularised depiction of sustainable development as the intersection of a tripartite Venn diagram (used by this author in Chapter 2) simplifies the concept to a sustainable development plane. In much the same vein, Hodlen *et al.'s* (2013) development of the 'sustainable development area' reduces the concept to a series of x and y co-ordinates. Whereas these definitions provide quantitative insight into the relative effectiveness of interventions, developments or policy on pre-defined scales of success, they overlook

and negate to appreciate the process driven nature of sustainable development, the qualitative richness of systematic stakeholder engagement and the identified secondary-dimensions of sustainable development.

Almost a resignation amongst stakeholders that the aviation industry has to grow, *a fait accompli*

> *Obviously the airport has to grow. It gives an economic development for the people that are living here, because obviously the more it grows the more jobs it will give to local people.* [SRA1_LCR2]

Sustainable development requires choosing the *best* solution to a multi-faceted issue involving socio-economic factors that are affected by a dynamic and temporally shifting value landscape.

Often the discourse regarding the epistemological stances of sustainable development are presented as weak vs. strong, business vs. the environment (Des JardNilsen, 2010; Pearce, 1993; Pezzy, 1992), a dichotomous presentation, a clear division between the two, is far from the observed reality. Though the sustainability spectrum (Pearce, 1993b), presented in Chapter Two: Section 2.3 , presents a range of stances, with varying degrees of adherence to the principles of substitutability, growth and ethics. Participant perspectives ranged from very weak interpretations, with one extolling the sentiment of free-marketer Milton Friedman's classic article *The Social Responsibility of Business is to Increase its Profits* (1970):

> *I think it is business staying in business whether it is an airport or an airline staying in business is really rather important.* [SRA1_ACC]

In many cases the participants demonstrated a confusion of sense when defining sustainable development. Definitions rarely conformed discretely within the confines of accepted definitions, but adhered to certain principles in each; in some cases 'cherry picking' across the spectrum. A case in point being LCR2_LRA who identified clear limits to the damage and deleterious effects on the local natural environment (the application of limits being aligned with a strong definition of sustainable development), but when considering global impacts (e.g. climate change) there was the acceptance of damage being offset by economic game (the application of 'substitution' being aligned with weak interpretations of sustainable development).

Not surprisingly, an individual's response to defining sustainable development was shaped by that individual's point of view and position within the aviation system. Those individual participants who were either representing or part of an organisation, presented definitions of sustainable development drawn from corporate literature or their agreed corporate stance. Individual's definitions of sustainable development more often related to environmental impacts of aviation, particularly those local environmental impacts that they could witness or directly perceive (noise, smoke, local air pollution).

There is the risk that sustainable development becomes a fashion trend in development. The term sustainable development has become "an article of faith, a shibboleth; often used but little explained" (Tolba, 1987; p.98). This can be seen across the breadth of interpretations held by interview participants within the aviation stakeholder system; epistemological stances: ranging from very weak to strong. Most stakeholders use the term interchangeably with ecological sustainability, economic sustainability, or environmentally sound development.

The utilisation of CBA involves the aggregation of costs and benefits from a range of social, economic and environmental impacts. Thus, CBA is intrinsically associated with a weak sustainability perspective and a reductionist stance, as previously discussed in Section 2.5

One of the central themes identified within this research is that sustainable development is a process of change which introduces a temporal element. This temporal element is vitally important when making decisions about infrastructure development to meet future need and demand. Sustainable development is a value laden concept, requiring the identification of impacts, their relative importance, how the effects of these impacts should be distributed amongst stakeholders (both beneficial and detrimental) etc. A practical example of how this relates to aviation is evidenced in the *Attitudes to Noise from Aviation Sources in England* (ANASE, 2007) commissioned by the DfT, a follow-up to earlier work conducted in 1982: *United Kingdom Aircraft Noise Index Study*. A comparison between the results of both studies indicated the same dose-response relationship of increasing annoyance with increased level of noise exposure. However, the contemporary study found an increased sensitivity to noise exposure (from aviation) at lower levels, concluding the impact of a "taste effect", whereby respondents have become less tolerant of noise over time.

The analysis of the stakeholder interpretations of sustainable development highlighted a prevalent weak interpretation of sustainability. These interpretations accept a form of sustainability that is consistent with 'business as usual' scenarios and existing neoclassical economic structures within society. Excluding the two participating environmental NGOs, participants broadly fell into the weak or very weak interpretations of sustainable development (see Table 21). Both interpretations accept substitutability of 'capital' between the three dimensions of sustainability (economic, environmental and social), and the aim of development to enhance the total 'capital stock' of society. In both of these definitions eco-efficiency is accepted as the premise for development, and therefore does not challenge the current approach of development and *ergo* broadly an acceptance of 'business as usual'. These technocentric interpretations highlight the role of technology in overcoming environmental, and to a lesser degree social concerns and pressures: greenhouse gas emissions, noise, resource scarcity and use etc. This 'technical fix approach' or 'technocentricism' (Welford, 1997) are intended to allow the continuation of present systems and structures, requiring no behaviour change of end users in addressing environmental pressures.

Examples of this technocentricism to addressing the challenges of sustainable development within aviation include the adoption of new lightweight and novel materials in airframes (e.g. carbon fibre reinforced polymers CFRP), new engine variants and the introduction of biofuels.

Views of stakeholders within this research, and their reliance on technocentric solutions, agree broadly with societal views on the impact of flying, and transport more widely, on the environment. The British Social Attitudes Survey (2012; DfT, 2013c) echoed stakeholder sentiment within this research: that people should be able to travel by plane as much as they like (see **Error! Reference source not found.**). Participants, besides the two participant NGOs, did not want to reduce the scale of aviation in the UK, but saw the attainment of sustainable development and the addressing environmental and social challenges (gaseous emissions and noise) through the adoption and development of new technologies (e.g. airframes, engines, biofuels), rather being willing to reduce the amount they fly (see Figure 26). This is broadly reflective of wider attitudes in society. The population is more inclined to address environmental concerns (in this case the use of cars) through the adoption of models that reduce the environmental impact of use (in this case CO_2 emissions) rather than curtails or in some way rations use.

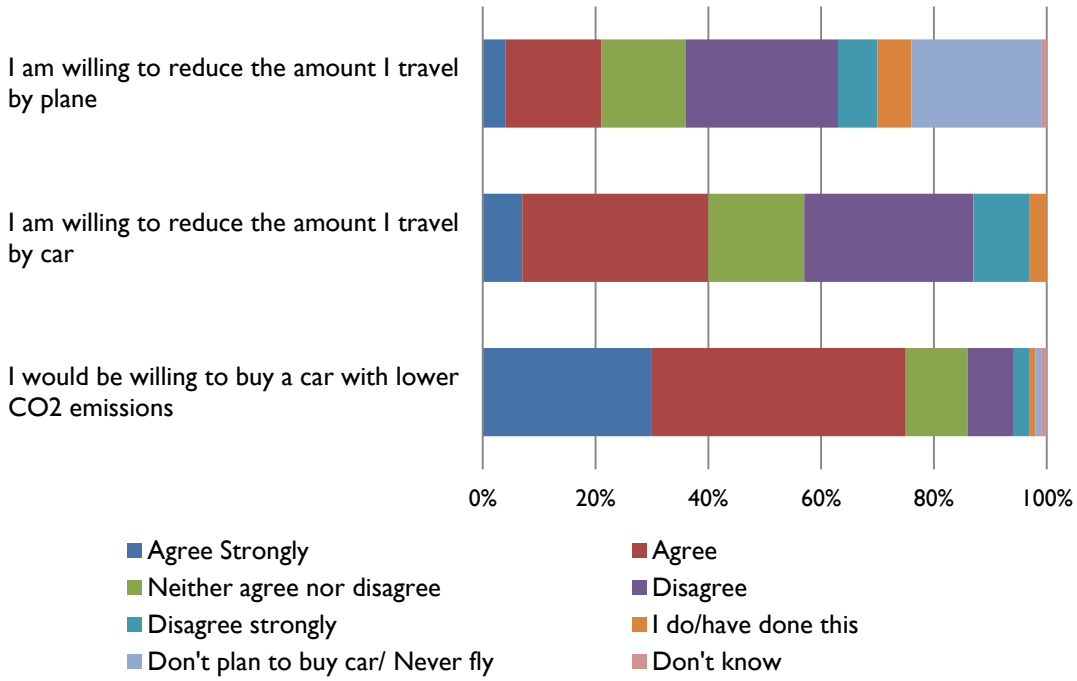

Figure 26 Attitudes towards mitigation options for the reduction of environmental impacts of flight and car travel. (Data source: British Social Attitudes Survey, 2012; DfT, 2013c)

Sustainable development is as much concerned with the end state of a system as it is with the process and 'direction of travel' in meeting this end state (Gasparatos, 2012). Stakeholder participants highlighted this in their definition of both what sustainable development was in practice and also what their respective contribution to the attainment of that vision. Freeman (1984) originally highlighted in *Strategic Management: a stakeholder approach* the importance of stakeholder participation in the decisions making process on the basis of social justice. Criticisms of stakeholder theory underemphasise the procedural fairness associated with stakeholder enterprise, by extension this proposed framework, and over emphasise the financial distribution amongst stakeholders (Phillips, 2003). The view of SRA1_LCR1 is a case in point: "*I think it works if everybody feels they have had the opportunity to say something and they understand the other person's point of view and there is a balance. In the end I suppose, we all have to know that we can't get our own way all the time*", where the end distribution of costs borne was more acceptable, if those affected had the opportunity to voice their concerns and was felt considered, a view echoed by LRA_LCR2. This result chimes with the earlier observations of Lind and Tyler (1988) that people are more accepting of the outcomes when the procedure for distribution is perceived as fair, even when the outcome distribution on those involved is poor.

