Sustainable supply chain management and decision theory: a qualitative exploration using planetary boundaries and social foundations.

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Summary:

The research considers the use of sustainable supply chain management (SSCM) policies as a means to forge a bridge between the micro scale of individual firm operations and the macro scale of ecological and societal impact (referred to as Kleindorfer's Challenge). Qualitative case study research is conducted across different economic sectors identified with specific macro-scale challenges that are taken as a more precise and up-to-date definition for sustainability. This research assumes the planetary boundaries (PB) framework, developed by environmental scientists led by Rockstrom & Steffen et al., and the social foundations (SF) framework, from international development movement, defined by Raworth & Leach et al. as the basis for the definition used.

Eight firms grouped into five case studies are subjected to in-depth investigation into how they relate their own operations to sustainability outcomes via their SSCM policy and the barriers they face. To understand the nature of knowledge versus uncertainty within each firm, decision theory is adopted and elaborated in the context of sustainability. In particular, Snowden's Cynefin framework and Keeney's value-focussed decision analysis are adopted as aspects of the dominant logic for each firm. This shapes their decision making abilities when faced with complexities and ambiguities in delivering SSCM in the context of various external pressures (notably from legislative, investor and customer demands).

The resulting evidence informs a model of substantive sustainability, whereby firms with significant impacts are distinguished from those without substantive impacts, in terms of the PB+SF frameworks . This helps firms realise the extent to which they should be concerned about sustainability issues, with some firms having a disconnect between their stated goals and their actual influence, and other firms with substantial impacts receiving insufficient attention from academia and practice.

"*When they who to the sea go down, and in the waters ply their toil,*

are lifted on the surge's crown, and plunged where seething eddies boil."

(Littledale, 1867)

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Glossary of abbreviations

ABS - Association of Business Schools
AFDA - Alternatives-focused decision analysis
B2B - Business to business
B2C - Business to consumer
BS - British Standard
CAS - Complex adaptive systems
CEMARS - Carbon Emissions Management and Reduction Standard
CO_2 - Carbon dioxide
CH_4 - Methane
CSR - Corporate social responsibility
DA - Decision analysis
DL - Dominant logic
DSC - Direct supply chain
DT - Decision theory
ESC - Extended supply chain
ESOS - Energy Savings Opportunity Scheme
EU-ETS - European Union Emissions trading scheme
FMCG - Fast moving consumer goods
GHG - Green house gases
GRI - Global Reporting Initiative
ISO - International Standards Organisations
MCDA - Multi-Criteria Decision Analysis
NGO - Non-Governmental Organisation
OECD - Organisation for Economic Co-operation and Development
OEM - Original equipment manufacturers
OM - Operations management
OR - Operational research
PB - Planetary boundaries framework
PB+SF - Planetary boundaries plus social foundation frameworks
P/N - Phosphates and Nitrates
SCM - Supply chain management
SD - Sustainable development
SDG - Sustainable development goals
SF - Social foundation framework
SOM - Sustainable operations management
SRB - Sustainable and responsible business
SRI - Socially responsible investment
SSCM - Sustainable supply chain management
SSM - Soft systems methodology
STEM - Science, technology, engineering and mathematics
UN - United Nations
UNESCO - United Nations Educational, Scientific and Cultural Organisation
UNFCCC - United Nations Framework Convention on Climate Change
UNGC - United Nations Global Compact
USC - Ultimate supply chain
VFDA - Values-focused decision analysis

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Chapter 1: Introduction

The research field: Sustainable Supply Chain Management (SSCM)

Increasingly, organisations are interested in corporate social responsibility (CSR) and sustainable development (SD) as part of their supply chain management (SCM). Sustainable SCM (SSCM) can be considered the pursuit of SD objectives through the management of an organisation's supply chains, with due regard for the social, economic and environmental impacts of those supply chains (Linton, Klassen, & Jayaraman, 2007; Walker & Jones, 2012).

SD is frequently defined with reference to the following quote,

> "*Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs.*" (Brundtland, 1987)

Yet this definition does not suggest how SD might be addressed via formal processes in organisational management. As such, the detailed, definitions and actions regarding SD remain diverse, unclear or even contested (Markman & Krause, 2016; Preuss & Walker, 2011). SSCM as the implementation of SD via SCM can include prioritising local purchasing or Fair Trade certified suppliers to address poverty in de-industrialised communities or emerging economies, respectively (Hall & Matos, 2010; Preuss & Walker, 2011); or choosing emerging economy suppliers with particular labour standards may encourage wider adoption of those standards as order qualifiers (Eltantawy, Fox, & Giunipero, 2009). By including environmental criteria in contracts, buyers can seek to make a similar contribution to ecological challenges, such as climate change (Handfield, Sroufe, & Walton, 2005)

The definitions of SD and related concepts such as the triple bottom line, suggest that the social, economic and environmental aspects should all be considered. It is important to therefore understand how firms take this into account in their practical implementation of SSCM policies and actions. Furthermore, it is important to understand how such actions contribute to the effective meeting of the goals of SD. By conducting such research valuable

insight can be gained as to the sources of problems that prevent the practical implementation of SSCM from meeting the goals of SD.

The research topic: Decision Theory (DT) as a means to develop theory in SSCM.

Questions of implementation can be addressed in conceptual and practical terms as instances of organisational decision making. Referring to the attempt to balance different criteria in SD, including phrases such as making trade-offs, are examples of this, which are formally addressed via processes of decision analysis, formalised by the academic topic of Decision Theory (DT). This concerns both rational, mathematical and behavioural, psychological fields to determine how best to make decisions alongside study into how decisions get made in reality.

Rather than accept the plurality of definitions in SD, the research adopts recent findings in environmental science and international development to give a benchmark on what definitions of SD should include as a necessary minimum. The planetary boundaries (PB) framework (Rockström et al., 2009) highlights three extremely urgent priorities necessary for environmental sustainability; climate change (primarily from greenhouse gas pollution), biodiversity loss (primarily from changes to land use) and bio-geo-chemical pollution (primarily phosphate and nitrate pollution). See Table 1.

The social foundations (SF) framework (M Leach, Raworth, & Rockström, 2013) highlights urgent priorities for social sustainability, established via consultation with national governments for the United Nations Rio+20 summit ('The future we want'). See Table 2. Together, this PB+SF framework can be considered as a new definition of necessary conditions for SD,

> "*to ensure that the use of Earth's resources achieves the human rights of all – 7 billion people, rising to at least 9 billion – while simultaneously ensuring that the total pressure on Earth systems remains within planetary boundaries.*" (ibid. page 85)

#	Earth system process	Control variable[1]	PB	Current level
PB1	Rate of biodiversity loss	Extinction rate (E/MSY)	<10-100	100-1000
PB2	Biogeochemical flows	P cycle flow from rivers to oceans	6.2 Tg P yr (regional)	14 Tg P yr
	Biogeochemical flows	N cycle industrial fixing	62-82 Tg N yr	150 Tg N yr
PB3	Climate change	CO_2e ppm or energy imbalance Wm^2	350-450 ppm +1 Wm^2	400 ppm +2.3 Wm^2
PB4	Stratospheric ozone	O_3 concentration DU	290 DU	200 DU
PB5	Ocean acidification	Carbonate ion concentration	>80%	~84%
PB6	Freshwater use	km^3 per year	4-6000 km^3/y	2600 km^3/y
PB7	Land-system change	Area of forested land as % of original forest	75%	62%

Table 1: Planetary Boundaries (PB) Framework. Source: Steffen et al. (2015)

[1] This table is a simplification the data table provided in Will Steffen, Richardson, et al. (2015). This provides a detailed account across a range of environmental indicators, which include certain zones of uncertainty and a number of areas subject to seasonal and regional variation. See the paper for full details, including for abbreviated units, such as CO_2e ppm = green house gases in carbon dioxide equivalent parts per million by volume, E/MSY = extinctions per million species per year, DU = Dobson Units, a measure of atmospheric concentration of ozone. Ocean acidification appears characterised by uncertainty at the time of writing. As a secondary consequence of atmospheric carbon emissions being absorbed in the oceans, the clear urgency of PB1 is taken as sufficient in the case selection undertaken in this thesis.

#	Social foundation	Extent of global deprivation	% pop.	year
SF1	Food security	Population undernourished	13%	2006-8
SF2	Income	Population living below $1.25 (ppp) per day	21%	2005
SF3	Water & Sanitation	Population without access to an improved drinking water source. Or access to improved sanitation.	13% 39%	2008 2008
SF4	Healthcare	Population estimated to be without regular access to essential medicines	30%	2004
SF5	Education	Children not enrolled in primary school. Illiteracy amount 15-24 year olds	10% 11%	2009 2009
SF6	Energy	Population lacking access to electricity. Population lacking access to clean cooking facilities.	19% 39%	2009 2009
SF7	Gender equality	Employment gap between women and men in waged work (excluding agriculture). Representation gap between women and men in national parliaments.	34% 77%	2009 2011
SF8	Social equity	Population living on less than the median income in countries with a Gini coefficient exceeding 0.35	33%	1995-2009
SF9	Voice	e.g. population living in countries perceived (in surveys) not to permit political participation or freedom of expression.	To be determined[2]	
SF10	Jobs	e.g. labour force not employed in decent work	To be determined	
SF11	Resilience	e.g. population facing multiple dimensions of poverty	To be determined	

Table 2: Social foundations (SF) framework. Source: Leach et al. (2013)

[2] At the time of publication precise metrics relating to a number of social foundations remained 'to be determined' and other metrics are now ten years old. However, in this thesis, the precise amounts are not an important aspect of the work presented.

In the context of business and management scholarship, the PB framework has been highlighted by Whiteman, Walker, and Perego (2012) as a means to address a gap between increasing interest in corporate sustainability, but an apparently ever-worsening status for the global environment. This disconnect was identified as an issue by a pioneer of the topic of sustainable operations management, the late Paul Kleindorfer. Establishing the bridge between the micro-scale of the organisation and the macro-scale is outlined in a retrospective of his work by Cohen and Kunreuther (2007), and referred to here as Kleindorfer's challenge.

This research takes PB+SF as a macro-scale set of necessary criteria as to how to achieve the goals of SD. A novel contribution to the literature is thus made in addressing PB+SF rather than just PB. A specific exploration of the sources affecting those criteria can be considered. This entails a multi-level analysis, where sector, region and organisation are all relevant. The perspective taken here starts from SSCM, which is an organisation level undertaking that involves inter-organisational communication. The initial, level of analysis in this thesis is thus how the actions of individual firms and the influence they may exert through their supply chains can be considered in light of the SD objectives defined by PB+SF.

However, the history of DT shows that assembling data is not enough to deliver results (S. French, Maule, & Papamichail, 2009). Given the fundamental nature of business enterprises to maintain economic profitability, managers are constrained in their decision making to ensure the survival of their company, and not sacrifice economic performance in pursuit of social or environmental performance (C. Carter & Rogers, 2008). Secondly, the data relating their SSCM practices to resulting sustainability outcomes is often not available, uncertain or ambiguous (Hahn, Preuss, Pinkse, & Figge, 2014; Preuss & Walker, 2011).

DT provides a form of analysis for understanding these constraints to decision making, but this approach appears nascent and under-utilised in the literature on SSCM. The objective of the thesis is therefore to establish if DT can help better understand SSCM as either a structured (quantitative) or unstructured (complex) problem via relevant aspects of DT. These include 'prescriptive decision analysis' (S. French et al., 2009), 'values-focussed

decision analysis' (Keeney, 1996), and the 'Cynefin framework' - a typology of sense-making across structured or unstructured decision contexts (Kurtz & Snowden, 2003).

The evolution of the initial research questions into the formal research questions therefore leads to:

RQ1: How do firm's SSCM policies relate to PB+SF in practice?

This addresses Kleindorfer's challenge as to the bridge between firm-level activity and ecological or societal level impacts.

RQ2: How does DT help explain barriers to meeting PB+SF via SSCM?

This addresses the organisational context that permits or constrains effective decision making in relation to SD and SSCM.

The research method

Due to the exploratory and theory elaborating nature of this research, the appropriate alignment between theory and method is that of qualitative case study research (Dubois & Gibbert, 2010). Multiple case studies are defined across supply chains associated with PB+SF impacts. In-depth interviews with senior decision makers involved in SSCM are conducted using the semi-structured elite method (Vaughan, 2013). Coding and analysis of the findings establishes patterns in the concepts emerging from the data that form a theoretical model suitable for analytic generalisation (Pauwels & Matthyssens, 2004).

The research contribution

The social and environmental impacts of business are identified as important topics and implementation has been seen as problematic (Whiteman et al., 2012). Challenges include lack of clear definitions, uncertainty, ambiguity and complexity (Abbasi & Nilsson, 2012), and the interplay between economic factors, external regulation and consumer acceptability or public opinion (Hahn et al., 2014).

In seeking to address these challenges, the research makes a number of novel contributions. Firstly, it is the first to use SSCM as a means to study PB and SF as a stronger concept for SD than the triple bottom line. It is also the first to consider both quantitative and behavioural

DT in SSCM, in contrast to existing work that takes either an operational research (OR) tradition, or behavioural tradition in isolation. This is done via a novel application of the Cynefin framework, a typological meta-model of knowledge management and decision making, and values-focussed decision analysis (VFDA), which incorporates ethical, non-quantitative approaches to decision making. Together these provide a conceptual perspective that can address issues of uncertainty, ambiguity and complexity in SSCM and thus bring a new theoretical perspective to answering issues of how to deliver SD. Furthermore, by bringing both PB+SF and DT together through a practical investigation into SSCM, insight is given as to the scale of impact that organisations have in relation to macro-scale challenges, and the strategic opportunities or barriers that enable or prevent action. This results in a number of theoretical contributions regarding the effectiveness of SSCM and corporate sustainability or responsibility initiatives in general.

The research method aims at providing a rich, empirical account of the implementation of SSCM, where theory and data are considered in parallel. This approach is recommended for theory elaboration, where existing theory (in SSCM) is extended and applied on the basis of evidence, as opposed to generated afresh from data or tested via large-sample statistical methods. The theoretical approach developed means a further contribution is made in methodology, in particular the way in which the Cynefin framework provides deeper conceptual explanation as to the constraints and opportunities occurring in quantitative and qualitative research. This then makes possible a review of existing SSCM literature in terms of DT, particularly in relation to complexity, ambiguity and uncertainty. It also enables an extension of work within DT that relates to environmental and social issues, thereby extending both the academic field of sustainability more broadly and also the specific way in which it has been addressed in the interdisciplinary field of DT.

This SSCM research is built from an empirical foundation of how firms operate in the real world, and the various pressures and issues they face. As such the research provides practical insights to the managers of organisations that should make it easier to focus on what matters in the attempt to improve their own operations in light of the scale of specific, important sustainability challenges.

The structure of the document.

A literature review of SCM, SSCM, DT and their related intersections is conducted in Chapter 2. Theoretical consideration then forms an approach for the primary research. Chapter 3 summarises the way in which this is brought into a research design. Alongside methodological issues, the actual data collection process is also described. Chapter 4 then describes each case in relation to the central concepts. Chapter 5 conducts cross-case analysis and discussion. Chapter 6 discusses the theoretical conclusions and implications for practice and future research. A compilation of primary data in the form of relevant quotes from interviews is provided in Appendix B. Readers may benefit from reviewing this material prior to reading Chapter 4.

Chapter 2: Literature review

The scope of the research and the literature reviewed is in accordance with the interpretation of the central problem noted in Chapter 1. This is into the overlap between the fields of sustainable development (SD), supply chain management (SCM), and decision theory (DT), as shown in Figure 1, which shows a Venn diagram encompassing these three areas, each section of which is labelled A to G. This provides a plan for this chapter, where each section is briefly described in turn, with explanation on the nature of the overlap, plus historical development and future directions. A narrative continuity is established explaining the links between each field.

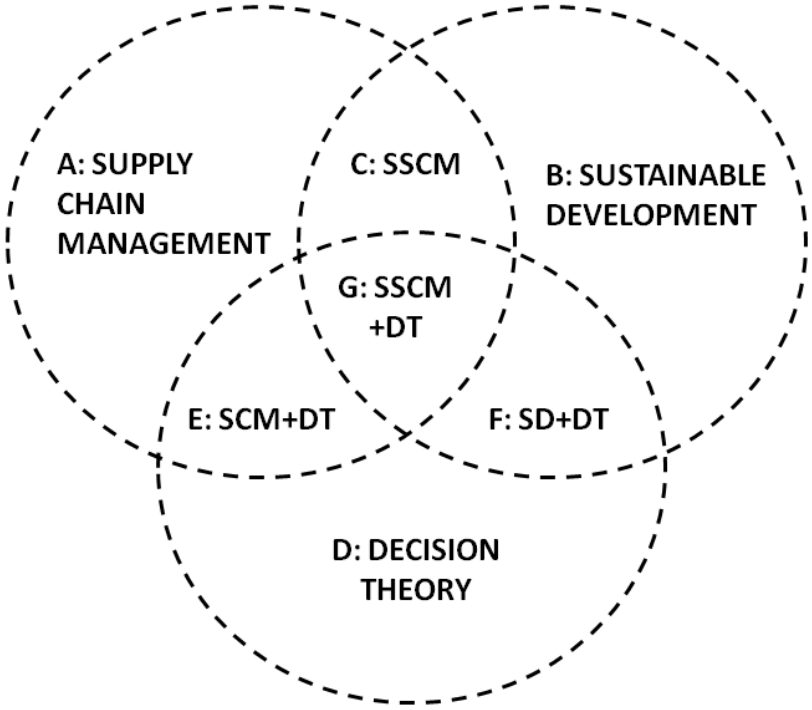

Figure 1: Literature review Venn diagram

As shown in Figure 1, Sections A and B concern SCM and SD respectively, Section C then considers the overlap of these as SSCM. Section D then covers DT. Sections E and F are only considered in brief. Section G, where all three areas overlap is then subjected to a formal systematic literature review, according to Tranfield, Denyer, and Smart (2003). This aspect of the literature review has also been published as Alexander, Walker, and Naim (2014), but is updated here to take into account additional literature published up to May 2016. A

summary section then synthesises the themes to provide the basis of the conceptual framework in Chapter 3.

A: Supply chain management (SCM).

In a recent review of the history of supply chain management (SCM), C Carter, Rogers, and Choi (2015), describe the term as being first ascribed to consultants in the early 1980s and then quickly adopted by academia. Giannakis, Croom, and Slack (2004) note that SCM rose in tandem with externalisation of business processes through outsourcing, particularly in response to increasing globalisation. They identify four major theoretical paradigms in SCM research as systems theory, transaction cost economics, game theory, and industrial network theory. Functional, decision-focussed SCM research addressing specific processes in logistics, inventory and procurement also grew, adding to previous attention to these topics within management science and operational research (OR). Examples include decisions over whether to outsource and whether to build cooperative relationships or transactional relationships, with either single suppliers or multiple suppliers (Blome & Henke, 2009).

However, a major review of SCM research conducted by Chicksand, Watson, Walker, Radnor, and Johnston (2012) notes an increasing plurality of theoretical approaches taken and a large amount of research that is a-theoretical. This suggests that while SCM is an important topic for research it is not a discipline according to scientific definition. This would require different theories to be able to disprove each other so as to then advance an increasingly coherent body of knowledge.

The recent paper, C. Carter et al. (2015), seeks to establish a more solid and coherent theoretical foundation by shifting attention from the management of supply chains to a clearer definition of what the supply chain is, then attending to how it should be managed. In their formulation, while the supply chain is a web of connections between a large number of companies, any given focal firm has a limited horizon or visibility boundary. The awareness of a focal firm to other organisations in the wider network and the activities that take place therein, are thus central to their theory creation for SCM.

This approach seeks to integrate some of the previous paradigms. It develops concepts from the network paradigm, whereby endless connectivity at multiple tiers of a supply chain are in practice effectively bounded by the awareness of any given observer. This can be compared with an early definition of the supply chain by Mentzer et al. (2001) that there is a direct supply chain (of a buyer and supplier dyad), an extended supply chain - where there is awareness of second tier suppliers, or beyond, which benefits strategic resilience (Sheffi & Rice, 2005) - and an ultimate supply chain, which traces links back to raw material extraction. Notably, resilience is a concept drawn from systems theory, in that having been perturbed, a resilient system will correct back to its previous state (Folke et al., 2010).

C. Carter et al. (2015) also consider the evolution of systems theory into complex adaptive systems modelling, leading to the statement, "*The supply chain as a network operates as a complex adaptive system, where every agent grapples with the tension between control and emergence.*" (ibid. page 6)

Additional aspects of SCM research that are relevant here are also those seeking to provide taxonomies of the structure of supply chains. For instance, C. M. Harland (1996) describes SCM as relationships involving either relatively simple chains, or more complex networks. This is further developed in Blome, Schoenherr, and Eckstein (2014) on the simplicity or complexity of both the product and the supply chain and the impact this has for knowledge management, particularly in relation to flexibility or agility of the focal firm's activities.

In addition, work in SCM on game theory concerns the modelling of human behaviour based on expected rewards or punishments resulting from different decisions, hence it is concerned with perception (Harsanyi, 2004; Jarimo, Pulkkinen, & Salo, 2005; Ni & Li, 2012).

The above papers are relevant to the work conducted in this thesis as they all concern the limits to understanding experienced by managers of supply chains. The forms of this include the level of complexity of the supply chain, the extent of their awareness of the wider network beyond the dyad, and the nature of psychological and political bias that may hamper rational decision making in SCM. Hence, perceptual issues are central to the application of behavioural DT to SCM. Sections E and G continue this discussion.

B: Sustainable development (SD)

It is common for academic and practitioner work in sustainability, including SSCM, to refer back to the so-called 'Brundtland Report' as the seminal document for the concept of sustainable development (SD) (Christopher, 2011). This UN report *Our Common Future*, produced by the UN's World Commission on Environment and Development, headed by the Norwegian Prime Minister Gro Harland Brundtland (Brundtland, 1987) is taken as defining SD as meeting the needs of the present without compromising the ability of people in the future to meet their needs. These words are not presented in the text as a formal definition of the term but addressing poverty, ecological limits and intergenerational justice are explicit in the surrounding text (ibid. page 16).

The Brundtland promotion of SD combines the concept of basic need from international development (Chichilnisky, 1977) with ecological principles from the conservation movement (IUCN, 1980). The now common theme that SD consists of three connected elements of economic, social and environmental sustainability, was formally adopted by the UN at the Rio+10 Earth summit (UN, 2002). This also dated from work in the 1970s by the famous Club of Rome report, *Limits to Growth* (Meadows, Meadows, Randers, & Behrens, 1972). This was closely based on the systems theory ideas of Forrester (1948, 1958) and used computer models of 'the economic system', 'the social system' and 'eco-systems'. The concept of SD thus draws intellectual foundations from post-war systems theory and political ideology around equity and justice.

Critiques of SD that acknowledge this origin are provided by Littig and Griessler (2005), Stacey (2009) and Robinson (2012). These respectively concern the nature of SD as a normative aspiration, the contrast between general systems theory and complexity theory, and the apparent failure of SD policy since its formal adoption with Brundtland (1987).

Besides Brundtland (1987), academic literature on sustainability in business often cites Elkington (1997) as a seminal reference (Kleindorfer, Singhal, & Wassenhove, 2005). This non-academic book popularised the three-systems model of SD as 'the triple bottom line' (3BL). A critique of the rapid rise of this concept is provided by Norman and MacDonald (2004), who argue that,

"*what is sound about the idea of a Triple Bottom Line is not novel, and...what is novel about the idea is not sound...on both conceptual and practical grounds...the Triple Bottom Line is an unhelpful addition to current discussions of corporate social responsibility...the Triple Bottom Line paradigm cannot be rescued simply by attenuating its claims: the rhetoric is badly misleading, and may in fact provide a smokescreen behind which firms can avoid truly effective social and environmental reporting and performance.*" (ibid. page 243)

Regardless of such criticisms, the adoption of the 3BL concept has continued to become widely established among practitioners, policy-makers and academics. Yet the lack of clarity over how to define relevant aspects of environmental performance, social performance or economic performance, in corporate performance management or corporate reporting means a highly pluralistic approach, including many contradictory and conflicted responses. Hassini, Surti, and Searcy (2012) note several hundred different performance measurements used in sustainability reporting, ranging across a huge variety of topics from worker welfare to community development to environmental impacts. Many scholars have modelled these criteria and the potential for trade-offs between them, seeking rational weighting, yet in practice there is a high degree of subject-specific contextuality. Sarkis and Dhavale (2015) show how this mix of different 3BL criteria can produce radically different outcomes in corporate decision making as there is high sensitivity to the organisational preferences of the firm in question. While Brundtland's SD set a macro-scale goal, the implementation of SD at the organisational level is highly contextual and is oriented on the basis of what prioritises firm-advantage.

Bowen (2014) shows that corporate communications on 3BL and related terms such as 'people-profit-planet' are largely symbolic posturing aimed at placating stakeholder concerns. Similarly, Markman and Krause (2016), reviewing 500 of the most cited academic papers on sustainability, state that,

"*scholars and managers often struggle with the concept and applications of sustainability. To some, sustainability is about environmental preservation, to others,*

it is about addressing societal needs, and yet for those who use a financial lens, sustainability is primarily about the economic bottom line. Then there are scholars and managers for whom sustainability is synonymous with corporate social responsibility, ethical issues, shared value creation, and/or legal compliance." (ibid. page 3)

This provides clear evidence of the plural and contested nature of sustainability. Essentially, neither the concepts of SD or 3BL are necessarily effective in helping organisations to improve performance towards social and environmental goals. While both Brundtland and Elkington have done a great service in popularising SD and sustainable business, the lack of definition has produced problems for implementation. The term sustainability, at worst, is reminiscent of the character of Humpty Dumpty in Lewis Carroll's Alice in Wonderland who remarks that words mean whatever he wants them to mean, until he wants them to mean something else.

Some clarity has been sought on the issue of corporate sustainability performance via the field of operations management (OM). Kleindorfer et al. (2005) conducted a systematic review of sustainability work in OM & SCM, framing sustainability in the context of quality management and business process engineering. The interplay between economic performance and sustainability initiatives in OM & SCM has become a growing area of research (Esty & Winston, 2009; Golicic & Smith, 2013; Haanaes et al., 2011; Kiron, Kruschwitz, Haanaes, & Fuisz-Kehrbach, 2013; Lubin & Esty, 2010). However, Kleindorfer reiterates that the challenge is to find a valid bridge between micro-scale, firm-level performance and macro-scale, ecological and social outcomes (Cohen & Kunreuther, 2007; Kleindorfer et al., 2005).

In seeking to address this, there have been moves towards advancing corporate reporting of social and environmental issues via clear, unambiguous metrics amenable to independent auditing and reporting. These include, for example, the UK Govt. Office of National Statistics 'National Accounting Matrix including Environmental Accounts' (NAMEA) (Vaze, 1999), natural capital calculations (Ekins, Simon, Deutsch, Folke, & De Groot, 2003) now part of the UN's System of Environmental & Economic Accounting. Contributions to such new

approaches by professional bodies such as the Institute for Chartered Accountants in England and Wales (ICAEW) or organisations seeking to advance such practices (such as the collaboration between clothing company Puma/PPR, accountancy firm PwC and sustainability auditor Trucost) show that practitioners and policy-makers are starting to move in this direction, but there is some way to go before these enter standard practices of management accounting, and subsequently OM and SCM decision making.

Planetary Boundaries (PB) framework as a normative model for environmental sustainability

While the public policy space comes to consider environmental accounting at the macro-economic scale, and practitioners start to consider the individual organisational (micro) scale, the persistence of pluralism and vagueness can be given a new focus by progress within the field of environmental science. This points to both the urgency of the environmental challenges due to their scale and seriousness, and also the ineffectiveness of organisations to date in doing anything about these problems. There is a huge gap between the macro scale impacts observed by environmental scientists and public policy organisations (such as the UNFCCC), and organisational scholarship that might influence organisational practice. This is summed up by the following quote from Kallio and Nordberg (2006), which broadly persists some ten years hence;

> "*We simply do not know to what extent corporate greening actually contributes to ecological sustainability or whether it does at all. Of course, there is some case-level evidence and figures of yearly emission levels. These are, however, insufficient and trivial when trying to understand what is actually happening; really understanding this phenomenon requires the cross-fertilisation of natural and social scientific approaches*" (ibid. page 447)

In Whiteman et al. (2012) a major review of sustainability literature within business and management scholarship is undertaken. The above quote is included to highlight that there is little evidence that years of awareness of these issues has resulted in any meaningful change. Both of these papers echo Kleindorfer's challenge as to how to bridge micro-scale, firm-level activities with macro-scale, ecological-level impacts. Whiteman et al. (2012) begin

by showing the traditional, strong link between business and management literature and theories in sociology or economics, but near total absence to literature in the leading natural science journals. They seek to remedy this by introducing the relatively recent Planetary Boundaries (PB) framework into business and management studies.

PB is the outcome of a major international research programme within environmental science as to the factors playing a critical role in maintaining our current climate and other ecological systems in a relatively stable state. Historic records show that the holocene era, beginning at the end of the last ice age (10,000BC), has been especially stable, and this stability has enabled the growth of human agriculture and hence civilisation. Industrial impacts on the Earth's environmental systems are disrupting this stability.

In the original paper on PB (Rockström et al., 2009), nine planetary boundaries are identified, of which three were seen has having exceeded the level that will prompt instability (see Table 1). These three critical PB are climate change (primarily caused by greenhouse gas pollution), eutrophication of water ways (caused by phosphor and nitrogen flows) and species extinction (primarily caused by habitat loss due to land-use changes from wilderness to agriculture). References linking these PB impacts to specific sectors are provided below, which is a consolidation not found in any previous literature.

A recent updating of the PB model is in Will Steffen, Richardson, et al. (2015), which develops the science further in order for it to be considered by the United Nations in relation to their policy formulation of the Sustainable Development Goals (SDG). This paper also answers critiques of the 2009 paper, such as around appropriate units of measurements required for policy mechanisms, and the interconnections between different boundaries.

Whiteman et al. (2012) argue that the PB model offers a strong basis from which to consider the macro-scale impacts given the increased level of precision provided by progress in environmental science since Brundtland (1987). However, although determining significant gaps in the research base, the role of SCM and SSCM as a relevant intermediate level and academic subject between macro and micro is not considered. SCM and SSCM literature

thus provide an opportunity to consider a bridge between micro and macro, where the environmental aspects of the macro are henceforth taken as being PB.

Social Foundation (SF) framework as a normative model for social sustainability

While PB offers a more precise definition of environmental sustainability, and the critique of Elkington's 3BL by Norman and MacDonald (2004) highlights problems with the 'tripartite model' of SD it is not necessary to abandon the notion of social responsibility within corporate sustainability. Their critique of 3BL is that it adds little to the long-standing concern within business and management studies for social responsibility, not that social responsibility is problematic. The term corporate social responsibility (CSR) can be traced back to Bowen (1953), with later theoretical development by Carroll (1979). Whilst social responsibility links firm activity to areas such as business ethics, social sustainability is as plural and contested a concept as environmental sustainability, as discussed by Littig and Griessler (2005).