7.4 The notion of 'balance': Noise

Noise was highlighted by all participants as one of the major detrimental impacts of both contemporary aviation activity, and planned future development and expansion. Furthermore, the empirical findings of this study, established from the developed stakeholder-sustainable development framework, has allowed the identification and utilisation of an appropriate assessment method: the hedonic price method.

The identification of noise is consistent with the past statements of Government made over the last decade: "[noise is] one of the most objectionable impacts of airport development" (DfT, 2002). The notion of 'balance' and a 'balanced strategy' have been central components of government policy regarding the future development of aviation for over a decade, and corroborated by this study. A 'balanced strategy' was central to the 2003 White Paper *The Future of Air Transport* (DfT, 2003) and subsequently reaffirmed in the 2013 updated *Aviation Policy Framework* (DfT, 2013b):

> *The aviation sector is a major contributor to the economy and we support its growth within a framework which maintains a balance between the benefits of aviation and its costs, particularly its contribution to climate change and noise.*

(ibid, p.9)

This 'balanced strategy' is echoed in industry publications regarding aviation noise and future noise management and mitigation (ICAO, 2001; Sustainable Aviation, 2013). Hence, the findings of the interview process, and the core grounded theory category of 'Balance and Trade-off' by stakeholder participants (presented and discussed in the previous section), are consistent with this. The views of balance, and subsequently the prevalent adoption of a weak interpretation of sustainable development, support the concept of substitution, in this case the social costs of noise being offset by a gain in physical capital: jobs, economic prosperity and local development.

From the application of the grounded theory categories and insight garnered from the application of the developed stakeholder-sustainable development framework, the hedonic pricing method (HPM) was identified as the most relevant technique of non-market valuation. HPM is consistent with the developed grounded theory categories of balance, notions of stakeholder status and the understanding and perception of the geographic limitations of stakeholder claims and impacts.

The possibility of validating the calculated noise impacts of this study by comparison to others in the published literature is limited; previous studies into the monetisation of noise impacts have been limited to the individual airport scale (Bateman *et al*., 2001; Nelson, 2004), or at a global scale (He *et al.,* 2014). This study is the first example found by the author of a UK-scale calculation of aviation noise. It should be noted that the calculation covers the fifteen study airports representing the vast majority of UK aviation activity; 92.5% of terminal pax and 82.4% of total ATMs. As noted in Section 6.3.2, the calculation was limited by available and consistent noise maps with population exposure data.

As a result the vast majority of noise impact evaluations have been limited to high income countries, particularly the US, Western Europe, Canada and Australia (Bateman *et al.,* 2001; Nelson, 2004). A recent analysis by He *et al.* (2014), utilising a novel noise-monetisation methodology based on personal income, at 181 airports worldwide calculated an annual noise impact of $1.3 billion (£0.83 billion) in 2005. One limitation of extrapolating the HPM to other contexts is the limited availability of data of house prices, rental yields and noise exposure at a fine resolution for any airport under investigation.

This research estimates the noise social cost of air travel in the UK to be approximately £102.2 million (for the year 2013), a cost that is directly borne by residents within close proximity of the airport and bounded within the noise footprint of an airport. However, the impact of noise, and the debate regarding its significance, is often presented relative to the national level benefits of aviation (ATAG, 2014; AOA, 2014; Sustainable Aviation, 2013), which in the UK are estimated to be in the region of £21.3 billion (OEF, 2011).

The analysis presented considered the impacts of two data input assumptions: long-term interests (utilised in the capital recovery equation) and the noise depreciation index (NDI). The valuation of noise was most sensitive to the assumption of the NDI. The NDI utilised was identified as the mean from a meta-analysis of prior HPM studies, with a range of 0.29% to 2.3% and a corresponding valuation range of £47.9-£371.9 million. The upper bound calculation is approximately 44% of the global total of the He *et al* (2014) global study.

One of the central methodological issues of utilising the HPM, in calculating and valuing noise impacts, is the requirement, and subsequent assumption within the research, of a perfectly functioning real market, in this case the residential retail market. Section 6.2

outlined the assumptions made by individuals when valuing a market, these valuations are assumed to be rational and made utilising all available market data. A study by Pope (2008) indicates that buyers of residential properties are not fully informed of the noise levels at homes, the result being an underestimation of marginal noise impacts. As part of the *Consumer Protection from Unfair Trading Regulations Act 2008* estate agents are obliged to divulge information of a property that may affect the transactional decision of a consumer; in this case whether a property is within a noise footprint of a local airport. Thus, it is assumed prospective buyers make a rational decision and can understand the impact potential noise nuisance may have on their utility and value a property proportionately.

The HPM values the noise impact of aviation on marginal utility and does not directly calculate the impacts of noise on health (sleep disorders, hypertension). The HPM can capture some of the impacts on health only if it is assumed that purchasers have a full comprehension of the links between noise impacts and their health. As highlighted earlier in this study (see Section 2.6.2), understanding the link between health impacts and aviation noise is not well understood and is an evolving field (WHO, 2011; Hansell, 2013; CAA, 2014b).

The HPM calculates the direct impact of noise on utility, or "use valuation" and is therefore not a complete 'total valuation'. A total valuation of noise would take into consideration non-use or passive aspects, an example being the impact of noise on tranquillity in local landscapes. As such, the computed valuation of noise is incomplete, but could provide a working estimate of the scale of noise impacts in the vicinity of airports.

A recent review (Jones, 2010b) of the impact of aircraft noise on children's' learning summarised evidence "of a deleterious impact on memory, sustained attention, reading comprehension and reading ability" (p.18). The integration of these impacts into a comprehensive understanding and valuation of aircraft and aviation noise would be methodologically challenging, and goes beyond the scope and limited resources of this project.

7.4.1 Broader notions of balance in sustainable development

The novelty of the developed stakeholder framework informed the selection of assessment technique and methodology of noise. In turn this was used to calculate the annual noise social cost borne by local communities within the noise footprints of

airports. But, how does this advance the implementation of, or our understanding of sustainable development? Balance and trade-off was established as the core developed grounded theory category. Stakeholder theory entails the balancing of competing stakeholder interests and need (Freeman, 1984; Phillips; 2003), though how balance is achieved is not prescribed. As such, several philosophies related to distributive justice exist (Marcoux, 2000):

- *Egalitarianism* – Distribution similar to John Rawls' *Difference Principle* costs and benefits broadly equally shared, but inequalities may exist if "they are to be of the greatest benefit to the least-advantaged members of society" (Rawls, 1971; p.47)
- *Equalitarian* – Equal shares for all stakeholders
- *Meritocratic* – Distribution relative to input

This research highlighted that in the distribution of costs and benefits within the aviation system there can be losers, i.e. they bear a net cost as a result of aviation activity. Participants strongly favoured a meritocratic system of benefit distribution reflective of the inputs, risks and costs borne by each stakeholder. Identified as the greatest 'net-benefiter' from aviation should be the passenger themselves, as long as the ticket price and the market reflects the total costs to society, or as much as can be reasonably calculated. Thus, the findings agree with Phillips and Freeman's (2003) earlier thoughts on stakeholder distribution in a corporate-centric application of stakeholder thinking: "corporations should attempt to distribute the benefits of their activities as equitably as possible amongst stakeholders, in light of their respective contributions, costs and risks" (p.488). This could quite easily be modified for the consideration of a concept such as sustainable development in aviation: a system should distribute benefits amongst salient stakeholder in light of their respective contribution, costs, risk or other ethical/moral considerations (principles of sustainable development: e.g. human need).

The fairness of the distribution is inextricably linked to the fairness of the *overall* development procedure. As discussed in Section 7.2 and 7.3 sustainable development is not just concerned with the distribution of impacts related to development, but the process too.

7.4.2 Charges, tax and balance

As highlighted in the previous chapter, though participants accepted a weak interpretation of sustainable development and notions of substitutability between forms of natural (environmental), social and physical (economic) capital, they rejected direct compensatory payments to individual stakeholders (households with the noise footprint of the airport). But, participants did support the compensatory financial payments to local community funds that provide social value broadly through affected communities.

Charges, levied on passengers or airports, related to noise are not without international precedence. In the US the *Federal Aviation Authority Passenger Facility Charge* is levied on passengers and used to fund services such as noise insulation programmes. The levy, $4.50 (£2.87) for each boarded passenger at commercial airports, totalled $2.811 billion (£1.79 billion) in 2013 (FAA, 2014). At a European level, the *Tax on Air Transport Noise Pollution* France is a varying levy on ATMs dependant on the airport from €0.5 to €68 (£0.39 to £53.7) (Ministère de L'Écologie, 2014). The purpose of the charge is to enable investment in the local community and support airport development.