One recent updating of the social context undertaken in concert with PB is the establishing of the social foundations (SF) framework, first assembled by the international development NGO OxFam and later published by UNESCO (Leach et al., 2013; Leach et al., 2012). This establishes social priorities in international development as provided by governments to the United Nations Rio+20 sustainable development summit in 2012. These are shown in Table 2.

Joining the PB framework's ecological definition of a 'safe operating space for humanity' with the SF framework is described in Hajer et al. (2015) as helping to define a 'safe and just operating space' for the macro-scale of human activity in terms of both environmental and social impact. It is notable that providing data on specific challenges has helped direct NGOs and philanthropists towards particular areas of attention such as clean cooking and sanitation. The new challenge that this research has prompted is for the UN Sustainable Development Goals to increase the meeting of the SF framework whilst reducing the environmental impacts identified by the PB framework (Leach et al., 2013).

Just as the PB framework is a simple model of the most urgent environmental issues the SF framework provides a similar, simple model of the urgent priorities for international development. Social sustainability criteria can be interpreted alongside this framework as issues such as human rights and labour rights sit within these categories (and are important considerations at the organisational-level and sector-level). It is also notable that specific areas such as water and energy, and economic activity more broadly, may be considered as bottom of the pyramid markets (Schrader, Freimann, & Seuring, 2012). It is also notable that the last three categories, voice, jobs and resilience, remained undetermined. This may be due to the availability of data or the politically sensitive nature of such constructs when viewed from a global scale.

A further, final point to note is the nature of the concept of economic sustainability. Under the original definition from Chichilnisky (1977), this is about sufficient economic activity occurring in a community to ensure it can meet its own needs and is not reliant on international aid organisations or international development organisations for subsistence. This concept has remained in place in the case of SSCM policies, for instance, that encourage organisations to ensure their procurement favours local suppliers or SME suppliers (Brammer & Walker, 2011; Meehan & Bryde, 2011; Walker & Brammer, 2009). Such SSCM policies can help facilitate long-term economic development, and hence contribute to what we might now call the social foundations (SF) or social sustainability.

However, a modified interpretation of the term 'economic sustainability' is also seen in work such as C. Carter and Rogers (2008) where it is applied to the context of firms rather than communities. Here, it is taken as economic performance of the firm, considered alongside the social and environmental performance of the firm. Economic sustainability thus becomes a proxy for longevity of the firm (i.e. its sustainability). This is arguably synonymous with the strategic management concept of sustainable competitive advantage (M Porter, 1985). This interpretation of economic sustainability is somewhat different to that of Chichilnisky (1977).

In concluding this short review of the concept of SD and its development through 3BL and link to CSR, the PB and SF frameworks are taken as a more up-to-date and precisely defined version of SD. These are hereafter referred to in this thesis as the PB+SF framework. It is taken as a normative baseline against which to consider organisational level SD actions, specifically as related to organisation's SSCM policies and activities.

At the commencement of this research in 2012, no other research was found specifically applying this PB+SF model in business and management scholarship and specifically in SCM & SSCM scholarship. However, in the wake of Whiteman et al. (2012) a number of papers have highlighted PB in relation to SCM and SSCM. A review of peer-reviewed scholarly papers containing the words 'planetary boundaries' and 'supply chain' in the ABI-Global Inform database finds 17 papers up to April 2016 across both management and environmental science journals. These include Neely, Ahi, and Searcy (2015) which reviews metrics for social sustainability, Beske-Janssen, Johnson, and Schaltegger (2015), reviewing performance metrics in SSCM who argue for the value in using PB as a reference point (ibid. page 673).

Similar mention of PB is made in passing by Drake and Spinler (2013) in discussion on the legacy of Paul Kleindorfer and the relevance of sustainability to operations management as a problem of the use of resources. E. G. Hansen and Schaltegger (2016) also provide similar mention to PB in relation to a review of sustainability as an extension to the balanced scorecard method. Isaksson, Garvare, and Johnson (2015) consider both PB and SF in relation to organisational strategy, and Matthews, Power, Touboulic, and Marques (2016) mention PB in a call for alternative approaches to SSCM. These literature review and conceptual papers provide validation that the application of PB(+SF) is supported by other academics, however none of these papers conducts primary empirical data collection in respect of this, as is the case in this thesis. The next section reviews Section D of the literature review diagram, discussing the nature of research to date on SSCM as an extension of SCM.

Linking PB+SF impacts to specific sectors.

As is shown in the following chapters, this thesis takes the PB+SF model as the basis for case selection in an exploration of SSCM practices. The precise format of this is shown in Table 3. This takes the three PB that are clearly in the danger zone, species extinction, biogeochemical flows (industrial overloading the phosphor/nitrogen cycle), and climate change, plus a consolidation of the social foundation framework into a single 'social' category, as the social foundation (SF) is also taken to be a priority, making a total of four areas.

PB+SF framework
Social foundations (SF)
Biodiversity (Species extinction) (PB1)
Biogeochemical flows (Phosphor / Nitrogen cycle) (PB2)
Climate change (PB3)

Table 3: The PB+SF framework as a new, normative model of the minimum necessary conditions for SD.

Addressing the sectors most responsible for these impacts helps shape the next stage of the research described in this thesis. The selection criteria used for the primary data collection are shown in Chapter 3. However, additional background data is relevant to this and so is shown here in the literature review.

The research is centred on UK-based organisations, though with international links through their own operations as well as supply chains. The PB+SF categories of 'social foundations' and 'species extinction' are primarily addressed as supply chain impacts taking place overseas and not in the UK. While issues including slave labour and bio-diversity are concerns within the UK, it is at a small scale compared to that in certain emerging economies. International companies operating in emerging countries, or companies whose supply chains include emerging economies include agriculture (for food and textiles industries), manufacturing (particularly labour intensive textiles production, assembly and

some heavy industry), and extractives (particularly metals and minerals mining, but also oil & gas). Newly emergent sectors such as services, particularly in telecommunications, software development, customer support etc. are not considered in this research. These are associated with the growth of an affluent middle class in emerging economies, rather than those currently working close to the poverty line, and the related environmental impacts of these sectors are assumed to be small. Table 7 at the end of this section summarises those sectors seen as most relevant to addressing SF via SSCM.

Similarly, species extinction is associated primarily with habitat loss caused by land-use change to convert wilderness into farm land. This has been particularly noticeable in, for instance, places like South American countries where rainforest has been converted to pasture for cattle or arable land for cash crops such as soya beans. Similarly, South East Asian countries have conducted extensive deforestation for conversion to palm oil plantations to establish export markets. These agricultural commodities thus enter the supply chains of the food and chemicals industries. To quote a major study by the European Commission Directorate-General for the Environment, the sources of bio-diversity loss are,

> *"Land-use change...[from] agricultural expansion: growing food production in developing countries...[and] the case of biofuels...Infrastructure development...Deforestation...Air pollution...Water pollution...Marine pollution from oil spills...Unsustainable natural resource use...Fisheries...Mining...Commercial wood extraction"* (Slingenberg et al., 2009)

While these first two categories in the PB+SF framework (Table 3)Table 3 are seen as occurring upstream in the supply chain, the last two categories are primarily seen as impacts that take place downstream in the supply chain. Both of these are consequences of pollution occurring at the point of consumption of their related products. Regarding the linked bio-geo-chemical flows of the phosphor/nitrogen cycle, responsible for eutrophication of river systems and coastal waters, the most recent UK government research commissioned on this identified the following sources of total diffuse phosphorous load into UK river basins (White & Hammond, 2006). As shown in Table 4, household detergents are seen as the most significant source.

An additional point on context at a smaller scale is in relation to the phosphor and nitrogen boundary. There is a significant regional variation in the data within the country, and this figure is for the national average. For instance, in Wales, the source percentage is broadly reversed as the ratio of population to agricultural land is different from that in England or the UK as a whole. In addition, the East of England has a different characteristic as the difference in soil type and climate affects the nutrient performance in river eco-systems. Also, the nitrogen and phosphor cycles are shown as linked as changes in one affects the other. However, the variability in nitrogen is affected by differences in soil types and plant species grown. As such, this PB factor is considered just in terms of phosphor in the following primary data collection.

Category	**Value (kilotonnes of phosphor per annum)**	**%**
Households (detergent)	25.3	61%
Agriculture	11.8	28%
Industry	1.9	5%
Background sources	2.7	6%

Table 4: Sources of phosphor pollution in the UK. Source: White and Hammond (2006, page 2)

In terms of climate change, greenhouse gases are the primary driver, which are recorded via formal systems put in place as a result of international climate policies, established via the UNFCCC (United Nations Framework Convention on Climate Change) and the UK 2008 Climate Change Act. The formal, legal reporting of the sources of greenhouse gases, calibrated to equivalent global warming potential by the metric of carbon dioxide equivalent (CO_2e), are shown in Table 5 (CCC, 2015). The power category covers electricity generation from power stations using carbon-based 'fossil fuels', coal, gas and oil.

Category	Value (Mega-tonnes of CO_2e per annum)	%
Power	122	23
Industry	109	21
Buildings	85	16
Transport	118	23
Agriculture and LULUCF	47	9
Waste and F-gases	39	8

Table 5: UK greenhouse gas emissions by sector. Source: CCC (2015, page 48), % added by author.

An important point examined in this research is the role of nuclear power as a source of carbon-free energy. This is a fact that is controversial among some social groups, particularly in certain countries. However, data from the OECD on the carbon intensity of the electricity of different countries, Table 6, measured in CO_2/kWh shows the implications of different power generation technologies in their electricity grids. Sweden, Switzerland and France, with a high percentage of nuclear generation are below the target level of 100g CO_2/kWh set as the target needed to address climate change (CCC, 2015; MacKay, 2010).

Countries with a mix where fossil fuels make up more than half of energy generation, such as Germany, the UK, and USA, are four times over the limit. The German policy of increasing solar, wind and biomass generation does not show as having reduced the carbon intensity at a national level, likely due to coal remaining a high contributor to national energy demand. In Japan, a large rise in carbon emissions can be seen resulting from the impact of temporarily closing its nuclear power stations in 2011 after the tsunami and Fukushima accident. Canada, by contrast, has shown a declining trend in carbon as a result of its recent nuclear programme. Saudi Arabia, where electricity generation is highly carbon intensive, is shown as a further contrasting example. The time to prepare and publish the data means 2013 is the most recent year, as of Nov 2015 http://www.oecd-library/energy.

	2009	2010	2011	2012	2013
Sweden	42.293	50.771	40.927	32.679	35.065
Switzerland	36.71	39.144	39.723	37.757	36.783
France	86.946	90.336	73.853	74.581	71.437
Germany	444.739	439.427	449.289	450.848	448.636
Japan	424.767	427.569	508.341	562.241	568.766
United Kingdom	445.426	447.805	439.199	481.819	454.629
United States	516.756	522.574	503.502	480.804	482.288
Canada	173.573	183.418	169.178	161.428	159.129
Saudi Arabia	763.368	742.7352	760.6178	744.2286	727.0362

Table 6: national carbon intensities in CO2/kWh, source: OECD.

Returning to Table 5, on the sector breakdown of energy demand in the UK, the industry category includes emissions from industrial processes, such as coke used in steel forging, emissions from the manufacture and curing of cement and other chemical processes. The buildings category is gas consumption for heating. The transport category divides roughly 40% domestic vehicles, 40% commercial vehicles and 20% public transport (road and rail). International shipping and aviation are not included in national inventories, but are addressed by the CCC and the UNFCCC. Agriculture and LULUCF (Land Use, Land Use Change and Forestry) includes both emissions produced and absorbed by farming and forestry.

Waste includes emissions from land-fill sites and sewage works. including methane (CH_4). F-gases are flouride gases including those used in manufacturing processes in areas such as electronics, aerosol propellants, plastics, etc. As a minority source, these are listed separately from the industry category. The largest four sector-based sources of greenhouse gases (83% of the total CO_2e) are represented in the acquisition of primary data discussed in the following chapters.

The PB+SF categories in Table 7 bridge national and international scales because of the nature of the link between the impacts and their related causes. the international

development aspects inherent in the SF framework, for instance, mean that impacts are ostensibly minor in developed countries. Similarly, land use change driving species extinction is more pronounced in developing countries (also referred to as emerging economies). The high degree of country-specific context on these issues prevents the provision of clear percentages on impact from given sectors. This data should be available in principle, but is not established in the research to date. This is shown in Table 7 via the abbreviation 'n.k' for 'not known' as these are specific to a given country context.

PB+SF categories	Location of impacts	Major sectors (%)
Social Foundations (SF)	In emerging economies	Extractives (n.k.) Agriculture (n.k.) Manufacturing (n.k.)
Species Extinction (PB1)	In emerging economies	Extractives (n.k.) Agriculture (n.k.) Built environment (n.k.)
Phosphor / Nitrogen cycle (PB2)	Percentage refers to UK (water courses) but if products are exported then other country data needed.	Household detergent (61%) Agricultural fertilizer & pesticides (28%) Industrial processes (5%)
Climate Change (PB3)	Data is for UK (air pollution) but emissions also occur upstream in supply chain (covered by other country emissions reporting, except for emissions in international waters or international airspace).	Electricity generation (23%) Transport fuel (23%) Industrial processes (incl. steel & cement) (21%) Heating buildings (16%) Agriculture and LULUCF (9%) Waste & F-gases (8%)

Table 7: Consolidated sector analysis of PB+SF impacts.

The primary data collection investigating PB3: climate change, and the associated greenhouse gases, involves consideration of alternatives to carbon-intensive fuels for transport and electricity generation. These are discussed in the relevant sections of Chapter 5, however in relation to the data provided in Table 6, the legislative policies around climate change in the UK require the decarbonising of electricity production first as this then enables the potential to decarbonise both transport and heating of buildings via electrification (CCC, 2015). This is relevant to SSCM in relation to PB, discussed in Cases 5.2 and 5.3.

Levels of analysis to meet Kleindorfer's Challenge: the potential for SCM/SSCM.

As described by Kleindorfer et al. (2005) and Cohen and Kunreuther (2007) a major challenge for sustainable business is to find a bridge between macro-scale ecological impacts, and micro-scale organisational practices. Considering the broad topics from the firm level to the macro-environmental level, different academic disciplines relate to different levels of analysis, as shown in Table 8. The first three levels, A, B & C are covered by life cycle analysis research and practice (Adhitya, Halim, & Srinivasan, 2011; Guinée, 2001). Levels C, D, and E are covered by commodity economics (Begg & Ward, 2007). Level B, C and D are covered by business and management studies. At Level A and B, the locus of decision making is internal to company, and at Level C, the locus of decision making is spread between companies. Finally, at Level D, E and F, the locus of decision making is political (external to commercial organisations, but subject to stakeholder engagement and influence, e.g. via public affairs).

	Level of analysis	**Scale**	**Academic discipline / locus**
A	Product level	Micro	Environmental engineering / product design
B	Firm level	Micro	Operations Management / operations strategy / strategic management.
C	Supply Chain Level (vertical)	Meso	Supply Chain Management (incl. procurement & logistics) / operations strategy / strategic marketing / strategic management
D	Sector Level (Horizontal)	Meso	Strategic management (competition & co-operation), economics, strategic marketing / macro-marketing.
E	National, Regional & International Level	Macro	Public policy / macro-economics / geography & ecology (plus/incl. industrial ecology / Earth systems science)
F	Global Level	Macro	Earth systems science / ecology / industrial ecology

Table 8: Academic and functional disciplines at different levels of analysis for SD and PB.