The two levies vary in how they are imposed from a per passenger basis to a per ATM charge. From the results of the analysis conducted by this study the noise impacted averaged across the 15 airports was £0.55/pax or £68/ATM with the extreme example of Heathrow having an impact of £1.20/pax and £177/ATM. It is clear that the federal levy imposed in the US represents a more severe charging regime if applied at a similar level here in the UK. It should be noted that the calculation of impacts from this study are based on both inbound and outbound passengers.

Airport Passenger Duty (APD) is a tax levied on all outbound flights from the UK or Isle of Man, with more than twenty available seats. The rate at which APD is levied varies dependent on the flight length (distance from London to the capital city of destination), and the configuration of 'seat classes' (economy, business, first) on the flight (see Table 28). APD is a general environmental tax on flying to compensate for the full range of detrimental environmental damages. Additionally, as aviation is VAT exempt by EU VAT Directive, APD is seen as a way of taxing the sector which would otherwise have been 'under-taxed' (DfT, 2013b).

Table 28 APD rates effective 1 April 2014 (HMRC, 2014)

Band (approximate distance in miles)	Reduced rate (lowest class of travel)	Standard rate (other than the lowest class of travel
Band A (0-2000)	£13	£26
Band B (2001-4000)	£69	£138
Band C (4001-6000)	£85	£170
Band D (over 6000)	£97	£194
From 1 April 2015		
Band A (0-2000)	£13	£26
Band B (over 2000)	£71	£142

The UK Government does not intend to vary the rate of APD by airport e.g. at a congested airport (HM Treasury, 2013). *A Fair Tax on Flying,* An industry campaign with cross-sector support, calls for fundamental reform of APD, as it is regressive and uncompetitive comparative to other European airports, especially where airports are competing with other European airports especially at the 'hub-level' (AOA, 2014). APD is a rather crude form of taxation in that it does not take into account or reward investment by the airlines to improve the fuel efficiency of aircraft for competitive advantage. If APD was charged per ATM and relative to the fuel efficiency of the aircraft in use there would be provided an incentive to utilise the most modern aircraft or improve the fuel efficiency of aircraft by operating at a higher load factor. As LRegA_AR attested "we [airlines] are ruthlessly opportunistic" and as such, reforms to encourage the adoption of more efficient or quieter aircraft and address market failures, it is hypothesised, would be used to create competitive advantage by airlines.

7.4.3 Local community trust funds

As highlighted by the empirical findings of this study, noise nuisance was perceived to be partially balanced by the economic gain of airport operations in the local community (within the noise footprint of the airport), though not fully at present. Each airport runs a community trust, the primary objective of which is to support communities within a defined geography which are directly affected by the operations of the airport (impacts not exclusively noise related). A direct compensatory mechanism to individual households was not supported by participants, but rather an investment in the local communities of those affected. At present, a range of airports within the 15 study

airports operate such 'community funds'. Table 29 compares the investment by airports in their respective trust funds relative to the calculated annual noise social cost.

Table 29 A summary of study airport community funds

Airport	Calculated annual noise social	Community fund[a]	Notes
Birmingham	£4,829,500	Yes. £50,000/annum	Annual airport contribution £50,000 + noise penalties. Average fund payout '98-'10 = £74,569 (Birmingham Airport, 2010)
Blackpool	£41,100	No[b]	
Bournemouth	£200,690	Yes. £10,000/annum	Operated since 2008. Total distributed £50,000 (Bournemouth Airport, 2014)
Bristol	£375,280	Yes. £106,600 (2014)	Contribution a function of Pax (Bristol Airport, 2014)
East Midlands	£709,560	Yes. £50,000/annum	Fixed annual contribution (East Midlands Airport, 2014)
Gatwick	£1,006,670	Yes. £190,000 (2013)	Fixed contributions agreed with West Sussex County Council + noise penalties imposed on airlines (Gatwick Airport Community Trust, 2014)
Heathrow	£83,809,400	Yes. £679,000 (2012)	(BAA, 2013)
Leeds Bradford	£441,350	No	
Liverpool John Lennon	£359,640	No	
London City	£748,690	No	
Luton	£484,350	Yes. £50,000 (2014)	Fund managed by Bedfordshire and Luton Community Foundation (Luton Airport, 2014)
Manchester	£7,007,600	Yes. £145,600 ('13-'14)	Annual airport contribution £100,000 + noise penalties. (MAG, 2014)
Newcastle	£375,890	No.	
Southampton	£709,670	Yes. £50,000 (2012)	(BAA, 2013)
Stansted	£1,090,410	Yes. £250,000 (2012)	The Stansted Community Fund was terminated as of 31 December 2012.

Table Notes

[a] Annual community fund payments for latest year reported. Where no single year is given average annual payment is calculated.

[b] During the undertaking of this research Blackpool International Airport ceased operating

Many of the options to reduce the absolute noise levels at airports rely on airlines to invest in quieter and modern aircraft. The powers of airports are limited to fining airlines that violate noise restrictions, encouraging airlines to use quieter aircraft through a reduction in landing fees (also known as quiet slots), and mitigating noise disturbance through a local programme of installing acoustic insulation (Thomas and Lever, 2003).

7.4.4 Advocating market based reform

Highlighted within the core developed grounded theory category of *balance and 'trade-off'* was the function and role of the market in addressing and attaining sustainable development. The focus of this section is to draw together the discussion of the noise social cost assessment, taxation and charges.

"The market" is perceived to be the most efficient and effective means of dictating the development of aviation. As such, national government should refrain from the central planning of the future form and structure of UK aviation. It is recognised that 'top-down' reform e.g. regulation and taxation should be the primary means of attaining and encouraging sustainable development. As Freeman and Pierce (2000) attest "behind every stakeholder concern is a potential market place, if approached with the innovation mind-set" (p.53). This view is strongly advocated by LRegA_AR, that any market reform should be an opportunity for innovation by airlines for the benefit of passengers.

The emphasis on market innovation advocated by this research is at odds with the position of Starik and Kanashiro (2013) who posit that "thories of sustainability management probably would not include an obsession with ... neoclassical economic values" (p.19). But, this is at odds with the finding of this research where there is broad support by the vast majority of participants for market based reform within traditional neoclassical markets. Adaption of current and present business and management approaches is likely an easier avenue of channelling the type of actions required to move to a sustainable future (Hörisch, 2014).

7.5 The limitations of unilateralism

Responsibility and *power and influence* were identified as two grounded theory categories related to sustainable development. Aviation, by its very nature, is international in its scope and reach, and subsequently its impacts. As such, many of the issues related and highlighted by this research, in relation to sustainable development, require an international response.

Sustainable development is a trans-sectoral concept, in the sense that its impacts, both negative and positive, cannot be confined to solutions on a sector to sector approach. Several impacts are global in scope e.g. climate change. In this case, despite the actions of an individual country, or even sector, it may only cause part of the harm. It could be argued that it is not in the interests of individual sectors to pursue sustainable development without a much wider shift in national and international economies. The IPCC (Kolstad, 2014) identify climate change as potentially "a tragedy of the commons" (Hardin, 1968). What is reflected in the findings of this research project is that effective progress towards sustainable development would not happen if each individual stakeholder group, airport group, airline etc. acts independently in its own interest. Moreover, aviation should not be treated as a special case, as some industry participants would advocate. One kg of CO_2 whether released from a jet-engine on an aircraft or the tailpipe of a car makes an equal contribution to climate change, so should they be valued differently? Policy actions such as those related to containing carbon emissions or the noise certification of aircraft are the result of international agreement. Therefore the ability of "The Government", the stakeholder repeatedly identified as bearing the greatest responsibility for the attainment of sustainable development, possesses limited power to enact fundamental reform purely through national legislation.

The results of this research echo those highlighted in the *Brundtland Report* which contained a stark warning that "perhaps our most urgent task today is to persuade nations of the need to return to multilateralism" (WCED, 1987, p. x). To date, it is a task that we as a society have yet to achieve.

7.6 Views on stakeholder thinking

In this research stakeholder thinking is utilised in its concept-centric form (Steurer *et al.,* 2005) to explore the issue of sustainable development in aviation. The historic development of stakeholder theory has been developed from the corporate-centric

perspective, with the corporation or organisation at the centre of the stakeholder network, typified by the hub-spoke model of stakeholder relations (Figure 11). Rather, this research has highlighted a more complex network of inter-related stakeholder relationships. Though accepting the existence of a focal organisation, in this case the airport, the stakeholder network has evolved from the mapping of transactional stakeholder connections, with the firm at the centre, to one where the focal organisation is just one node within a much wider interrelated stakeholder network. The focal organisation is itself a stakeholder of other organisations and stakeholder groups within the system. The implication being rather than stakeholder thinking being a 'ready-made' and prescriptive process, it is instead a reflexive process which is shaped by the particular context in which it is applied (Gao and Zhang, 2001). This notion is of stakeholder theory being flexible and adaptive is supported by Freeman *et al.* (2010), where stakeholder theory is:

> *"a framework, a set of ideas from which a number of stakeholder theories can be derived...Researchers would do well to see stakeholder theory as a set of shared ideas that can serve a range of purposes within different disciplines an address different questions " (p.63).*

The developed stakeholder-sustainable development framework has been utilised to explore sustainable development and thus gives insight into the challenges of enacting sustainability from which strategies can be developed. The inclusion of stakeholder thinking was valued in two ways: an ethical or moral consideration and an instrumental value.

SRA2_AR reflects on the instrumental value of stakeholder thinking with respect to local community, planning and government stakeholders: "*you will never keep everybody happy ... but, if you are upsetting as little people as possible, or keeping as many people as happy as possible* ***within your sphere of influence*** *or as stakeholders, then your opportunity to develop further is always greater".* Thus, the stakeholder framework gives managerial insight into system stakeholders and how they could contribute or hinder the attainment of sustainable development. From this insight stakeholder influencing strategies could be developed for the attainment of managerial objectives (Konrad *et al.*, 2006).

7.6.1 Nature as a stakeholder: Part 2

One of the most contentious and unresolved issues within stakeholder theory is the status of nature and the natural environment. This particular strand of the stakeholder discourse was presented earlier in this thesis (see Section 3.5 The environment is a key dimension of sustainable development, therefore establishing the status of environmental considerations within a stakeholder-sustainable development framework is paramount.

The environment is not *one* abstract or homogenous entity, but rather has differing meanings, interpretations and therefore differing values placed on it by different stakeholder participants; this difference being identified as the result of the position of the stakeholder in the system shaping their 'world view'. The environment was determined to consist of three aspects and dimensions: local, regional (national), and international (see Figure 17 and Section 5.4.1.2). The findings of this study do not support the notion of considering nature as one or multiple stakeholders, but rather "non-human, natural entities may merit moral considerations of other sorts" (Phillips, 2000; p.195). The stakeholder network and the identification of salient stakeholders is defined in purely anthropocentric terms; saliency being gained by stakeholders with a contractual obligation or property right. The only outlier to this 'narrow' definition (Orts and Strudler, 2002) would be the inclusion of the two participant NGOs and SRA2_AAG.

Failure of the stakeholder framework to capture all aspects of the environment could be construed as its failure (Starik and Kanashiro, 2013; Starik, 1995). However, this criticism is without merit. The framework does capture and allow understanding of certain aspects of the environmental dimensions within sustainable development at the local environmental level e.g. amenity value of nature in the vicinity of airports, the intrinsic value of local ecosystems. The emphasis here is the recognition of the environment from a purely anthropocentric perspective i.e. how local communities derive value from the local environment: LRegA_LPG utilises the example of a local woods in the vicinity of his community, LRA_LCR3: "*a threat to local wildlife*", SRA2_ACCS highlights the value placed on a local breeding site for birds.

The limitations of the framework are in considering, and giving due weight, to environmental impacts that are at the global scale (e.g. Global Warming and the impacts associated with the emission of GHGs). Despite a growing evidence base of the scale of the issues and potential costs of climate change (IPCC, 2014; 2007; Stern;

2007) climate change did not rank as the primary concern of stakeholder interests of the aviation system (see Table 20, Section 5.6). Stakeholder interests were dominated by "self-interest" or interests, be they environmental or otherwise, perceived at the same scale as their involvement (e.g. local community representatives identified the impact of noise, a highly localised environmental/social impact concentrated on a relatively small population). Additionally, stakeholder interpretations of sustainable development were heavily weighted toward *weak* interpretations (see Figure 19). As such, there is strong belief in the capability of technology to overcome the environmental impacts, particularly with reference to GHG emissions; a view projected by industry: "*there are technological alternatives [to carbon based fuels], I don't see any contradiction between sustainable development and aviation*" [NR_MTB]. Rather than the framework being deemed not 'fit for purpose', it rather highlights both the limitations of the proposed framework and stakeholder theory more broadly: "stakeholder theory should not be used to weave a basket big enough to hold the world's misery" (Clarkson, 1994).

Stakeholder representation, and therefore stakeholder need, is highly concentrated at the airport-level which emphasises the readily perceived local environmental impacts e.g. noise. Thus, the application of the stakeholder framework in this instance highlights the potential for unbalanced dimensional biases in the stakeholder output: the identification of stakeholder need within the system, the relative weighting of identified impacts and the perceived notions of balance. Bias towards one or more impacts related to sustainable development is not in itself indicative of failure, but can be justified as reflecting stakeholder needs within the system under investigation. However, strong bias may give a skewed and unrepresentative view of system performance and need.

How should the framework account for this limitation? Global environmental impacts of aviation were recognised by all participants as a particular concern, but the direct impacts on an individual were remote or not perceived. However, this does not mean that it should not be enacted upon as NR_NGO1 reflects: "*climate change fairly obviously affects everybody ... it affects people on the other side of the world just as much as it does us ... [but] nobody will take personal responsibility for it. They all say, 'Well it is not us, it is China'. So we need an international agreement".* SRA_LCR1 extends this further by developing a moral and ethical basis for action to control the emission of GHGs and an intergenerational timescale: "*Deep in their hearts or deep in their conscience they are saying to themselves ... 'I am a bit worried about that this might be doing to my grandchildren's*

chances". Many other participants introduced the need to consider 'the future', 'future generations', 'grandchildren' etc. dimensions and considerations for which there is no shadow market, such as noise, to measure *value*. Orts and Strudler (2002) recognise the shortcoming of stakeholder theorising as a human-to-human consideration and the identification of ethical and moral dimensions can supplement stakeholder thinking in relation to the environment: "... management must include an appreciation of [the] ethical value of the natural environment ... dimensions of ethical value are not easily measured ... in a framework of human interests" (p.227).

As such, environmental impacts such as global warming should not bear managerial saliency due to stakeholder need, but a higher societal 'hypernorm' (Donaldson and Dunfee, 1999). As discussed over the previous sections, action on the management of GHG emissions is dependent on government policy, particularly at the international level. As Phillips, Freeman and Wicks (2003) defend stakeholder it is not "an answer to all moral questions" (p.493), but Freeman *et al.* (2010) as philosophical pragmatists, offer stakeholder theory as a means of improving the human condition which is aligned with the principles of sustainable development. As the findings of this thesis suggest, stakeholder thinking can be an excellent tool to capture considerations of the local environment and inform the development of policy related to global impacts.

7.7 Visions of the future: challenges and opportunities

The paradox of aviation growth was highlighted as one of the main motivations for this research in Chapter One: how should the growth forecasts of aviation be aligned with the principles of sustainable development. Aviation forecasts from a variety of commercial and governmental models predict strong growth over the coming decades, even through to 2050 and 'mature' markets like the UK (DfT, 2013; 2011b; Airbus, 2011; Boeing, 2011). The impacts of aviation (noise, GHG emissions, LAP) occur at various scales and magnitudes and are imposed on a variety of stakeholders. A case in point would be the contribution of aviation to climate. Though the improvements in technology and operational performance in aircraft is resulting in reduced fuel burn per passenger km of 1-1.5% per annum (Kahn Ribeiro, 2007), this is out stripped by forecast growth resulting in annual emission increases of 3-4% per annum. With relation to UK carbon targets to contain the emission of GHGs at 450ppmv, Bows *et al.* (2005) concluded if aviation emissions were to remain unconstrained, *all* other sectors of the UK economy would have to potentially decarbonise by 2050. This leaves the question: as a society is this something that we wish to allow?

For too long the debate of sustainable development in aviation has been a well rehearsed argument between advocates of aviation growth and proponents of environmental protection. As NR_ITB reflects these two stances represents fringe, however vocal, perspectives. The findings of this research support a consensual if not tacit agreement on the important benefits that aviation can bring to the UK, but also a responsibility to address the challenges of its impacts from noise to carbon emissions to highlight but two.

A prevalent weak interpretation of sustainable development supports and enhances the role of technology in addressing environmental and social challenges. The role of technology is an area of overwhelming stakeholder consensus. There exists already technology capable of relieving the burden of aviation impacts, most notably noise and climate change impacts. The widespread transition to 'next-generation' aircraft architecture based on CFRPs e.g. Boeing 787-Dreamliner, a quieter aircraft with the potential to reduce life cycle CO_2 emissions of approximately 20% for an individual aircraft (Timmis *et al*., 2015). The emissions savings of a transition of the global fleet is limited to 14-15% due to interactions with the market promoting growth due to lower operating and maintenance costs. Other actions may include increasing the loads factor on flights from a European average of 60% to 90%, which may require changes to the business models of airlines (Bows, 2006), or the use of open-rotor engine design which can reduce fuel burn, but increase noise and results in slower flight times (SBAC, 2007). But, the role of technology is limited. The aviation sector is technologically mature, is characterised by long 'lead-in times' (development) and in-service times: aircraft entering service today may well be operating late into 2040 (IPCC, 1999).

This research advocates the use of markets (e.g. carbon pricing, landing fees varied by noise certification of aircraft) to address some of the externalities of aviation. However, aviation and sustainable development cannot be considered in isolation, nor should any sector. International agreements on issues such as climate change are vital to drive innovation and a transition to the most efficient aircraft, operational modes and utilisation of resources. The pricing of aviation that better reflects its perceived impacts may drive a fundamental shift in society as to how the freedom to fly is valued.