The relevance of this is that operations management (OM), supply chain management (SCM) and operations strategy (OS) sit between the physical, operational aspects of technology, designed and delivered by engineers, and the cost-based implications of

political economy or inter-organisational relations, discussed by stakeholder theory (Freeman, 1984; Freeman, Harrison, Wicks, Parmar, & De Colle, 2010) and institutional theory (Berrone, Fosfuri, Gelabert, & Gomez-Mejia, 2013; DiMaggio & Powell, 1983). As discussed in Section B and C, below, SCM and SSCM research crosses these other levels of analysis and related research. As noted in Section A above, determination of this within SCM theory is affected by a firm's visible horizon (C. Carter et al., 2015), and this thesis extends this idea via the application of the sustainability topic, thus seeking theory development in the field of SSCM.

SSCM is thus seen as a 'meso' level that is essential for breaking out of the micro-scale of the firm and considering the wider macro context. This is because at a firm-focussed level of analysis alone, organisations in developed economies, based in, say, the West, can readily appear to reduce their environmental impact by outsourcing processes, thus moving them outside of the formal boundary of the firm. Because of globalisation, the negative environmental impacts from industrial facilities can now take place elsewhere in an outsourced supply chain, in potentially far-off non-Western, emerging economy countries. Closer to home, even the buildings that an organisation occupies can be removed from their books by simple sale-and-lease-back contracts (Alexander, Touboulic, & Walker, 2014).

A similar process is seen at the national level where, for instance, the UK economy has experienced a reduction in its carbon footprint, yet has effectively outsourced its manufacturing industries to places like China, where some 25% of that country's carbon footprint is directly attributed to manufacturing of goods exported to the West (CarbonTrust, 2011). The de-carbonisation of the economy is thus only at the national level, not the macro, international level, which is why global concentrations of carbon in the atmosphere have continued to rise.

Investigation into the concept and application of scales is a familiar one in the topic of human geography, including environmental impact. According to Adger, Arnell, and Tompkins (2005), " *actions are not autonomous: they are constrained by institutional processes such as regulatory structures, property rights and social norms associated with*

rules in use" (ibid. page 78). For a topic such as climate change these scales range from the inter-governmental, via the UN, to the national, as well as regional governments, city authorities, as well as industries and firms. Business and management literature is relevant in that it addresses the firm-level or sector-level motivations for types of action, and the underlying decision making processes. This is absent from the geography literature, and while some work in organisational studies, such as Spicer (2006), cover the issue of scalar perception in relation to organisational logics and globalisation, this does not refer to the issue of environmental and social impacts.

Will Steffen, Richardson, et al. (2015), in updating the PB framework in order to engage with policy-making via the UN, note that it is not designed to be disaggregated to smaller scales such as nations. However, they also state,

> *"there are severe implementation gaps in many global environmental policies relating to PB issues, where problematic trends are not being halted or reversed despite international consensus about the urgency of the problems."*(ibid. page 8)

The environmental science community, and indeed the public policy community, may therefore require the input of business and management studies on the organisational contribution to these serious environmental impacts. The interplay between environment, regulation and operational activity is thus central to meaningful progress on PB issues.

SSCM is well placed to meet this call, but it is also to date a relatively young topic of research and potentially under-developed for achieving this. Miemczyk, Johnsen, and Macquet (2012), for instance, highlight that the firm-level perspective has remained dominant in SSCM research and yet is insufficient for addressing sustainability. Hence, they argue that research that extends beyond this, into a network-level of analysis, is important.

This aligns with the observation of Whiteman et al. (2012) that business and management research on sustainability is largely concerned with the impacts on firm-level performance, not on addressing the collective role of organisations in global ecological challenges. With large-scale meta-analytical reviews such as Golicic and Smith (2013) maintaining that the

question of whether SSCM policies contribute to improved economic performance has been answered, the topic should shift to the effectiveness of SSCM not at meeting firm-level economic benefits but macro-scale environmental and social ones; in other words the PB+SF goals.

Conceptualising this divide has been attempted by Whiteman et al. (2012) in relation to general management, and Pagell and Shevchenko (2014) in relation to SSCM. Both note that the problem with concentrating on the economic benefit of corporate sustainability or SSCM policies, is that anything that is 'non-synergistic' with the commercial self-interest of any firm is ignored.

These papers thus stand in contrast to Porter and Kramer (2006) in strategic management, and C. Carter and Rogers (2008) in SSCM, who both argue that economic performance is the pre-eminent requirement for SSCM, as without it well-intentioned firms go bankrupt and their noble social and environmental goals go unmet. The Body Shop is an example of a firm that put social and environmental outcomes ahead of its own economic management, resulting in near total collapse and takeover by a major multinational rival, L'Oreal (Devinney, 2009).

These two positions might be described as representing a paradox for business sustainability. On the one hand, firms need to have a positive business case for sustainability, but on the other if only a firm-level perspective is taken, then anything non-synergistic will go unmet even if it is in the public interest. Such themes within the interplay of micro-firm performance and macro-scale outcomes thus encompass issues of strategic management as a fundamental part of SSCM. This theme was introduced in terms of Kleindorfer's challenge to bridge the micro and macro. The next section provides an overview of the SSCM field and its contribution to understanding these pressures in organisational activity seeking to meet both the traditional economic value maximization of SCM with the social and environmental outcomes of SD.

C: Sustainable Supply Chain Management (SSCM)

SSCM concerns the attempt by companies to consider the sustainability impacts occurring in their supply chains. This is an increasing concern of companies, particularly when faced with compliance to particular environmental, social or ethical standards. Ahi and Searcy (2013) conduct a review of the various definitions appearing and provide a synthesised definition of SSCM as being:

> *"The creation of coordinated supply chains through the voluntary integration of economic, environmental, and social considerations with key inter-organisational business systems designed to efficiently and effectively manage the material, information, and capital flows associated with the procurement, production, and distribution of products or services in order to meet stakeholder requirements and improve the profitability, competitiveness, and resilience of the organisation over the short- and long-term."* (ibid. page 339.)

The academic study of SSCM, as distinct from SCM, can be traced to papers such as Lamming and Hampson (1996), *The Environment as a Supply Chain Issue*, in the British Journal of Management, and C. R. Carter and Jennings (2002), *Logistics Social Responsibility: An Integrative Framework*, in the Journal of Business Logistics. The growth of the topic has been addressed in various special issues and literature reviews (Ahi & Searcy, 2013; Ashby, Leat, & Hudson-Smith, 2012; C. Carter & Rogers, 2008; Gimenez & Tachizawa, 2012; Gold, Seuring, & Beske, 2009; Hassini et al., 2012; Miemczyk et al., 2012; Joseph Sarkis, Zhu, & Lai, 2011; Seuring & Müller, 2008; Srivastava, 2007; Touboulic & Walker, 2015). A short review of these reviews establishes some of the main themes in the subject and establishes the rationale for the following conceptual framework underlying the research in this thesis.

Echoing the work in Chicksand et al. (2012), Alexander and Walker (2013) and Touboulic and Walker (2015) review the use of theories in 308 papers representing SSCM research and find a large plurality of approaches. SSCM as a topic can clearly be examined from a wide variety of viewpoints. The resource based view, stakeholder theory and institutional theory are found to be the predominant theories used. The first two of these are strategic management theories and thus concerned with firm-level performance, and institutional

theory is a sociological theory, applied to consider external pressures on a firm. Even minority theories such as transaction cost theory or the natural resource based view, which is concerned with how firm advantage is based on access to natural resources, are fundamentally about firm-centred performance. No theories are mentioned in this review of SSCM literature that explicitly link to environmental science or international development theories. However, by selecting papers only from journals that are in the fields of business and management, such wider perspectives are likely to be excluded, reiterating the point by Whiteman et al. (2012) that business and management literature draws on sociology and economics but has weak links to natural science.

A further example of the firm-focussed basis of SSCM research is seen in Ahi and Searcy (2013), who conduct a review of 180 papers, finding 12 unique definitions for green or sustainable SCM. Addressing these from the micro-level perspective of the firm versus the macro-level perspective of PB+SF, some explicitly define SSCM as being about the performance of the organisation as a unit whose performance can become environmentally or socially sustainable (although not defining what this means) (C. Carter & Rogers, 2008; Jorgensen & Knudsen, 2006), or that the firm's supply chain can become sustainable (Pagell & Wu, 2009). This latter position assumes that sustainability is a potential property of a supply chain, and thus that there is such as thing as a supply chain that can become a sustainable supply chain by itself having no negative impacts associated with it and thus be a model for other non-sustainable supply chains to follow.

Instead, taking the PB+SF perspective into account and the extreme urgency of PB expressed by environmental scientists (Hansen, Kharecha, & Sato, 2013; Hansen, Kharecha, Sato, et al., 2013; Rockström et al., 2009; Steffen, Broadgate, Deutsch, Gaffney, & Ludwig, 2015; Steffen, Richardson, et al., 2015), it is more important to define sustainability at the ecological level and then address the major sectors that are relevant to addressing these and the related supply chains. Otherwise, paying attention only to companies and their SSCM policies that are proactive on the issue yet focussed only on their own performance, without considering how that performance is relevant to the wider macro goals, risks not being attentive to those goals at all. This is shown in the reviews by Kallio and Nordberg (2006) and Whiteman et al. (2012) where the advancing of corporate concern over

sustainability remains wholly disconnected from a notion of effectiveness at meeting macro-scale sustainability.

In the synthesised definition in Ahi and Searcy (2013) above it is clear that SSCM is regarded as primarily an organisational-level concept that again assumes that the survival of the organisation takes precedence, and adds that actions should be voluntary. This can be considered as a 'firm-level' perspective on SSCM. Just as SCM scholars have argued for the need to shift the unit of analysis towards the level of the network rather than the individual organisation (C. Carter et al., 2015; C. R. Carter, Meschnig, & Kaufmann, 2015), it follows that SSCM research should be concerned with levels of analysis above the individual organisation, and indeed should be concerned with a clearer understanding of the macro impacts that progress is sought on.

Furthermore, the consolidated definition of SSCM derived by Ahi and Searcy (2013) states that meeting 'stakeholder requirements' is sufficient to advance sustainability. However, there is no specification as to who should be defined as stakeholders, or any of the wider criticisms implicit in stakeholder theory, such as its lack of status in corporate law compared to shareholders (Keay, 2011) or problems in defining civic society as a stakeholder in order to meet notions of public value or the common good (Lepineux, 2005).

As discussed above, and as also recently noted by Pagell and Shevchenko (2014) in the SSCM literature, the problem with this approach is that anything that is not in the economic interests of any given firm will not be addressed. In other words, only sustainability issues that are synergistic with market interests are tolerated within this - according to Ahi and Searcy (2013) - widespread definition of SSCM. Similar findings can be drawn from a similar compilation of definitions in Touboulic and Walker (2015). Given the severity of impacts identified by PB(+SF) and related scientific and policy work, this situation requires additional consideration and hence can be identified as a gap in the existing SSCM literature.

This thesis therefore sets out to meet this gap by determining the link between SSCM at the firm level and PB+SF at the macro level to help reveal what is non-synergistic, the nature of the conflict between synergy between firm-level economic performance and macro PB+SF

issues, and how these are presented via the ways in which SSCM is implemented. This presents an opportunity to advance theory in SSCM, building on three overlapping areas:

- a network view of the supply chain as a complex adaptive systems,
- issues of perception in what is known about the supply chain and what is unknowable,
- the constraints that managers are faced with in enacting SSCM policies
- how these impact on the economic performance of their organisation and the performance of the social and environmental outcomes resulting from their business operations and those of their suppliers.

The persistent focus on SSCM as being concerned with firm performance prompts the risk that while micro-level SSCM may be a necessary condition for achieving macro-level sustainability, it is not a sufficient condition, as, by definition, unless the urgent PB are addressed at an aggregate level, sustainability cannot be achieved. Kleindorfer's challenge is not met by the tendency in SSCM research to limiting the focus to the organisational level.

Yet, the paradox of business sustainability noted above is that because economic performance is the primary responsibility of managers there is a divided responsibility between their own firm's economic performance (its economic sustainability) and responsibility for the wider societal impacts of their firm's activities and those of their supply chain. Having a legal responsibility to the former and an ethical responsibility to the latter is a central challenge and it is important to understand the firm-level perspective on SSCM in relation to PB+SF while also considering its position in relation to those impacts at the level of the supply network.

Taking this focus on SSCM in terms of PB+SF is a novel contribution under-developed in the literature to date. However, this is not to underplay the importance of research and practice in SSCM to date. Much of this is extremely important in its own right, such as demonstrating the value of adopting industry standards (Arimura, Darnall, & Katayama, 2011), or

there is much that is uncertain and ambiguous; Preuss and Walker (2011) for instance, conduct a qualitative investigation into psychological barriers at work in SSCM implementation. Lack of knowledge, complexity in the supply chain and ambiguity or lack of clarity as to what the definition of sustainability should be, are all cited as barriers.

The degree of responsibility over a supply chain that any given organisation possesses is an issue of context. As noted by Blome et al. (2014), taking a contingency theory view, the level of product complexity and supply chain complexity are barriers to flexibility. At an ethical level, the notion of responsibility implies agency. Can firms therefore be responsible for practices over which they have no power? If so how, and if not, why not? Certainly, ethics suggest that ignorance is no defence, and this is an acute issue often highlighted by the impact of disasters (Huq, Stevenson, & Zorzini, 2014; Skilton & Robinson, 2009) or investigative reporting by the media or NGOs (Reinecke & Ansari, 2014). Power itself is also correlated with the size of a firm or a market, with large multinationals having power over smaller customers or suppliers (Touboulic, Chicksand, & Walker, 2014).

Abbasi and Nilsson (2012), conduct a systematic review of 190 articles on SSCM to determine a fuller picture of the challenges to SSCM. Five areas are identified; uncertainties, complexity, operationalisation, costs, and mindset & cultural changes. To advance SSCM, they maintain there is a need for, "*novel approaches which do not try to eliminate but instead comprehend the complexity*." (ibid. page 525). Operationalisation is also hampered by the inability to readily translate the Brundtland descriptions of social, environmental and economic sustainability into "*relevant and prioritised activities for every process and/or individual in a supply chain.*" (ibid. page 526). This is described as a problem of interpretation, and derives directly from the lack of definition inherent in the historic concept of tri-partite sustainability.

> "*Consequently, there is a great challenge in incorporating sustainability and environmental management principles into the daily decision-making process and the processes carried out in supply chains...In conclusion, there is a great need for models and frameworks which consider the complexity involved, take holistic perspectives,*

and challenge the basic assumptions underlying most of the research published" (ibid. page 526-527).

Two topics extend from these conclusions. First is in the notion of what they call a 'holistic perspective' where they cite Haake and Seuring (2009), who say, *"in the long run there can be no such thing as "80% sustainable"*" (ibid. page 284). This supports the argument above that sustainability is not a micro-scale firm-level property, but a macro-scale, global ecological and societal property. Secondly, they highlight that it is organisational decision making that is hampered by these challenges.

Addressing barriers to decision making provides a specific angle from which to investigate the challenges to SSCM and the ways by which SSCM can be a means to address PB. Abbasi and Nilsson (2012) call for novel approaches to comprehend the difficulties in trade-offs and ambiguities but do not address the existence of decision analysis as a branch of academia that exists to study such issues.

An additional example is seen in the major literature review on SSCM in Carter and Rogers (2008) extended into middle range theory development for SSCM in Carter and Easton (2011), and used as a foundation for Abbasi and Nilsson (2012). Here, an analysis of previous literature leads to a typology of characteristics, which in C. Carter and Rogers (2008); Carter and Easton (2011) are defined in terms of requirements, called the Four Facets of SSCM, and in Abbasi and Nilsson (2012) in term of challenges to SSCM. The criteria established by both of these are listed in

Table 9.

Elaboration in the right-hand column shows how the outcome of these reviews highlights elements central to organisational decision making in the implementation of SSCM. This includes the role of transparency, risk, uncertainty and complexity, plus the organisational culture and mindset, as well as fundamentals such as cost, strategy and operationalisation. Some of these relate to the nature of data or information and how it can inform decision making, and indeed how to make decisions in the absence of clear knowledge, such as in conditions of risk, complexity and uncertainty. Operationalisation and strategy are both

examples of management decision making, which as discussed in Section D, below, are correlated to elements of a traditional organisational hierarchy, the seniority of which is also correlated to the level of structure in the decision making process. The central issue of cost, and indeed how this relates to other aspects of risk, uncertainty and operationalisation, suggest that underneath the surface of these necessary conditions for implementing SSCM and related barriers (challenges), are questions about decision making.

Four Facets for SSCM	*Carter and Easton (2011); Carter and Rogers (2008)*
Transparency	Data on the supply chain is required
Strategy	The SSCM policy must align with competitive advantage
Risk Management	Mitigation of potential problems incl. probabalistic threats
Organisational Culture	Internal characteristics of an organisation
Five Challenges for SSCM	*Abbasi and Nilsson (2012)*
Uncertainty	Outcomes are ambiguous or unpredictable due to lack of knowledge
Complexity	Outcomes are ambiguous or unpredictable due to non-linearity
Cost	The benefits must be affordable, or meet comp. advantage.
Operationalisation	Changes must be measurable under performance mgt.
Organisational Culture & Mindset	Internal characteristics of an organisation and the individuals working in it.

Table 9: The Four Facets and Five Challenges of SSCM

Other studies into SSCM implementation have also scratched the surface of the topic of management decision making, notably Pagell and Wu (2009) and Wu and Pagell (2011), but do not address the existing literature on DT. These two papers identify the use of 'guiding principles' by firms as a means to address complexity or ambiguity in SSCM decision making. However, no reference is made to Keeney (1992), a key text in DT that defines value-focussed decision analysis (VFDA) and provides deeper conceptual explanation as to why guiding principles aid such decision making in comparison to the quantitative approaches of traditional OR, or structured decision making. Similarly, Christopher and Holweg (2011), noting that unpredictability has become the new norm in the global business environmental more generally post the 2008 financial crash - and thus a major challenge in SCM - do not

draw on literature that centres on the nature of decision making under conditions of inherent uncertainty (S. French et al., 2009). As Touboulic and Walker (2015) propose,

> "*For the field to gain in maturity, researchers in SSCM should consider testing and extending other potentially relevant theories from various disciplines, outside the few popular lenses that have been applied to date...[and] research needs to build a more holistic and multi-level understanding of SSCM rather than being constrained by the prevalent...competitive paradigm...*" (ibid. page 34)

Therefore, SSCM should consider DT as a means to do this. Some instances of the application of DT to SCM and SSCM do exist, with one particular branch of DT being particularly dominant, and these are looked at in the sections below. Operational Research (OR) or Management Science (the origin of which is referred to as a rebranding of 'applied micro-economics' by Simon (1959)) is an extension of the normative, rational, quantitative branch of DT. A review of the application of some of these approaches in SSCM is provided by Seuring (2013). An interesting complement to this is provided by Sarkis et al. (2011) reviewing the current and potential use of organizational theories for SSCM, including complexity theory (Prigogine & Stengers, 1984) and structuration theory (Giddens, 1984), which concern the nature of the external context and how it is understood and reacted to. The connection of both of these reviews to the topic in this thesis of elaborating the use of DT for SSCM will become clear in the following section.

One original contribution being made in this thesis is to apply a contemporary framework in DT that encompasses complexity and uncertainty alongside simpler, structured contests, called the Cynefin framework (Kurtz & Snowden, 2003; D. Snowden & Boone, 2007) shown in Figure 2. The next section provides a short review on the history of DT and its development with regard to complexity, uncertainty and ambiguity, which, as the research above shows, appear as central concerns in sustainable development (SD), SCM and SSCM. The direction of travel for the thesis is the extent to which management practices in SSCM expect stable, structured, quantifiable models, and the extent to which the external context is instead complex and uncertain. The use of DT helps explore these issues.

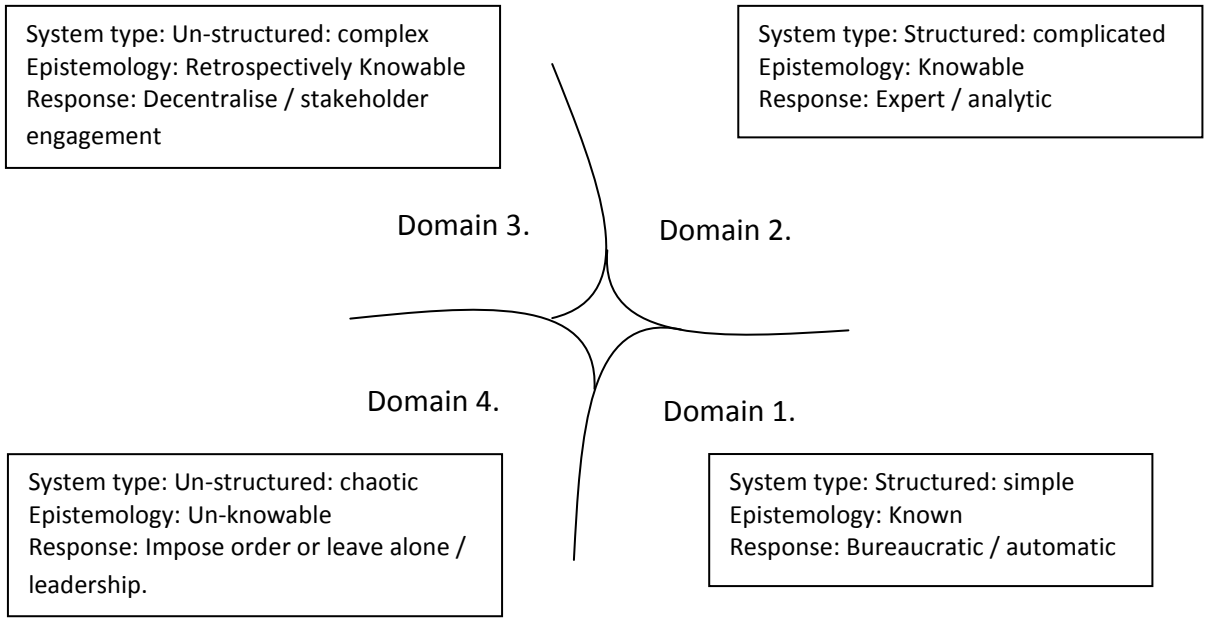

Figure 2: The Cynefin Framework, based on Snowden and Boone (2007), adapted by the author to incorporate labels.

D: Decision Theory (DT)

Organisational responses to SD can be regarded as having moved from a 'why' phase to a 'how' stage, and in so doing questions of implementation become vital. As Abbasi and Nilsson (2012) conclude from their major review, operationalisation is one of the central challenges for SSCM, which suggests there are problems with the ways in which SSCM is integrated into management processes.

As mentioned above, DT directly relates to many concepts in SSCM research. The five challenges for SSCM in Abbasi and Nilsson (2012), or the four required features of SSCM in Carter and Easton (2011) (

Table 9) or the guiding principles used by exemplars of SSCM in Wu and Pagell (2011), all cover aspects of decision making related to organisational culture and mindset, yet make no reference to DT. Similarly, no theoretical review has explicitly noted DT. Hence, in Section G, below, a novel literature review into the use of DT within SSCM research is conducted

(published as Alexander et al. (2014)). As mentioned above, while some reviews on SSCM research are implicitly based on DT, such as the basis of modelling in the study of operational research (OR) or management science, which is fundamentally about decision analysis (Bloemhof-Ruwaard et al. 1995; Seuring, 2013), these represent one branch of the wider subject of DT, and do not draw an explicit link with the origins of this branch in terms of DT and related literature.

A recent text book providing a comprehensive review of DT, bringing together its distinct branches in mathematics, psychology and organisational studies, is S. French et al. (2009). This is taken as a core text for this thesis. This explains the evolution of DT in management studies, its theoretical positions and the various relevant universal and rational mathematical tools and contextual psychological and political factors at play in decision making. This incorporates a wide range of topics in business and management studies, including operations management, management accounting, strategic management and business ethics.

The basic toolkit of DT that can be applied by managers and scholars includes analysis of individual decisions, group decisions, the use of decision tables showing different options and their known consequences, or decision trees that show how particular options open up others, and influence diagrams that show conditional dependency or independency. Different tools are appropriate for different types of decision problem, and the various techniques - such as for considering multiple criteria at the same time or different possible goals - have been subject to considerable development over recent decades, particularly boosted by the rise in personal computing (S. French et al., 2009). However, although potentially providing valuable insight, additional factors to consider include the accuracy of the underlying assumptions and data, and issues around interpretation and implementation. To quote Baba and HakemZadeh (2012),

> *"Decision making is arguably the core of managerial tasks but often managers make decisions under pressure and with incomplete information...In addition, managers are confronted by an overload of information...The results of poorly supported*

decisions are choices that waste company resources and even risk the future of the organisation." (ibid. p832-833)

These limits to rational modelling of decision problems is known as the phenomenon of bounded rationality. This was defined by one of the main pioneers of DT in management, the polymath scholar Herbert Simon, who was awarded the 1978 Nobel Prize in Economic Sciences for his work. Whilst the rational approach of decision making on the basis of mathematical modelling had a significant role to play, it had to be tempered by the internal cognitive limitations of people making decisions and aspects of the external environment as to whether phenomenon were occurring in predictable or unpredictable ways. By introducing the concept of 'bounded rationality', Simon (1957), created a clear split of DT into two camps (Figure 3). Firstly, the rational camp dating from the likes of Taylor (1911), is based on mathematical models using empirical data, but is normative, i.e. it explains how we ought to best make decisions. This is central to the traditional field of OR where mathematical techniques are applied to management decision making on the assumption that people try to make the most optimal choice because they should act rationally to maximise their best possible outcomes.

However, in contrast to this the behavioural branch of DT investigates how decisions are actually made in reality. This means addressing the limits to knowledge and sources of bias which are subject to powerful cognitive and social forces. As such, this branch has been a major research area in psychology and political science. In recent years it has come to the fore in business and management studies through the rising profile of behavioural finance and economics (Subrahmanyam, 2008). For example, Statman and Caldwell (1987), show how political pressures over-ride rational analysis in disinvestment decisions. Evidence from the disc-drive industry showed how non-rational, behavioural factors by managers empire building or clinging to personal projects could bring down whole companies.. This branch of DT, in contrast to the rational and normative, is described as behavioural, or empirical and descriptive DT.

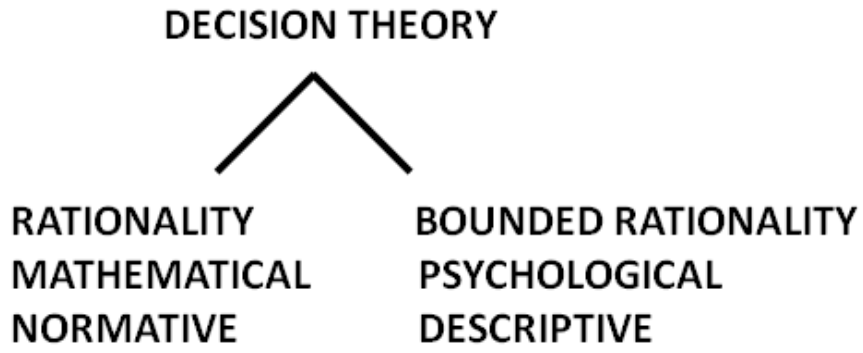

Figure 3: The two branches of DT

Bounded rationality is a foundational concept for behavioural DT as it describes how people are limited in their logical reasoning capabilities and subject to various biases in perception. These include 'issue framing', 'evaluation', 'perception of risk and probability', 'institutional pressure' and 'heuristic short-cuts'. 'Prospect theory' shows that when things are going badly, people's aversion to risk goes down and so they make riskier decisions. Under conditions of stress, our decision making capability can thus become impaired and so emotional states are as significant as rational capability. A detailed account of the effect of this in the 2008 financial crash is provided by Tett (2009).

In reviewing the historical development of these two branches, S. French et al. (2009) describe how taking a rational, normative analysis and then considering the sources of distortion introduced by the behavioural, descriptive analysis, then allows a recalibration back to an optimum output, or best decision, through a combined process called prescriptive decision analysis.

However, it is an important aspect of DT that all of these techniques are to merely produce 'decision support systems' to help inform the judgment of a decision maker. The responsibility for the decision rests with the decision maker (Simon French & Niculae, 2005). Such models are:

> "*tools for thinking...ad-hoc exploratory devices for reflection before action...A model intended as a tool for thinking needs to be adequate for the task, and it must be skilfully used if the task is to be done well*." Pidd (1999) p120.

DT also links the nature of decision making to organisational hierarchy. Responsibility for taking a decision must remain with the individual or group who holds authority. As noted by Simon (1947, 1960), and further explored by Mintzberg (1972a, 1972b) and Jaques (1989), there is a link between organisational hierarchy and the characteristics of decisions. Strategic decisions tend to be 'unstructured', having to consider multiple factors, uncertainty and change, while operational decisions are more definable, stable or structured and thus amenable to programming.

This is an important distinction, discussed in Simon (1977), where an easily structured problem leads to an essentially mechanical or analytical approach to solutions. Unstructured problems are common in strategic decision making, where there is less certainty, and longer time-scales required before success or failure is apparent. Strategic decisions are important, but have a low frequency, or are completely unique and non-repeating, and thus are unstructured. Corporate strategy is about setting long-term goals, while the operational level does the detailed work to try to meet those goals, and the 'hands-on' level then delivers the work. These higher level problems can be addressed through less quantitative and more general management models. Porter's Five Forces, for instance, is fundamentally a decision model operating in the 'unstructured domain' of corporate strategy (S. French et al., 2009; M Porter, 1985), where indicative rather than necessarily quantifiable factors can be considered.

Simon (1977) discussing the divide between well-structured problems and ill-structured problems shows that the border between the two is not distinct. Layers of bounded rationality take place here too. This is all relevant to the question of SSCM and its ability to make a meaningful contribution to PB+SF, as management decisions related to SSCM can be characterised by multiple stakeholders, multiple criteria and uncertainty as to present or future circumstances. They are also likely to have strategic significance. The presence of plural and contested definitions and potential barriers to visibility and accuracy of data through all stages of the supply chain, mean SSCM clearly seems to be ill-structured or unstructured (Büyüközkan & Çifçi, 2012; S. French & Geldermann, 2005).

Assuming the structure of the system is stable, if the key attributes are known and measurable, then a predictive OR model can be generated, enabling the comparison of various alternative options, and preferred outputs can be calculated and put into practice. However, if the decision context is characterised by uncertainty or complexity it cannot be modelled in a structured way, and different approaches are needed. While various attempts to incorporate uncertainty within mathematical models exist, such as probability, fuzzy logic, grey sets, swarm algorithms, etc. these all deal with specific knowns (such as the level of probability), or seek to impose a form of structure on unstructured contexts.