7.8 Chapter Summary

This chapter has provided an analysis of the findings from the two research phases that form this thesis: the stakeholder interviews and the monetary valuation of the identified impact of noise. Together these two stages form the application of the earlier

developed stakeholder-sustainable development framework. The limitation of the stakeholder framework is the assessment and due consideration given to global environmental impacts. Stakeholder needs were dominated by self-interest and impacts perceived at the local level or on their day-to-day lives.

The first part of this chapter presented and discussed the developed stakeholder-sustainable development framework and its application in relation to the extant discourse of stakeholder theory. The application of stakeholder thinking is identified as a means of exploring and understanding the competing needs, wants, priorities and relationships of stakeholders within the aviation system.

Secondly, the understanding of sustainable development that is attained from the application of the framework was evaluated: including a summary of the four developed grounded theory categories from the empirical interview data, their interconnections, and their relationships to the core category of 'balance and trade-off'. These findings were in turn contrasted and compared with the extant literature of sustainable development. The findings of this research highlight the importance of process and governance structures in sustainable development, elevating participation, in this case stakeholder participation, to be as important as the balance of the economic, social and environmental dimensions of development.

Thirdly, the chapter turned to the quantitative assessment of aviation noise, the results of which were presented in the previous chapter (Research Process: Stage 2 – Noise Impact Valuation). The results were compared with comparable assessments of noise from the existing literature. In turn, the discussion utilised the findings of Stage One of this research, the qualitative stakeholder interviews, to explore the implications of this quantitative assessment e.g. the implications of 'balance' and the role of taxation and financial charges for addressing non-market impacts and externalities within the aviation system.

The views on stakeholder thinking are subsequently presented, with specific consideration given to the representation of the natural environment in the framework. The inclusion and consideration of the natural environment within stakeholder thinking has been one of the most contentious aspects of its development. This research supports the inclusion of the natural environment via stakeholder proxy, though representation of the global environment is limited.

The following and final chapter presents the broad conclusions of this research and how the aims and objectives set out in the first chapter have been addressed and met. Additionally, the chapter identifies how this research has made theoretical contributions within the management and sustainable development discourse, its practical contributions to the attainment of sustainable development and ideas for future research.

8. Conclusions and Future Research

8.1 Chapter overview

This chapter reviews this research thesis in relation to the prior stated research questions, aims and objectives. Firstly, a summary is presented of the three stages of the research: theoretical background, research process and discussion.

Secondly, the key findings and results are reviewed in relation to the overarching research questions, aims and objectives. Subsequently, the research contributions of the study are reviewed in light of its contribution to knowledge (i.e. stakeholder thinking), the sustainable development debate and the contribution to development in the aviation sector.

Fourthly, the research process and the methodological approach are retrospectively evaluated. And finally, future research and additional avenues of study are highlighted.

8.2 Study summary

Understanding the impacts of an international transportation system, and assessing its development within a framework of sustainable development, is increasingly complex. The findings of this research are not a blueprint of what a future UK aviation system should look like, nor are they a roadmap; this was never the aim of this research. The objectives of this thesis were to develop a stakeholder-based framework to understand and assess sustainable development in a specific context. Over the course of this research it has been shown that the attainment and management of sustainable development can be advanced through leveraging and extending the concept of stakeholder theory.

The stakeholder-sustainable development framework established by this research is intended to provide new understanding of the attainment of sustainable development. The findings of this study show that sustainable development within aviation is a highly contentious topic. Despite competing and often contradictory stances between stakeholders within the discourse of sustainable development, there is a great emphasis and broad agreement for supply-side technological, political and managerial interventions. Four aspects of sustainable development were identified as central to the concept: *balance and trade-off, context and process, power and influence and responsibility*. As such, the balance and end state distribution of costs, benefits and capital, though being at the core of the concept, is but one facet. The *process* of sustainable development is of equal consideration and value. Thus, stakeholder participation in the identification of the purpose of a system, the identification of impacts and their relative weighting, and consideration of 'stakeholders' status' within any evaluation of development scenarios is of importance, if of immeasurable value. The application of the framework is not guaranteed to develop a comprehensive vision of future development, but can be used as a useful tool to explore the myriad of potential scenarios.

This research contrasts with Starik and Kanashiro's (2013) development of a distinct theory of sustainability management. Rather than developing sustainability management as a distinct branch, or competing paradigm within business management, this research advances the widely accepted corporate theory of stakeholder management into the concept-centric realm.

Sustainable development is a multi-faceted concept, however stakeholder thinking and the application of the proposed framework has been shown to successfully identify,

understand and advance the concept to a more operational basis. The framework successfully works over multiple levels and scales. The framework is not 'one size fits all', but is reflexive and adaptable to multiple scenarios and contexts. The limitations of the proposed framework may not lie in the identification of the perceived wants, needs or impacts of stakeholders, but human and scientific knowledge in understanding them (e.g. carrying capacities of ecosystems). Additionally, the framework, much like stakeholder theory is not intended as an answer to all moral questions, nor does it take precedence in all moral questions (Phillips, 2003). The identification and relative importance of environmental impacts was strongly determined by the stakeholder's position in the aviation system and network, with emphasis given to the impacts directly perceived in their day-to-day lives. As such, environmental impacts at the global-scale e.g. contributions to anthropogenic climate change, despite increasing scientific and economic evidence of its detrimental impact (IPCC, 2014; Myhre *et al.*, 2013; Stern, 2007) were given less prominence than for example noise. Outputs of the framework reflect the values of stakeholders within the system; critics may point out this as a failure of stakeholder thinking for not capturing such pressing issues as climate change. However, Donaldson and Dunfee (1999) contend that even an application of stakeholder thinking must respect and adhere to societal 'hypernorms', that transcend the interests of individual stakeholders such as the protection of the natural environment or future generations (Orts and Strudler, 2002; Phillips and Reichart, 2000). Therefore, the proposed framework may well advance the attainment of sustainable development, but it cannot be attained simply by application. Overall this research confirms "stakeholder relations management [stakeholder thinking] is certainly no substitute, but a complementary approach to purposeful and predictable government intervention" (Konrad *et al.*, 2006; p.102).

Highlighted by the results of this research is how there exists broad support across all stakeholders for the continued development of the aviation system to support the wider UK economy and the demands of society for increased air travel. Future development, both of new infrastructure and the utilisation of existing infrastructure, should be driven by the demands of the market; a market which at present fails to account and sufficiently reflect a broad range of environmental and social impacts.

The quantitative analysis of noise presented in this study is retrospective, in the fact that it assessed historic noise data; the calculated environmental and social costs (£102.2 million per annum) and has limited utility in assessing future scenarios. However, the results have illustrative value in demonstrating the relative importance of

the impact category and its distribution within the aviation system, and also the costs borne by local community stakeholders in the vicinity of an airport.

The stakeholder assessment framework, developed by this study, could be utilised in future scenario planning and decision-making, and also in other sectors. Additionally, the proposed framework is not limited to advanced economies, or the aviation sector, but could equally be applied in international scenarios.

The aviation sector in 2015, both in the UK and internationally, stands at an inflection point regarding its development. As Redclift and Benton (1994) suggest "one of the most important insights that the social scientist can offer in the environmental debate [in this context: sustainable development] is that the eminently rational appeal on the part of environmentalists for 'us' to change our attitudes, or lifestyles, so as to advance a general 'human interest' is likely to be ineffective" (p.8). There is no popular ground swell, even amongst local communities (identified as bearing one of the highest costs of aviation) or the participant NGOs in this study for the cessation of flying. Rather than a system that is fundamentally broken and in need of revolution, is a system in need of reform to meet the needs, challenges and aspirations entailed within the concept of sustainable development. 2015 will witness the publication of the findings of the Airport Commission regarding the development of additional runway capacity in the South East of England, and ICAO will publish their recommendations for the management of aviation related greenhouse gases through a market-based mechanism; a development the findings of this research actively support.

8.3 Key findings and results

The following sections review the relative success of the research in addressing the developed aims and objectives of the research. This research began with the statement of two overarching research questions. To aid the reader the research questions have been restated:

8.3.1 R1: *How can a stakeholder management framework be utilised as a means of understanding sustainable development?*

The utilised framework has enabled the concept of sustainable development to be explored and new substantive grounded theory regarding the concept to be developed (R1). Four aspects of sustainable development were identified as central to the

concept: *balance and trade-off, context and process, power and influence* and *responsibility.* The process of sustainable development, and subsequent stakeholder participation is of equal and commensurate value to the end distribution of impacts and capital. This result elevates public participation to a central and primary dimension of sustainable development rather than a subservient secondary consideration. This research provides new insight into attainment of sustainable development aspirations being unique to the context in which they are studied. In this case, the issues were dominated by local interests at airports.