Previous research suggests SCM, and hence SSCM, should suffer from inherent complexity (T. Y. Choi, Dooley, & Rungtusanatham, 2001; Christopher & Holweg, 2011; S. French & Geldermann, 2005). This suggests that unstructured decision making techniques are required. However, the evidence from the literature review suggests that many firms and researchers adopt a structured approach, based around either bureaucratisation of key variables (Hervani, Helms, & Sarkis, 2005), or expert analysis of complicated structured relationships (Zhu, Dou, & Sarkis, 2010).

The Cynefin Framework

French et al. (2009) draw on a typology of decision spaces that illustrates these contrasts. This is called the Cynefin framework (Kurtz & Snowden, 2003; Snowden, 2002; Snowden & Boone, 2007) after a Welsh word, meaning roughly habitat or home, but associating the multiple aspects of context and belonging, from landscape through to culture. The Cynefin framework builds on the mathematical theories of complex and chaotic systems to provide a knowledge management, sense-making framework that distinguishes between structured and unstructured decision contexts (Figure 2). Each of these is sub-divided into two further categories. The lines dividing each domain are shown as curved as a reminder that the boundaries between the domains are changeable based on context. The black area in the centre is taken as the domain of uncertainty or ignorance before a particular decision space has been considered.

The structured domains are stable and ordered, where cause and effect can be determined. The simple, known domain includes standard operating procedures, while in the complicated, knowable domain, cause and effect are not readily apparent, but can be determined by analysis and so are separated by time. This is the realm of classical economics, traditional OR and System Dynamics.

Against this are set the unstructured, complex and chaotic contexts. In the complex domain there are many inter-relating influences but order is emergent. It is a decision context characterised by inherent uncertainty but patterns do emerge. This order is not quantifiably predictable in advance, but cause and effect can be determined in retrospect. The chaotic realm is also unstructured, but there is no emergent order. Figure 4 shows the Cynefin domains in terms of their implications for knowledge management and classical scientific inquiry using instrumental rationalism.

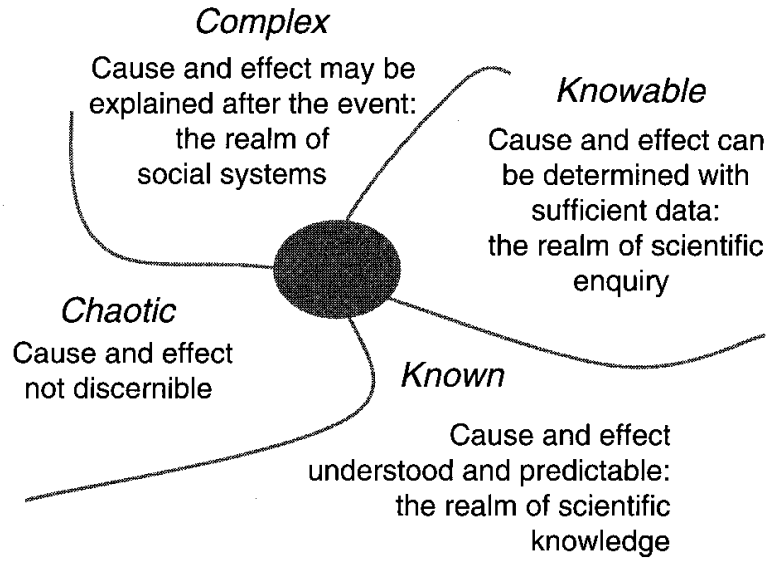

Figure 4: The Cynefin framework. Source: Snowden (2002) with implications for knowledge.

Faced by the role of both complex numbers and sensitivity to initial conditions in non-linear equations, there are fundamental limits on the potential for models to be predictive. As such, complexity is an instance of bounded rationality - a topic that Simon himself explored as the mathematics of chaos theory (Lorenz, 1963) and complexity theory (Prigogine & Stengers, 1984) were developed in the latter part of the 20th century (Simon, 1996).

Snowden and Boone (2007) discuss the management implications of each decision context. Faced with a chaotic environment, leaders may seek to impose order, set a direction for travel with a hand on the tiller, or simply wait for the system context to stabilize back into one of the other realms. Both of these correlate to the strategic domain of decision making, where behavioural instinct and long-term strategic vision and guiding values can be more practical than rational analysis.

The Cynefin framework provides a pragmatic overview that reminds us that when facing a decision, we must be mindful that the type of decision context has a major influence on how it should be approached. As a knowledge management tool, it assists in prescriptive decision making (S. French, 2012; S. French et al., 2009). Addressing the perception of the decision context is why Cynefin is described as a sense-making framework. Notably, sense-making theory says that lack of perception, or lack of shared perception, as to what is actually happening (especially in, for example, a crisis or emergency) is all important.

While the work of Weick is seen as pioneering sense-making research (Weick, 1995; Weick, Sutcliffe, & Obstfeld, 2005), it is noted by Browning and Boudès (2005) that Weick and Snowden, "*virtually ignore each other's work despite the major overlap between their premises and practices.*" One of the significant areas of overlap is that both consider sense-making not merely as an issue of perception, but also of corresponding action. DT is a useful extension of theory in both Snowden and Weick because it is inherent in the concept of a decision that it results in an action being taken (S. French et al., 2009).

The Cynefin framework can be regarded as a useful expression of decision space encompassing both rational analysis and bounded rationality. It is essentially a meta-model, or a model-of-models, as both normative, rational OR models and complex & chaotic, unpredictable models can both be considered alongside each other. Snowden's main contribution is to highlight the link between the external context and the internal response. The question this raises for managers, and indeed for managers concerned with SSCM, is whether what they are dealing with is on one side or the other. If a structured approach is taken to SSCM but the issues are unstructured, is there a mismatch and thus an ineffective response? The opposite is to consider whether a response is taken that is suited to the complex domain but that structured analytics could be more effective because the system is

more ordered and stable than realised. These issues are at the heart of the primary research.

As a practitioner framework developed in the field of knowledge management, the Cynefin is weakly referenced to previous literature. However, the existence of similar ideas in earlier studies helps to validate the Cynefin framework. Also, the original contribution it makes is in how it depicts the different decision spaces and the recommendations it gives as to how to respond in each domain. Precursors to the Cynefin framework include work in the philosophy of science, such as Weaver (1948) on the nature of scientific problems being those of ordered simplicity, ordered complexity or disordered complexity. Later, Popper (1965) distinguished between clock-like systems and cloud-like systems, and argued that where some philosophers of the European Enlightenment thought that all clouds were ultimately clock-like, instead, their cloud-like qualities were impossible to reduce to clock-like computations. There is no evidence that Popper was aware of Lorenz (1963) who had just proved the computational irreducibility of clouds in meteorology.

Similarly, in public policy and urban planning, Rittel and Webber (1973) defined tame problems, messy problems and wicked problems, which match to the first three domains. Grint (2005) adds critical problems and highlights the role of leadership as a response, which echoes the nature and reaction suggested in Cynefin. Additional parallels in management include Emery and Trist (1965), who discuss a typology of external environments for organisations ranging from stable to turbulent. and the divide between hard systems and soft systems, further developed in Checkland (1972); Checkland (1980). These echo structured and unstructured domains. Similarly again, the work of Mintzberg and Westley (2001) parallels the responses given for each Cynefin domain. These parallels are shown in Table 10.

Weaver (1948)	Popper (1965)	Rittel and Webber (1973), *Grint (2005)*	Checkland (1972, 2000)	Mintzberg and Westley (2001)	Kurtz and Snowden (2003); Snowden and Boone (2007)
Problems of simplicity	Most clock-like	Tame problems	Hard systems	Thinking First	Structured: Simple (known).
		Messy problems			Structured: Complicated (knowable)
Problems of organised complexity		Wicked problems	Soft systems	Seeing First	Unstructured: Complex (retrospectively knowable)
Problems of disorganised complexity.	Most cloud-like	*Critical problems*		Doing First	Unstructured: Chaotic (unknowable)

Table 10: Parallel works on structured simplicity and unstructured complexity & chaos

These precursors serve to support the Cynefin framework, which is adopted here as a more up-to-date model incorporating the mathematics of chaos and complexity alongside the traditional approach of stable, predictive modelling. Cynefin is also specifically focused on the management responses made to the different types of context and so bridges the mathematical and systems theoretical perspectives with business management issues around bureaucracy and leadership in relation to decision making. This is particularly relevant to the question of SSCM, especially in light of the PB+SF framework, which seems to present an additional paradox. To quote, S. French and Geldermann (2005)

> *"In the complex space, there are so many interacting causes and effects that predictions of system behaviours – often social-political behaviours – are affected by a wide range of uncertainty.... Our lack of understanding of the full causes and ramifications of climate change is but one example of a chaotic context for some of the most important environmental decisions facing us.... yet much work on*

environmental decision making seems to assume a known and knowable context."
(ibid. page 380)

This provides a theoretical perspective on SSCM decisions that may help to address the divide between micro-scale, firm-level action and macro-scale, ecological and societal impacts (Kleindorfer's bridge). The systematic literature review across the use of DT in SSCM (Section G: below) provides further evidence of this.

While Cynefin clearly has its precedents, there is a relative shortage of papers describing the application of Cynefin besides, for instance, discussion and application in S. French (2012), Fodness (2015), Sturmberg and Topolski (2014), Gorzeń-Mitka and Okręglicka (2014), Llinas (2014)). As a framework from the field of knowledge management, much of the references to the Cynefin framework are found in knowledge management or decision theory journals (Benson & Dresdow, 2009; John S. Edwards, 2008; Hammer, Edwards, & Tapinos, 2012; Neus & Scherf, 2005; Nicolas, 2004; van Wyk, Roux, Drackner, & McCool, 2008). The few papers that mention Cynefin and SCM or Cynefin and sustainability, do so only in passing. One criticism of Cynefin is found in Boje (2006), who objects to the nature of data capture for narrative analysis when Cynefin is applied within organisations. This aspect of the framework is not relevant to the research conducted here, so does not provide grounds to reject it.

Dominant Logic (DL) for decision making

Importantly, Cynefin refers to the way in which people in an organisation understand their context as a decision space. This parallels central aspects of organisational culture, as defined by Schein (1984). While culture is an abstraction, it plays a central role in the operation of organisations, and can be addressed via the specific artefacts (such as dress code), values and basic assumptions (the way things are understood or interpreted). The formal definition provided is,

"*A pattern of shared basic assumptions that a group has learned as it solved its problems of external adaptation and internal integration, that has worked well*

> *enough to be considered valid and therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems."* (Schein, 2006, page 17)

Prahalad and Bettis (1986) introduce the concept of the 'dominant logic' (DL) of an organisation as a means to capture the aspects of organisational culture that relate to the decision making rationale, or as they describe it,

> *"the mental maps developed through experience in the core business...defined as the way in which managers conceptualise the business and make critical resource allocation decisions."* (ibid. page 485)

They then go on to say,

> *"The ability of a top management group (a group of key individuals)...is limited to the dominant general management logic(s) that they are used to...In other words, the repertoire of tools that top managers use to identify, define and make strategic decisions, and their view of the world (mindsets), is determined by their experiences."* (ibid. page 491)

These tools are knowledge systems, described as schemas, that,

> "*represent beliefs, theories and propositions that have developed over time based on the manager's personal experiences...An organizational schema is primarily a product of managers' interpretations of experiences while operating within certain firms and industries.*" (ibid. page 489)

To introduce sustainability considerations into the strategic or operational decisions in a firm can be a challenge to the dominant logic of a firm. To take a single example, managers are rewarded, and indeed selected for their roles, on the basis of their ability to maximize profits in a particular business. If a new set of objectives are introduced around stakeholder considerations of ethics or environmental performance, that do not necessarily correlate to economic performance or do so in a way that is not predictably knowable, then this may contradict the dominant logic.

Similar sentiments are expressed in Lüscher and Lewis (2008), Angus-Leppan, Metcalf, and Benn (2010) and Hahn et al. (2014), addressing corporate social responsibility using the concept of sense-making (Daft & Weick, 1984). As noted by Browning and Boudès (2005), Snowden makes no reference to previous studies such as Weick's sense-making. As mentioned above, this is in part as the Cynefin framework was derived inductively from extensive practitioner experience, rather than extended from existing academic management theory (Snowden, 2000). The Cynefin framework does nonetheless correlate closely with the notion of dominant logic in organisational culture. It also highlights the divide in dominant logic across different types of organisational forms. As summarised in, for example, Senior and Swailes (2010), the bureaucratic organisational form is distinct from, say, the matrix form, and these correspond to the Cynefin domains of the structured and unstructured, respectively; description of organisational theory recognising complexity theory is also mentioned (ibid. page 49). It is also notable that an updating of the DL concept in Bettis and Prahalad (1995) makes an explicit link to complexity theory, reinforcing the approach taken in this thesis to use DL in relation to the Cynefin domains.

The importance of organisational culture and mindset for SSCM are highlighted in the major literature reviews by both Carter and Rogers (2008) and Abbasi and Nilsson (2012) shown in Table 9. Whilst this is mentioned as both a 'requirement' and a 'challenge', respectively, a deeper consideration of what organisational culture and mindset means in relation to SSCM is needed. As such, the DL as the basis for decision making in relation to SSCM is further supported as a concept to be explored in the primary data collection.

However, the DL is not about the Cynefin domains alone. A further aspect of culture relevant to decision making is found from the following literature review. This is the role of values, including moral values but not limited to them. As discussed in Section G below, a proportion of papers on ethical decision making in SSCM are found, and these are factored in to the analysis as an additional aspect of DL.

Instead, the topic of values is comprehensively addressed as an aspect of DT via the work of Keeney (1992, 1996) Keeney (1996) on 'values-focussed thinking'. This is an additional way of addressing both unstructured contexts and structured, complicated contexts that are

prohibitively expensive to solve. Values-focussed thinking, or values-focused decision analysis (VFDA), is an alternative to so-called 'alternatives-focussed decision analysis' (AFDA). To quote Keeney directly,

> "*Conventional approaches to decision making focus on alternatives. However, alternatives are relevant only because they are means to achieve values. Therefore, thinking about decision situations should begin with values. Value-focused thinking describes and illustrates concepts and procedures for creating better alternatives for your decision problems, identifying decision opportunities more appealing than the decision problems that confront you, and articulating and using your fundamental values to guide and integrate your decision making activities.*" (ibid. page 537.)

According to Keeney (1996), the best thing for an organisation to do is to invest in developing a clear understanding of its strategic objectives. Alternatives can then be compared against this and if necessary all can be rejected and different approaches sought. This role of values in organisational decision making is an important question and one that informs the nature of the empirical research design described in Chapter 3.

The benefit of VFDA, and the reason for its adoption in this research is that it contrasts with and complements the Cynefin framework categories. Cynefin does not refer to ethical values as part of DT so this is an area for theory elaboration, plus the VFDA approach can be applied across multiple domains of Cynefin, representing the guiding principles to help navigate unstructured contexts, or a heuristic for simplifying excessively complicated structured problems. VFDA does not contradict Cynefin but does represent an instance of a 'line of argument synthesis', extending the issue into new, relevant areas (Denyer, Tranfield, & Van Aken, 2008).

The different approach that VFDA takes into conventional approaches to decision analysis, gives an insight into the common use of phrases such as 'trade-offs'. Whereas standard texts in operations management, such as Slack, Chambers, Johnston, and Betts (2009), show that decisions over performance objectives involve trade-offs and use principles of economic modelling to analyze these (ibid. page 53-57), Snowden and Boone (2007), and precursors such as Rittel and Webber (1973) or Checkland (1980), show that certain conditions are necessary for this to be possible. In unstructured contexts it can become prohibitively

difficult to weigh up alternatives and conduct analysis on which is best. Single cause and effect variables cannot be isolated easily enough, there is lack of consensus on definitions, causal factors change rapidly and interact with each other, preventing analysis using the logic of 'tame problems' or 'hard systems' or 'quantitative decision modelling'.

Keeney (1992) meanwhile, shows that situations don't have to be regarded as trade-offs between specific alternatives. Focusing on strategic objectives in relation to organisational values can mean rejecting all the immediately obvious alternatives if they do not align with those values. This promotes creative problem solving, rather than a computational exercise between alternatives.

One of the obvious appearances of a rejecting of trade-offs is the notion of 'synergy' where there is not a binary choice between two possible benefits but instead both benefits can be achieved as a result of addressing a separate underlying issue. Quality management, for instance, can enable improvements in both reliability and speed of deliverability, rather than sacrificing one in order to achieve the other (Slack et al., 2009).

A further definition as to the divide between values-focussed and alternatives-focussed decision making, is that the former is called a principles-based approach, whereas the latter is a rules-based approach. A decision problem that can be quantified using clear, accurate and unambiguous metrics (Keeney & Gregory, 2005), and where predictable outputs can be generated by subsequent modelling, is a rules-based approach. The outcome of the decision model is set by the computational rules included. By contrast, a principles-based approach requires the decision maker to use their judgement, based on guiding principles or values (Lamond, Dwyer, & Agatiello, 2008). This contrast between rules-based and principles-based decision making is a major topic in jurisprudence and accountancy (Black, Hopper, & Band, 2007).

Using a values-focussed approach, where objectives are considered in terms of values first, is a form of heuristic. It is a means to simplify the decision making process used to make an optimal decision between alternatives, which are the norm in structured, computational, decision models. Heuristics can be mathematical short-cuts that work often enough for

them to be more effective ways to make decisions in practical, real-world contexts (Gigerenzer & Gaissmaier, 2011).

A consolidation of all of the above approaches in DT is shown in Figure 5. This illustrates the relationship between DL, the two sides of the Cynefin framework, plus the role of heuristics as an additional step that can move between these, and the role of prescriptive decision analysis (DA) as a way to address both the rational and behavioural approaches. This diagram goes beyond Cynefin to consider additional elements of DT. Overlaps between different concepts in DT are also shown in Table 11. With these, it is important to note that these are not necessarily synonymous terms, but parallel concepts. Each has their own properties distinct to their development. The boundaries between each are also not clear cut. In summary, the way in which organisations make decisions as an aspect of organisational culture is described by the concept of the dominant logic (DL). The use of either approaches to decision making shown in Table 11 are aspects of the DL of an organisation.

Researching the DL is a means to explore the presence of bounded rationality in SSCM and thence the potential for it to address a meso-scale between the micro-scale of the firm and the macro-scale of PB+SF in order to answer Kleindorfer's Challenge. The next sections briefly cover the remaining parts of the Venn diagram shown in Figure 1.

Rationality	Bounded rationality	Taylor (1911) / Simon (1957)
Normative, mathematical	Descriptive, psychological	Simon (1947)
Well-structured	Ill-structured	Simon (1977)
Structured	Unstructured	Kurtz and Snowden (2003); Snowden (2002); Snowden (2005); Snowden and Boone (2007)
Simple/complicated	Complex/chaotic	
Known/knowable	Retrospectively knowable/ unknowable	
Categorise / Analyse (bureaucrats/experts)	Probe / Respond (stakeholders/leaders)	
Operational / tactical (shop-floor / middle mgt.)	Strategic (board of directors)	Jaques (1989)
Clock-like	Cloud-like	Popper (1965)
Rules-based	Principles-based	Wróblewski (1990), Black et al. (2007)
Alternatives-focussed	Values-focussed	Keeney (1996)
Trade-offs between choices	Guiding principles	
Compliance	Conviction	Crawford (2006)
Think first	Sense first / act first	Mintzberg and Westley (2001)

Table 11: Parallel concepts relevant to DT

E: SCM and DT

To conduct a full systematic review of DT in SCM is beyond the scope of this thesis. Clearly, a very large amount of OR research relating to SCM is normative, rational decision analysis. However, it is notable that a small number of literature reviews in the last decade have examined SCM from the perspective of bounded rationality and behavioural DT. These include C. R. Carter, Kaufmann, and Michel (2007) and Kaufmann, Michel, and Carter (2009). These list the sources of bias that pull organisational actions away from rational SCM decisions and potential methods for de-biasing, respectively. In a review of behavioural DT in SCM, Tokar (2010) shows that quantitative decision models are dominant in SCM but because these generally neglect consideration of the role of people in organisations, they fail to adequately explore the impact of the high levels of human interaction involved in SCM. The predominance of the normative, rationalist DT of traditional OR is significant,

leading to the conclusion that SCM is lagging other disciplines in the application of behavioural DT to management issues, such as behavioural finance. This is strange when behavioural effects in supply chains have been a strong topic in logistics dating from the work of Forrester (1958), and the classroom SCM simulation 'the beer game' by Sterman (1989).

Considering the Cynefin framework, recent reviews of the literature on uncertainty in supply chains, including risk as a form of uncertainty, provide an additional response to the predominance for the structured perspectives aiming at accurate prediction. Simangunsong, Hendry, and Stevenson (2012) note that sources of uncertainty are multi-dimensional, and include unpredictable phenomenon in the external environment and inherent complexity. Sanchez-Rodrigues and Naim (2010), reviewing uncertainty in logistics find that unpredictable delays caused in transportation significantly hamper the ability to provide predictive modelling in practice. Once such unpredictability reaches a certain level, statistical probability must be used instead, meaning that answers have to be taken in terms of degrees of likeliness instead of predictive certainty.

This erosion of certainty is inherent in the mathematics of complexity and deterministic chaos, as described in the unstructured domains of Cynefin. Complexity is discussed in relation to SCM by Wilding (1998), and application of complexity to SCM is undertaken in detail by Choi et al. (2001) and Pathak, Day, Nair, Sawaya, and Kristal (2007). These further validate the conclusions of the Cynefin framework by showing that the traditional approach to top-down network design, using modelling to determine optimal network design that is imposed via a command-and-control approach, becomes sub-optimal once the supply chain starts to exhibit complexity.

Applying structured methods in an unstructured decision space could produce inaccurate, ineffective and potentially damaging results. As noted in, for instance, Pidd (2003), models should achieve the right level of simplicity - not too simple as to be inaccurate, but not so complicated that they become ineffective in use. By contrast, optimal performance in complex networks is achieved by decentralising decision making authority and allowing bottom-up emergence rather than top-down control on the basis of computational analysis (Choi et al., 2001; Nair, Narasimhan, & Choi, 2009; Pathak et al., 2007). This, again, echoes

the conclusions of the Cynefin framework that unstructured contexts require decentralisation and emergence.

A similar practitioner focussed approach to underlying unpredictability affecting global supply chains (described as turbulence) is seen in Christopher and Holweg (2011) who call for supply chains to be designed as inherently flexible to respond to sudden change. This echoes Mintzberg and Westley (2001) and corresponds to the notion of the 'leagile' operation or supply chain that seeks the best balance between the efficiencies of lean that are possible when the context is stable and structured, with the responsiveness of agile, which is essential when the context is unstable and unstructured (Purvis, Gosling, & Naim, 2014). Breite and Koskinen (2014) also describe supply chains as 'autopoietic learning systems', meaning they are networks that self-evolve towards order via principles of emergence seen in complexity theory, as reflected in Cynefin.

Overall, the birds eye perspective on DT provided by Cynefin explains these different themes and approaches in the SCM literature and offers some additional conceptual insight into these differences. However, an additional review of the words 'supply chain' and 'Cynefin' in peer-reviewed scholarly literature (via the ABI-Global database) showed only three papers. These refer to supply chains and Cynefin only in passing and are primarily concerned with business process management (Keong Choong, 2013) and knowledge management (Edwards, 2008; Edwards & Kidd, 2003). As noted previously, the Cynefin framework has come from the knowledge management and information technology fields and so is under-utilised in fields such as SCM. There is an opportunity to further elaborate theory around DT and SCM by further considering frameworks such as Cynefin, in light of SSCM or in SCM and OM in general.

F: SD and DT

While SCM research has traditionally engaged with DT predominantly via the structured modelling of OR, the field of sustainable development (SD) has developed quite an extensive approach to DT via geography and urban planning decision making. In the major systematic literature review into SSCM and DT (described in Section G, below) a large number of papers

(around 900) concerned decision analysis in SD but were filtered out of the analysis due to the lack of focus on SCM/SSCM. However, DT tools such as multi-criteria decision analysis are commonly used to support issues such as land use planning issues relating to SD. For example, it is more important to protect one habitat or another from development or potential flooding. Whilst these provide a wealth of information on the use of DT in SD, they are not pertinent to business and management scholarship, and so were excluded. Clearly, there is a large range of other areas of DT relevant to SD, including ethical decision making issues. These are only examined in relation to SSCM research, as described in the following section, including in journals outside of OM/SCM discussing supply chain issues, such as the Journal of Business Ethics.

G: SSCM and DT: A systematic review

The main part of the literature review that the previous sections have been building towards is the overlap of SSCM with DT. The full version of this review has been published as Alexander et al. (2014). This is conducted using the requirements of the systematic review process provided by Tranfield et al. (2003). This aims at repeatability of findings through providing the full details of the review in a 'research protocol' table, which is provided in Table 12. A further element of this process is to produce a wide search, with no individual selection bias imposed. This results in a selection that although systematic, is somewhat eclectic but potentially serendipitous. The journals included are therefore across all business and management titles in English that are peer-reviewed and a date range from 1980 to 2016, with SCM seen as a concept first appearing after 1980 (Giannakis et al., 2004). Table 40 groups those in non-ABS ranked journals, and

Table 41 shows those that are ABS ranked. While ranking on ABS is not a firm indicator of quality, some aspects of it may be interpreted as such (Harvey, Kelly, Morris, & Rowlinson, 2011). Non-ABS journals include those outside of the business and management discipline. The objective is to establish the spread of papers referring to SSCM and DT, which are then considered with respect to Cynefin and VFDA.

Research Protocol	Title: Set of 'SSCM' and 'Decision'.
Research variable	**Description**
Databases:	**ABI/Inform Global (Proquest) and Scopus:** These two databases cover a wide range of peer-reviewed academic publications. The initial use of ABI-Inform (more than 3700 titles) was found to exclude some key journals so Scopus (with more than 20,000 titles) was added to provide a comprehensive review.
Publication type:	**Peer-reviewed papers only:** These represent work at a final stage of completion.
Language:	**English-only:** This provides wide coverage, and there was no translation capacity.
Date range:	No limit is set on date range, but no papers were found before the 1980s. The final updated set of data for the review was compiled in May 2016. Exact repetition of this research should set this as the upper limit.
Search fields:	Search terms were applied to Titles, Abstracts and Keywords only
Search terms:	The primary search terms are the word 'Decision', plus synonyms for 'sustainability' and 'supply chain' (as described below). The scoping study found that all papers covering an aspect of Decision Theory, e.g. MCDA, used the word 'decision' at some point in the abstract if not in the title. Other papers referring to findings being 'of value to management decision-making' were also captured even if this made no mention of Decision Theory. Empirical papers investigating decision making were also captured. Search term strings relating to Sustainable Supply Chain Management and various synonyms were created to form the following search strings: 1: "Decision" AND "Sustainable Supply Chain Management" 2: "Decision" AND "Supply OR Supplier " AND ("green" OR "sustainab*" OR ethic* OR responsib* OR "triple bottom line" OR "ecol*") The word 'environment' was excluded as a search term as the scoping study found a very large number of non-relevant returns. The words 'purchasing' and 'procurement' were also excluded due to no papers being found from these terms that were not already found using 'supply' or variants of, and high returns in the marketing and public sector fields, respectively. Similarly, the word 'eco' was excluded as no papers were picked up that were not already found by the terms 'ecol*', 'green' or 'sustainab*' but a high number of non-relevant returns were captured. The above search strings were input into each database and the results then combined in a spreadsheet and duplications eliminated.
Deselection criteria #1: Semantic relevance	The primary deselection criteria is relevance to the research topic. This mainly deselects because a specific word has different meanings based on context. For instance, 'sustainable' and 'supply' captures papers refering to sustainability in

	energy supply, water supply, and even supply of finance. As decision analysis techniques are commonly used in environmental resource management, e.g. water management, energy provision, there were many such papers deemed non-relevant to SCM/SSCM.
De-selection criteria #2: Relevance to the research problem	Secondary de-selection criteria is relevance to the research question. Some are clearly directly relevant either from the title or the abstract. For the others, the full text was reviewed to determine relevance. For example, some papers mention the supply chain within a list of different functions of a business, but do not say anything more. Similarly, some papers mention 'decision-making' in passing, in particular as a potential implication of a piece of information determined by a paper, but are not primarily about decision making. Selected papers are those that describe decision-making processes relating to sustainability and suppliers in detail.

Table 12: Systematic literature review protocol

The results of the systematic literature review are that a total of 1123 papers were found, of which 931 were deselected. Detailed review was then conducted on the remaining 192 papers clearly covering SSCM and DT. Some could be readily classified due to explicit mention of a familiar decision analysis method that clearly related to a specific decision context. Where this was not possible, papers were read in detail to enable classification.

SSCM and DT research classified using the Cynefin typology

The papers are classified in relation to the decision contexts of the Cynefin framework. It is important to note that Kurtz and Snowden (2003) emphasize that Cynefin is a sense-making framework that should vary for each individual context in which it is applied, and that categorisation is a method only applicable to structured decision contexts. In this literature review, it is assumed that the results of the systematic literature review provide a closed set of structured data that is amenable to classification. This is, arguably, a simplification for the sake of theoretical exploration. The classification based on the Cynefin framework links the structural nature of the decision context to the type of decision making method applied. This looks at the extent to which the decision context is structured or unstructured, is about bureaucratic process, complicated analysis, complex emergence or inherent unpredictability. These classifications are discussed in the following section. The results of

this classification of the literature on SSCM and DT are shown in Table 13 below. A description of some of the papers in each category then follows.

Classification of papers	Examples of paper content	# of total
Cynefin Domain 1. Structured - simple	Procedural, KPIs, standards (bureaucracy)	5%
Cynefin Domain 2. Structured - complicated	OR models, MCDA etc. (Expert analysis)	62%
Cynefin Domain 3. Unstructured - complex	CAS, SSM (decentralisation & emergence)	5%
Cynefin Domain 4. Unstructured - chaotic	Heuristics, principles, values (judgement)	1%
Exceptions - unclassified	Literature reviews, descriptive case studies	27%

Table 13: SSCM + DT lit. review results by Cynefin domains.

Table 13 shows that the majority of the papers (62%) take a structured, complicated approach, almost all of which are traditional OR papers, but interestingly, a small number of papers (7 in total) are business ethics papers that are also normative, rational models. This category clearly dominates the research set and highlights a perhaps inevitable tendency for researchers to concentrate in areas associated with 'traditional scientific enquiry', as shown in Figure 4, above, noting the underlying epistemological constraints identified with each of the Cynefin domains.

Only a very small number of papers concern the unstructured chaotic and complex domains, and a similarly small number concern the structured simple domain. It is also notable that there are a significant number (27%) of papers that explicitly talking about decision making in SSCM that include literature reviews, conceptual papers or descriptive case studies, which cannot be classified using the Cynefin domains.