8.3.2 R2: *How can a stakeholder approach inform the assessment of sustainable development?*

Additionally, the framework has been utilised to undertake and inform an assessment of aviation noise, one of the key impacts identified in the stage-one empirical findings (R2). The framework enabled a novel development in the selection of assessment techniques by extending the notion of stakeholder status into the consideration of assessment tools. Rather than the selection of assessment tool being a 'value laden' decision of the researcher, the choice reflects those of system stakeholders (informed by the empirical stage of the framework). In this case, salient stakeholder status involved a geographic component, and the status was granted through property rights and ownership. Monetary assessments of sustainable development impacts and the imposition of taxes and charges so the market valuation of goods and services more fully reflects 'total' costs, are supported by system stakeholders.

8.3.3 A1: *Develop a stakeholder based empirical framework for the assessment of sustainable development*

The first aim (A1) was mostly accomplished through Chapter Two and Chapter Three in aligning and exploring the theoretical discourse of sustainable development and stakeholder theory. The resultant developed framework was presented in Chapter Four and the main empirical findings presented in Chapter Five. This aim was accomplished as fully as possible by the research given identified stakeholders that were willing to participate; Section 5.6.1explores non-participating stakeholders that were identified, primarily national governmental departments and international stakeholders e.g. aviation groups.

The developed stakeholder framework allows local sustainable development aspirations to be developed at different scales within a sector. However, stakeholder thinking

does take into account intergenerational and global environmental impacts with sufficient weight (comparatively to the science). As such, the developed stakeholder framework is a novel and complimentary tool to governmental regulation.

8.3.4 A2: *Consider the implication of a stakeholder approach in the implementation and assessment of impacts related to sustainable development*

The second aim (A2), based on the empirical findings of the stakeholder-sustainable development framework was achieved in Chapter Six, by exploring the externality of noise. The empirical findings (A1) allowed assessment techniques to be identified, assessed and chosen; the result being a monetary valuation based on the hedonic pricing method (HPM) within the defined 'noise footprints' of the study airports. The HPM allows a clear identification of affected stakeholders (those households within the noise footprints). Direct compensatory payments to affected individual stakeholders were not supported. The balance of benefits and costs within sustainable development is central to the concept. However, not everyone in the system has to be 'net winner', or have their imposed costs directly compensated. The transparency and the perceived fairness of the distribution of costs and benefits are of value to those stakeholders burdened by system costs.

8.3.5 O1: *Identify the perceived network of aviation system stakeholders*

The network of stakeholders within the aviation system is broadly divided into two groups: direct and indirect stakeholders. Direct stakeholders are defined as those with a contractual right and covers business, organisations and services providers. The engagement and recognition of direct stakeholders have instrumental value. Indirect stakeholder are those indirectly impacted aviation activity, e.g. local communities, NGOs, local business groups. The recognition of indirect stakeholders is due to normative values of the impact of business on society. The specific make-up of stakeholders at the local-level (airport) is unique to the context of study, with the stakeholder make-up being representative of local issues and values.

8.3.6 O2: *Explore the range of epistemological interpretations of sustainable development held by identified stakeholders.*

There exists a prevalent weak interpretation of sustainable development, accepting substitution between forms of capital (physical, environmental and social), with emphasis on the maximisation of total capital stocks. Technology is viewed as key to

overcoming the challenges of potential resource and environmental constraints. Such techno-centric interpretations accept the continuation of current forms of capitalism and socio-economic models.

8.3.7 O3: Establish how stakeholders and their respective interests are related and their responsibility in the realisation of sustainable development

Stakeholder interests were identified in relation to the aviation sector, and their primary interest collated (see Table 20). Stakeholder interests were broadly divided between direct stakeholders (organisations and companies associated with the provision of goods and services, and passengers) and indirect stakeholders (local community representatives and NGOs). As such, they are also broadly divisible between those concerned with the maximisation of benefits and the minimisation of burdens respectively. However, this crude division belies a broad consensus supporting the growth of the aviation industry through the utilisation of technology to address concerns relating to the negative impacts of flying, most notably noise and GHG emissions.

8.3.8 O4: *Review assessment methodologies for an identified impact related to sustainable development*

The notion of stakeholder status was extended into the selection of assessment techniques for the identified impact of noise. Monetisation methods were chosen due to the support by participants of neoclassical economics. Assessment review highlighted the hedonic price method as being most suited. The noise impact at the 15 study airports was valued at £102.2 million (2013), with Heathrow Airport accounting for 82% of the total.

8.3.9 Key findings in summary

The assessment of externalities other than noise was not considered. As discussed in Chapter Seven, noise was identified as a unique challenge of UK aviation with control, mitigation and management of the externality being confined to the sector alone. Other externalities identified e.g. CO_2, other GHGs and gaseous emissions though the scale of the *impacts* are most likely bigger than that of noise, so is the challenge of assessment. The emission of GHGs is not unique to the aviation sector, and as previously discussed, the management of such emissions is dependent on a global

agreement on the control of such emissions; ICAO is due to report on a market based mechanism for the management of aviation carbon emissions by the end of 2015.

The findings of this research may seem to pose more questions than the number it sought to answer. Initially, the questions that prompted this research included '*what does it mean for each and every community? How can it go beyond mere generalities and out into practice?*' (posed in Chapter One). This thesis has gone someway to answering the first and second by understanding the perceived impacts of aviation and their relationship to sustainable development. Now, we must ask how are we, as a society, willing to change to meet these challenges? If, as the findings of this research suggest, and given further understandings of the costs of additional impacts (local air pollution, climate change etc.), are we willing to pay more and internalise the social and environmental costs of flying? A theory that uncovers paradoxes, inconsistencies and anomalies related to sustainable development is far from defunct (Starik and Kanashiro, 2013), but can be seen as a means to better understand and advance both the theory of the sustainable development concept, and also its management (Krueger and Gibbs, 2007) this research proposes that the developed stakeholder-sustainable development framework is ideally suited to such a task.

The developed stakeholder framework utilised to assess sustainable development in UK aviation has demonstrated that the goal of attaining 'sustainable development' would have profound and wide-reaching implications for not only transport policy, but also wider economic, environmental and social structures, their development and policy. The empirical findings of this research accept a weak interpretation of sustainable development: the balancing of economic, social and environmental goals. The specific research contributions are discussed in greater details over the following sections.

8.4 Research contributions and key conclusions

8.4.1 Contribution to knowledge

The primary contribution of this research has been the advancement of the notion of stakeholder status within the application of sustainable development, both at the policy and practical implementation level. The investigative framework and methodology developed can advance an understanding of sustainable development at an operational level and are of instrumental value to its attainment. This research discovered that sustainable development is as much procedural, as it is concerned with the end state

distribution of impacts. As such, in an advanced economy, as this research is undertaken, satisfying basic human need is of lesser importance, and stakeholder participation should be elevated to one of the primary dimensions of sustainable development on a par with inter- and intra-generational equity. The framework has advanced the ability of managers and researchers to undertake empirical analysis of systems and their stakeholders in relation to sustainable development and to answer such questions as "which issues of sustainable development should be considered?

This research has advanced stakeholder thinking from a purely qualitative method of exploring stakeholder-business relations, but by extending the notion of stakeholder status and stakeholder thinking into quantitative valuation tools, it allows researchers and managers to explore the distribution of impacts (or value) to valid stakeholders. This advancement addresses recurring criticism of stakeholder theory of providing no framework for understanding 'balance' amongst stakeholders (Sundaram, 2004; Marcoux, 2003). As such, the novelty of this developed framework is not just its ability to undertake empirical analysis, but to develop analysis of instrumental value from which policy and management action can be developed.

The research has advanced the debate of development from an ideological level to a more operational positioning within a sector, in this case the UK aviation sector. The theoretical stakeholder framework is flexible and context specific. It helps to explore the concept of sustainable development within the context that it is applied. The social constructionist philosophical stance means that the direct research outputs (the developed grounded theory categories) should not be overtly extrapolated beyond the context in which it was developed, e.g. to alternative sectors or contexts. The research outputs reflect the values of participant stakeholders, whose values are thus influenced by their social setting and position; an application of the framework in an alternative context e.g. the developing world may yield starkly different results.

A secondary contribution of this research, applicable to the field of strategic management is the application of the developed stakeholder-sustainable development framework. The pursuance of stakeholder based management practice does not guarantee the identification of a strategic path to a 'sustainable future', but enables the exploration of the issues of sustainable development specific to the context within which it is applied. The applied framework is flexible to multiple contexts, it is appreciated that the challenges and issues of sustainable development is context specific and it is up to the skill of the researcher in applying the framework to explore the

emerging issues of relevance; the identified stakeholder network, the saliency of stakeholders and their assignation within the 'affect-affected by' binomial will be unique to the context in which the framework is applied.

Furthermore, this research has made contributions to the field of transport studies. Within any assessment of non-market impacts or externalities there exists a range of quantitative and qualitative techniques. Often the choice of method is left to the judgement of the researcher; a choice influenced by multiple factors: the availability of data, their philosophical position, experiences etc. The developed stakeholder framework integrates and extends the notion of stakeholder status to the assessment and quantification stage and answers question such as: how are system stakeholders represented in this assessment technique; what assumptions and interpretations of the impacts does the assessment technique make, and how do they relate to that perceived by stakeholders? The application of the empirical stage of the stakeholder-sustainable development framework allows such questions to be answered within the context in which it is applied.

8.4.2 Contribution to the sustainable development debate

The purpose of this research was not to develop a comprehensive and definitive definition of sustainable development, but rather to advance a framework, based on stakeholder thinking, to better understand sustainable development in a specific context. It is argued that this lack of clarity is an important facet of both the current and future success of sustainable development; it can broadly be agreed by all parties within the system to be the normative basis for development. Sustainable development in practice is susceptible to, and reflects the values, aspirations and goals of a multitude of actors and is thus likely to change over time, between cultures and geographies. The contribution of this research to the sustainable development debate is threefold.

*First, t*he developed stakeholder-sustainable development framework allows an understanding of local sustainability aspirations from which policy and subsequently assessment can be formulated. Sustainable development is as much procedural (often described as the direction of travel) as it is an end state of capital/value distribution. In this case, stakeholder (or public) participation is elevated to one of the primary dimensions of sustainable development, rather than being characterised and secondary in previous literature (Holden *et al*., 2013). Additionally, this public participation must be integrated throughout the entire process from understanding sustainable development issues, through to scenario development, assessment and enactment.

Previously public participation has been ascribed to discrete stages: indicator and metric development (Castillo and Pitfield, 2010; Amekudzi *et al*., 2009) or scenario assessment (Xenias and Whitmarsh, 2013).

This research also highlights the limitations of pursuing and understanding sustainable development on a sector-by-sector basis. Such a granular and piecemeal approach is of practical value for understanding the particular challenges facing a sector. However, the challenges of sustainable development span and transcend individual sectors and require consideration of national and international economic models of business and regulation.

Second, this research advances the notion of stakeholder status within the concept of sustainable development. The framework formalises the identification of salient system stakeholders and provides a means of understanding their needs and relationship to both the concept of sustainable development and with other stakeholders within the system and context of application.

Third, a meaningful transition to a more sustainable form of development entails choosing between competing strategies, technologies and scenarios. By advancing the status of the stakeholder through the developed framework, the choice of assessment technique, rather than being a value judgement of the researcher, can be chosen to reflect the stakeholder perceptions of the impacts and needs of stakeholders. As such, additional insight into the distribution of impacts amongst the system stakeholders and the value judgements of participants can be garnered. All system stakeholders supported the continuation of free-markets. Impacts and externalities where appropriate should be regulated and market prices should accurately reflect *total* costs.

Recommendations

- Application of a rigorous system-wide stakeholder analysis to understand sustainable development in a particular context
- Sustainable development is as much concerned with a process of change as it is the distribution of capital and impacts
- *All* stakeholders have a role in the attainment of sustainable development; specific roles will be context specific and vary by stakeholder
- The attainment of stakeholder development is dependent as much on 'top-down' government regulation as it does a 'bottom-up' action

8.4.3 Contribution to policy and practice

Sustainable development covers a broad spectrum of environmental, economic and social impacts, both costs and benefits. The developed stakeholder-sustainable development framework has provided a viable tool into investigating the perceptions of development from a multi-stakeholder and a multi-scale perspective. In turn, this insight allows the identification of a hierarchal ranking of impacts and their relationships (between stakeholders and between impacts) from which policy and management strategies, mitigation actions and developments can be assessed.

The findings have highlighted the importance of key stakeholder groups to the facilitation and attainment of sustainable development: national government, airport operators (management) and airlines. But, the utilisation of the research findings can be much broader in terms of developing stakeholder influencing strategies. The results of the stakeholder analysis indicates how stakeholder thinking can capture and represent the broad considerations of sustainable development and how stakeholders are related to the concept and even their potential and respective contributions.

The findings of this research support and confirm earlier claims of the instrumental value and link between stakeholder thinking and the realisation of sustainable development. The process driven dimensions of sustainable development actively encourage the integration of stakeholder thinking through public participation etc. This research proposed a stakeholder-sustainable development framework as such a means. However, "stakeholder relations management is certainly no substitute, but a complementary approach to purposeful and predictable government intervention" (Konrad *et al.*, 2006; p.102).

Recommendations

- This research provides a new evidence base of key aspects of the environmental, economic and social benefits and costs of UK aviation from a cross section of system stakeholders at various scales and levels (airport to national)
- System stakeholders may utilise the findings of this study to identify stakeholder groups with common interests within the sustainable development of aviation, from which strategies can be developed to advance their own interests, or contribute to the implementation of sustainable development

- Managers within organisations of the aviation system may use the theoretical framework to better understand their respective relationships with stakeholders from which to develop strategies of influence

8.5 Evaluation of research and identified limitations

The following section presents a reflection on the research process and relative success in exploring and addressing the proposed research questions of this study. The evaluation of the thesis is conducted in relation to the original aims and objectives that informed the entire research process.

The reasoning for the application of stakeholder thinking in exploring interpretations of sustainable development was presented as two-fold: the normative inclusion of stakeholder identity within the sustainable development discourse, and the strengths of stakeholder theory in exploring multi-actor systems and business-society relations. Despite stakeholder theory originally being a 'theory of the firm', this research expands the theory beyond its original purpose. Hörisch and Freeman (2014) testify that "a theory that does not refer to sustainability at all could even be the one that fits best to a specific sustainability issue, if it is applicable in the context of sustainability" (p.341).

As highlighted by the very findings of this study, sustainable development is defined by the context in which it is applied and studied. Additionally, the social constructionist philosophical stance of this research emphasises the context specific nature of the findings. The findings of this research reflect the societal values and worldviews of system actors. These values are not static, and may change with time, the advent of new technology, new understandings of the environment and ecosystems, or political systems. As such, this research provides a perspective at a particular point in time. Resources (time and finance), as with most research, is identified as potentially limiting factor.

The research employed stakeholder interviews as the primary means of investigation and examination. The particular limitations of interview research were presented and reviewed in Chapter Four. As such, this section shall reflect on the relative success in their application. The study successfully engaged with four study airports and a range of national representatives of the stakeholder system. The success of the recruitment technique can be validated by the broad based engagement that was achieved across a vast range of stakeholder types from local community representatives through to multi-national corporations and industry regulators. Successful interviews were conducted

with individuals that represented broader populations, thought leaders in organisations, or in positions that could shape organisational related strategy to sustainable development. However, participation was unsuccessful from some identified stakeholder groups, which tended to be international organisations and bodies or governmental departments. Involvement would have provided a more detailed insight, but their absence should not detract from the considerable achievements and outputs of this research.

Chapter Seven highlighted the primary limitation of this research was in its ability to investigate all identified impacts related to sustainable development. This limitation was primarily related to the scope and ambition of the project. Sustainable development is a multi-sectoral and interdisciplinary challenge that has economical, social and environmental dimensions. As such, the challenge of understanding sustainable development requires new ways of thinking, research and policy; challenges that go beyond the limited scope and resources of this project. Take for example the issues of greenhouse gas emissions and their contribution to anthropogenic climate change. Rather, this project chose to focus on the issue of aviation noise due to the prominence of the impact given by research participants, the unique nature of the impact to the aviation sector, and its role in the future development debate un UK aviation. Additionally, there is the potential for the framework to demonstrate dimensional bias due to the concentration of stakeholder groupings at specific locations and scales e.g. a strong emphasis on noise at the airport level.

As identified in the research findings, a move towards sustainable development in UK aviation requires actions on many scales, from national to international actors and institutions, which could not be fully explored within the resources and scope of this research, a matter discussed in additional detail in the following section of identified further research. However, the research method developed, with its reliance on stakeholder interviewing, itself a time intensive method of investigation, enabled a rich understanding of stakeholder perceptions of sustainable development at a national level.

8.6 Further research

With the reporting of the final recommendations of the Airports Commission in July 2015, the UK aviation sector is on the cusp of new and fundamental change that will shape the industry and sector for the next generation, and potentially beyond. This study has presented a new stakeholder-sustainable development empirical framework,

and new contributions and understanding of the phenomena under investigation: that of sustainable development in the UK aviation sector. The framework could, and it is hoped, be applied to additional sectors, or within the UK aviation sector at a much finer local scale to, or as a comparative longitudinal case study between airports.

Further research is identified in four distinct areas: methodological application and development, aviation impact analysis (broadening the current analysis) and developing a longitudinal attitudinal study.

8.6.1 Application of the stakeholder-sustainable development framework

The application of the developed stakeholder-sustainable development framework is limited to the UK aviation sector where the concept of stakeholder status and the debates of sustainable development are well established. There is no reason why the developed framework could not be successfully applied in other economic and transport sectors. Additional research could strengthen the process and identification of legitimate and valid stakeholder participants within the concept of sustainable development. It is likely the attributes of stakeholder status may be different in alternative contexts.

8.6.2 Understanding and assessing the benefits of aviation

A prevalent weak interpretation of sustainable development held by aviation system stakeholders implies the substitution of physical and economic capital for lost natural and human capital stocks. Economic analysis of aviation is limited primarily to the national scale. Detailed and robust granular economic analysis at the local or airport level highlighting the geo-spatial distribution of economic benefits, within both the geographic footprint of the airport and wider region, is lacking.

8.6.3 Broadening the analysis

Broadening stakeholder participation to include representation from The Government within the DfT, but also DEFRA and DCLG would strengthen the representation of the wider community, and stakeholders representing international perspectives may broaden the insight offered by the application of the framework. Further analysis of a broader range of stakeholder interests may change the focus of assessment, the relative importance and weighting of aviation impacts and provide further insight. Additionally, mechanisms and responses to the challenges of sustainable development within civil

aviation cannot be enacted at a nation state level alone. Sustainable development requires the involvement of regulatory bodies within the EU, ICAO, international civil aviation groups and international governments. Further research is needed to capture, understand and integrate perceptions of sustainable development at these levels.

This study focussed on just *one* of the identified impacts of aviation, that of noise. Primarily, noise was chosen due to the relative importance placed on it by all stakeholder participants, and as a means of demonstrating how the stakeholder framework could be utilised to understand and choose an appropriate assessment method of non-market impacts. This analysis could be expanded to other impacts of local air pollution, carbon emissions and NO_x, though the status of stakeholders may need further clarification. Unlike aviation noise, which can be isolated from other activities and sources, gaseous emissions are not unique to the aviation sector and their relative impact may need to be considered from a multi-sector perspective.

8.6.4 Attitudinal change

Highlighted as one of the key concepts within sustainable development was the notion of temporal change. Changes in development could affect the scale and nature of the perceived impacts. Equally, with time, the value systems of participants could change and influence the *desiderata* of system stakeholders. Future research may be required to assess attitudinal changes over a range of periods, potentially over the decadal time-scale.

A comparative longitudinal case study, at two or more study airports, would be able to capture attitudinal change to development. Additionally, a comparative study would be able to extend and further develop the stakeholder-sustainable development framework to explore the instrumental value of stakeholder engagement throughout the lifetime of multiple development projects.

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Appendix A – Generic interview guide

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A stakeholder approach to sustainable development in UK aviation

Interview Guide

Date: **Location:**

Time:

Interviewee:

Company/organisation (position):

Section A: Role of stakeholder

1. Can you please explain your role with regard to the aviation system?
    a. What does your role entail?
    b. How did you become involved in your role?
    c. You represent a stakeholder group, how do you interact with them?

2. Can you please explain what your interests in the aviation system are?
    a. Can you please explain what you regard as your primary interest i.e. that which you think is most important?

Section B: Impacts of aviation and other stakeholders

3. Who do you believe the stakeholders are in the aviation system?
    a. What do you perceive to be their roles?
    b. Could any stakeholder play a different role?
    c. Of the identified stakeholders which do you think possess complimentary interests?
    d. Of the identified stakeholders which do you think possess contradictory interests?

4. Which stakeholders do you think benefit from the aviation system?
    a. What form are these benefits?
    b. Who benefits the most and least?

Note: this may include no benefit

    c. What benefits do you/your stakeholder group derive from the aviation system?

5. Which stakeholders do you think bear the costs from the aviation system?

Note: these could be non-financial costs and could be described as burdens, dis-benefits etc.

    a. What form are these costs?
    b. Who bears the most and least cost?

Note: this may include no cost

    c. What costs do you/your stakeholder group derive from the aviation system?

6. How do you think the identified costs *and* benefits are distributed?
    a. Any refection on the distribution of costs *and* benefits?
    b. Who should derive cost *and* benefit of the aviation system?

7. Whose stakeholder claim/interest is *most* important in the development of aviation?

8. The following list of stakeholder interests are often cited when discussing the development of aviation. Could you please rank the following list in order of importance from *your* stakeholder perspective?

Note: you may dismiss any items which you think are not relevant

Global impacts

Local impacts

Regional connectivity

International connectivity

Economic development

   a. Could you please explain why you chose *X* as your most important interest?
   b. Could you please explain what understand/interpret by the interest that you have chosen?
   c. Are there any interests which you think are missing from the list?

Section C: Sustainable development and aviation

9. Could you define the term sustainable development?
   a. How does this relate to aviation development in practice?

10. Which stakeholder group do you think is responsible for the sustainable development of aviation?
   a. Is more than one stakeholder group responsible? If so, which?
   b. What is the role of your stakeholder group?

Closing the interview

- Additional information and comment
- Permission for further contact
- Contact regarding the findings of the study
- Thank you

Appendix B – Interview participants

Table 30 Summary of interview participants and terms of reference for interview analysis

Airport Typology	Stakeholder term of reference	Stakeholder acronym	Notes/comment
Small Regional Airport 1 (SRA1)	Local community representative	LCR1	ACC member and local councillor
	Local community representative	LCR2	ACC member and local councillor
	Local community representative	LCR3	ACC member and local councillor
	Local business group	LBG	ACC member Local Chamber of Commerce
	ACC chair	ACCC	
Small Regional Airport 2 (SRA2)	Local community representative	LCR1	ACC member and local councillor
	Local community representative	LCR2	ACC member and local councillor
	Airport management representative	AMR	Environment Manager (I) Public Affairs Manager (II)
	Aviation advocacy group	AAG	ACC member
	Local business group	LBG	ACC member and Local Chamber of Commerce
	ACC secretary	ACCS	
Large Regional Airport (LRA)	Local community representative	LCR1	ACC member and local councillor
	Local community representative	LCR2	ACC member and local councillor
	Local community representative	LCR3	ACC member and local councillor
	Local community	LCR4	ACC member and local councillor

Airport Typology	Stakeholder term of reference	Stakeholder acronym	Notes/comment
	representative		
	Airport management representative	AMR	Environment Manager
London Regulated Airport (LRegA)	Local community representative	LCR1	ACC member and local councillor
	Local community representative	LCR2	ACC member and local councillor
	Airline representative	AR	Operations manager
	Airport management representative	AMR	Public Affairs and Sustainable Development Manager
	Local business group	LBG	ACC member and Local Chamber of Commerce
	Local pressure group	LPG	ACC member
National Representatives (NR)	Non-governmental organisation (AEF)	NGO1	Aviation focus
	Non-governmental organisation (AW)	NGO2	Aviation focus
	Industry trade body	ITB	UK aviation industry
	Manufacturing trade body	MTB	UK aviation industry
	Original equipment manufacturer	OEM	Engine manufacturer
	Tier one OEM supplier	T1S	Airframe and other components
	Aviation regulator	AvR	

Appendix C – Noise social cost – assessment input data

Table 31 Population noise exposures surrounding study airports (DEFRA, 2006)

		Number of residents exposed per L_{den} band				
Airport	**IATA code**	55-59 dB(A)	60-64 dB(A)	65-69 dB(A)	70-74 dB(A)	>75 dB(A)
Birmingham	BHX	32,400	13,200	2300	0	0
Blackpool	BLK	400	300	0	0	0
Bournemouth	BOH	3300	100	0	0	0
Bristol	BRS	3800	900	100	0	0
East Midlands	EMA	8000	1700	700	0	0
Gatwick	LGW	9300	2700	400	200	0
Heathrow	LHR	561,500	140,300	44,600	8900	700
Leeds Bradford	LBA	7400	1000	0	0	0
Liverpool John Lennon	LPL	3500	2100	100	0	0
London City	LCY	10,500	1600	100	0	0
Luton	LTN	6500	2000	100	0	0
Manchester	MAN	63,100	26,500	2700	700	0
Newcastle	NCL	4400	1400	0	0	0
Southampton	SOU	10,100	2000	0	0	0
Stansted	STN	7800	1700	300	0	0

Table 32 Noise social cost assessment input data

Airport	IATA code	Average property occupancy rate	Average property price (£)
Birmingham	BHX	2.38	231,351
Blackpool	BLK	2.05	108,066
Bournemouth	BOH	2.06	210,648
Bristol	BRS	2.22	205,225
East Midlands	EMA	2.30	167,227
Gatwick	LGW	2,42	198,281
Heathrow	LHR	2,41	267,780
Leeds Bradford	LBA	2.26	170,188
Liverpool John Lennon	LPL	2.16	126,176
London City	LCY	2.58	215,115
Luton	LTN	2.54	162,269
Manchester	MAN	2.03	148,631
Newcastle	NCL	2.16	162,365
Southampton	SOU	2.25	173,663
Stansted	STN	2.37	309,082

Table 33 Summary of calculated number of residencies exposed to noise bands surrounding study airports

		Number of properties exposed per L_{den} band				
Airport	**IATA code**	55-59 dB(A)	60-64 dB(A)	65-69 dB(A)	70-74 dB(A)	>75 dB(A)
Birmingham	BHX	13,613	5546	966	0	0
Blackpool	BLK	195	146	0	0	0
Bournemouth	BOH	1602	49	0	0	0
Bristol	BRS	1712	405	45	0	0
East Midlands	EMA	3478	739	304	0	0
Gatwick	LGW	3843	1116	165	83	0
Heathrow	LHR	232,988	58,216	18,506	3693	290
Leeds Bradford	LBA	3274	442	0	0	0
Liverpool John Lennon	LPL	1620	972	46	0	0
London City	LCY	4070	620	39	0	0
Luton	LTN	2259	787	39	0	0
Manchester	MAN	31,084	13,054	1330	345	0
Newcastle	NCL	2037	648	0	0	0
Southampton	SOU	4489	889	0	0	0
Stansted	STN	3291	717	127	0	0