The predominance of structured OR methods may represent a problem given that the DT analysis covered above suggests that SSCM should be an unstructured, complex issue, as discussed in detail by French and Geldermann (2005). Or it may be that there is insufficient development of SSCM work using DT methods suited to unstructured-complex domains, such as using complex adaptive systems, despite some promotion in SCM (Carter et al., 2015; Choi et al., 2001; Pathak et al., 2007).

OR, by definition, is concerned with analyzing complicated sets of variables, which explains why the vast majority of papers are in the structured, complicated domain. There is also clear evidence of OR models that have environmental factors added as a variable with SCM considered as the application. These range from OR applied to SSCM as a means to reduce

waste, such as Everingham et al. (2008). Some add an environmental factor to a conventional quality, quantity or price model. Carbon dioxide is one such factor, not least as it is a measure of pollution under increasing regulatory scrutiny (Chaabane, Ramudhin, & Paquet, 2011; Choi, 2013; Harris, Naim, Palmer, Potter, & Mumford, 2011; Jaegler & Burlat, 2012). Other regulatory factors include the European Union Waste Electrical and Electronic Equipment directive (Quariguasi Frota Neto, Walther, Bloemhof, van Nunen, & Spengler, 2010). Aspects of supply chain structure are also discussed by using models to determine optimum outputs. For instance, Swami and Shah (2012) show optimum results from supply chain co-ordination and co-operation; Cruz and Wakolbinger (2008) compute optimum production outputs, given different levels of investment in CSR; Oglethorpe (2010) seek optimal outcome given different end results desired by multiple stakeholders.

In creating models to assist in decision making (including Decision Support Systems or DSS) it is important to not make the model more sophisticated than it needs to be (French et al., 2009). To quote Pidd (1999), "*models are always simple, but realities are always complex*". The more variables are needed in a model, the more complicated the decision context is and so a more sophisticated decision analysis processes is required. Various SSCM papers use Multiple Criteria Decision Analysis (MCDA) (Xiaojun Wang & Chan, 2013), Multiple Integer Linear Programming (MILP) (Metta & Badurdeen, 2013; Ramezani, Bashiri, & Tavakkoli-Moghaddam, 2013), or Analytic Network Process (ANP) (Hsu & Hu, 2009; Sarkis, 1998; Zanoni & Zavanella, 2012; Zhu et al., 2010) as examples of this. However, as noted in Sarkis (2003), establishing robust metrics and a realistic model can be prohibitively expensive, and thus may only apply to very large investment decisions that warrant the effort. Similarly, products may change faster than the process of recording key attributes and then modelling them, rendering the process ineffective. So, while OR models are highly valuable, the Cynefin framework (Figure 2) illustrates that this effectiveness is limited to the nature of the external context (a point validated by Christopher and Holweg (2011) in their discussion on rising levels of turbulence and volatility in the economic environment and the impact on the theoretical approaches used to understand SCM).

Some acknowledgment of limits to knowledge are addressed in a number of the OR papers found by the literature review that use fuzzy logic, grey sets or stochastic modelling as mathematical means to address uncertainty (see). However, this serves to accommodate

uncertainty within a structured model. It is not the same as addressing the unstructured, complex domain via complexity theory.

Further validation of the Cynefin framework is seen in another paper in the review, Higgins et al. (2009), which focuses on how OR techniques have failed when applied to sustainability and resilience of agricultural value chains. Farmers face inherent levels of unpredictability in their productivity as a result of dependence on the weather. Such factors are less common in the more controlled context of manufacturing where OR is more appropriate. Instead, Higgins proposes the analytical methods of Complex Adaptive Systems theory are needed.

Complexity theory and related techniques and implications are also discussed in a small number of SSCM papers classified by the review as being in the unstructured, complex domain. These include Halog and Manik (2011), Giannakis and Louis (2011), Fritz and Schiefer (2009), Vurro, Russo, and Perrini (2009), Tyler, Heeley, and Bhamra (2006) and Tavella and Hjortsø (2012). Further relevant conceptual discussion is provided by Cabral, Grilo, and Cruz-Machado (2012), where seeking to balance supply chain management practices from the lean, agile, resilient and green perspectives is described as, "*a complex problem, involving dependencies and feedbacks*." Finally, Hall, Matos, and Silvestre (2012) explicitly considers complexity theory for SSCM, arguing, as at the start of this chapter, that adding social and environmental elements on top of financial elements creates additional complexity but that shortcuts can be applied.

The unstructured, chaotic domain of the Cynefin framework is, by definition, characterised by high levels of uncertainty and by significant, unpredictable change or disruption. This is clearly a topic of interest to SCM and SSCM and discussed in papers on supply chain risk and resilience (such as, Harland, Brenchley, and Walker (2003), or Sheffi and Rice (2005), and uncertainty (Simangunsong et al., 2012; Sanchez-Rodrigues & Naim, 2010). However, such papers do not address supply chain risk or uncertainty with reference to both decision making and sustainability and so have not been included in this systematic review. Given the relative youth of SSCM as a research topic, although research has started to investigate the non-linear mathematics of chaos in SCM (for instance, Wang, Disney, and Wang (2012)) it has not yet been applied to SSCM and so is under-represented. Hence, the main way in

which the unstructured, chaotic domain may be represented in SSCM research is in relation to simplification heuristics or the use of values-focused decision analysis.

A further example of the significance of the unstructured domain is seen in Lawrence, Andrews, Ralph, and France (2002). This shows that improvements in environmental performance cannot be achieved unless the use of sustainability metrics in environmental decision-making are also integrated into strategic management decision-making. Under the perspective of the Cynefin framework, this means considering how structured, bureaucratic metrics for SSCM can influence the unstructured problem context of high-level corporate strategy. The adage that to manage something it must be measurable (Drucker, 1954) remains at the heart of many institutional logics, not least in the accountancy profession. Criticisms of this logic are outlined at length in Mintzberg (2015).

As shown in Table 13, 61% of the research on SSCM and DT is in the structured-complicated domain, and 5% is in the unstructured-complex domain. The remaining small percentages relating to the other domains are now briefly covered. The structured, simple domain includes papers that concern decisions relating to metrics and standards for SSCM, such as ISO14001. Examples include, Handfield et al. (2005), Vasileiou and Morris (2006) and Meul, Nevens, and Reheul (2009). Papers dealing with simplification heuristics, notably McIntyre, Smith, Henham, and Pretlove (1998) and Kalleitner-Huber, Schweighofer, and Sieber (2012) arguably belong in this space, though this may alternatively be thought of as something standing outside of the Cynefin categories. As described in the discussion on VFDA, heuristics can be employed as pragmatic tools to address complexity or situations where analysis of complicated decision problems is prohibitively expensive. Heuristics as a field within DT is demonstrated in, for instance, Katsikopoulos and Fasolo (2006) or Gigerenzer and Gaissmaier (2011). Wu and Pagell (2011) describe these heuristics as 'guiding principles' or 'technical standards' which although not providing categorical prediction and proof, give enough of a guide to enable effective decision making.

The use of simplification heuristics to deal with uncertainty (such as Pagell and Wu (2009); Wu and Pagell (2011)) or unmanageably large datasets (McIntyre et al. (1998), Kalleitner-Huber et al. (2012)) show the attempt to move a decision context towards simplicity. For instance, Kalleitner-Huber et al. (2012) describe the case of a firm seeking to determine the

relative environmental impact of a large number of product categories in order to determine which should be prioritised.

Interestingly, literature published after the primary research phase of this thesis began, includes a small number of papers relevant to the approach taken towards SSCM and DT. Three qualitative papers found by the literature review investigate bounded rationality and behavioural decision making in SSCM. Kirchoff, Omar, and Fugate (2016) examine the lack of rational decision making for SSCM in 'non-exemplar firms' using the behavioural theory of the firm (Cyert & March, 1963) (which in fact derived from Simon (1947)). Roehrich, Grosvold, and Hoejmose (2014) also use qualitative case studies to research the role of bounded rationality around SSCM decisions relating to reputational risk. Alblas, Peters, and Wortmann (2014) research SSCM in relation to new product development and find that requirements are often fuzzy or unclear, which hampers decision making in design and procurement decisions.

The Cynefin framework describes the response to the unstructured-chaotic domain in terms of leadership (Snowden & Boone, 2007). No papers relating to leadership and sustainability or ethics were found by this review, perhaps as there was no overlap with supply chain research explicitly talking about leadership and decision making. However, papers such as Gattiker and Carter (2010), not found by this review, show that leadership is essential for SSCM, but is often underexploited. This absence is likely due to leadership not being addressed in terms of decision making and SSCM, highlighting again that the narrow search terms limit the range away from potentially interesting applications that are implicitly relevant but not explicitly so. For instance, Mumford, Zaccaro, Harding, Jacobs, and Fleishman (2000) examine the link between leadership and complexity, but not in relation to SD or SSCM.

Other papers excluded from this review, despite potential relevance, include Reinecke and Ansari (2015), which discusses conflict minerals as a wicked problem, but does not explicitly mention supply chains or decision making. Similarly, Hahn et al. (2014) addresses the presence of ambiguity, paradox and contradiction in corporate sustainability, but does not draw a link with DT or SCM, despite there being a strong, albeit tangential, connection.

Ethical decision making

Interestingly, one empirical paper found by the review, Kalshoven and Meijboom (2013), examines eco-labelling in the fishing industry, a bureaucratic measure described as Cynefin domain 1. The paper finds that this approach is unable to assist in the complex decisions the sector faces. The paper concludes, "*in order to move forward, the sector needs to further reflect and elaborate on its core values.*" (ibid. page 101) This firstly supports the arguments of Snowden and Boone (2007) and also correlates with VFDA in Keeney (1996), which emphasizes the importance of establishing core values in order to address complexity or uncertainty.

Values, mindset, organisational culture and attitudes or 'orientations' to stakeholders such as investors are a common theme across a number of papers in the review. These papers do not fit readily into the discussion of the Cynefin framework domains and so form part of the final set of papers, which are those left unclassified.

As described above, SSCM is revealed as a classic messy problem (Mackenzie et al., 2006; Rittel & Webber, 1973). As shown by Chicksand et al. (2012), SCM lacks coherence necessary for it to be a scientific discipline. It thus follows that extending its range of concern into social and environmental factors inherently entails bringing in additional perspectives, including ones of political value judgments. Although these are directly relevant for consideration, these produce further plurality and heterogeneity. This is found by the review of theory in SSCM by Touboulic and Walker (2015). Taking a non-partisan perspective to the literature as recommended by Tranfield et al. (2003) and Denyer et al. (2008), increases the opportunities for inter-disciplinary synthesis to occur, which helps provide creative solutions and enable new theory to emerge.

As discussed by Tranfield et al. (2003), systematic literature review provides an opportunity for cross-disciplinary understanding, and the findings of this review support this. By searching for the word 'decision' - albeit a basic and relatively unambiguous phrase in management literature - in the context ethics, CSR and SSCM a small but significant set of papers has been included from the field of business ethics. This is a wholly different academic camp from OR but reflects the arguments of Keeney (1996). These papers on ethical decision making in supply chains do not mention DT, but there is a clear opportunity

for theory building through synthesizing this discourse with value-focused decision analysis (VFDA) (Keeney, 1996).

The earliest study discussing ethical values in the context of SCM is Waters, Bird, and Chant (1986). At this time CSR was not recorded as an ethical duty of companies. Instead, the theme is the ethics of exploiting of suppliers or customers, such as by providing false or misleading information. CSR in SCM decision making first appears in Haynes and Helms (1991) and then Plank, Landeros, and Plank (1994). These show that ethical behaviour in purchasing decisions is linked to organisational culture and overall business objectives.

Organisational culture is also a key feature in Lawrence et al. (2002), Davies and Crane (2003), Lahdesmaki (2005) and Jiyun (2010). Each of these papers discuss biases in the ethical decision making behaviour, in line with behavioural decision analysis. Benefits of alignment in ethical values between firms and their suppliers, customers or other stakeholders, is seen in Isern (2006) (following Pohlman and Gardiner (2000)), Svensson and Bååth (2008) and Reuter, Goebel, and Foerstl (2012).

A common theme developing through these papers is that stakeholder orientation is a significant influence on SSCM decisions such as supplier selection. Reuter et al. (2012) show that firms with a 'public orientation' are less sensitive to cost as a variable in the selection decision than those that are 'shareholder-oriented'. Thus, decisions affecting economic outcomes and social or environmental sustainability criteria in supplier selection is affected by the organisational culture. This can also be expressed as the dominant logic (DL) that shapes decision making, as discussed above.

Although the majority of ethical papers are descriptive, normative decision models include Fudge and Schlacter (1999) and Ferrell, Rogers, Ferrell, and Sawayda (2013). One example of 'prescriptive' decision analysis where rational analysis and a countering of decision maker bias, is seen in Woiceshyn (2011), although this only makes passing reference to supply chain issues.

Conclusion to the literature review: the state of the field of SSCM and DT

This chapter has described the three overlapping areas illustrated in Figure 1, and the systematic literature review specified in Table 12. This review captured an initial set of more than 1000 papers covering the broad areas of 'decision' and 'supply chain' before filtering down to 190 papers. Of these, the clear majority were in the structured-complicated domain, typical of classical scientific enquiry. Yet it has been established that SCM and SSCM are characterised by unstructured problems and notably a small number of papers have identified this and sought to develop understanding of the nature of this distinction. A very small number also address the interplay between the domains. A small but significant proportion, 11% of the total, are also business ethics papers. This shows that SSCM has a fundamental ethical dimension, and a useful addition to the topic is seen in the application of values-focussed decision analysis (VFDA) as a contrast to Cynefin.

A gap in the literature is therefore clearly identified in literature on the following grounds. No literature in SSCM references the Cynefin framework; hence, the division between structured and unstructured decision problems is under-represented in the literature. Only a small number of papers address a critique of the majority method (such as Higgins et al. (2009) which focuses on a failure of OR methods in a sector characterised by uncertainty). Only limited references in the literature are made to DT. Hence, while there are many papers that advance particular tools and approaches, and recognise the urgency of sustainability challenges. The consequences of this are that there is an opportunity to advance theory in SSCM by combining the DT approaches of the Cynefin framework and VFDA. This adds to the conceptual understanding of papers that use aspects of terminology from DT, and also puts all the SSCM papers found by this review into a wider context where the implications of the level of structure in their decision environment is clear.

The Cynefin framework describes how structured and unstructured circumstances relate to the understanding of the decision maker. Repeatedly we see the interplay between these two. Managers in some industries may call for SSCM to be translatable into simple and manageable metric models, yet some workplaces and their accompanying mindset may expect unpredictability, such as farming or fishing (Kalshoven & Meijboom, 2013;

Oglethorpe, 2010). Some cutting-edge models in OR embrace this complexity, finding ways to factor uncertainty into the modelling process, but this is generally underdeveloped in SCM research and more so in SSCM research.

By contrast, work on the role of organisational values is a separate stream of research. By taking a broader approach to decision making than, say, Seuring (2013) who focuses specifically on modelling, it has been possible to consider a synthesis of this using Keeney's value-focused approach to decision making. This means setting a direction that goes beyond the need for definable attributes for structured decision models. Moving towards a prescriptive decision analysis for SSCM reveals the importance of the political context of the decision maker/s, the role of their personal values and the organisational culture in which they work, described here as the dominant logic (DL).

There is a need for research that seeks deeper understanding of the interplay between behavioural and quantifiable factors associated with SSCM. Each has traditionally been in a separate academic camp, and yet the Cynefin framework provides a level that considers both of these together. Essentially, this is a revisiting of the contrast made in Simon (1947) between rational, normative decision making and behavioural empirical decision making under bounded rationality. While some papers have addressed behavioural factors and bounded rationality, none in SSCM have considered how both types of decision context can be reconciled and best addressed.

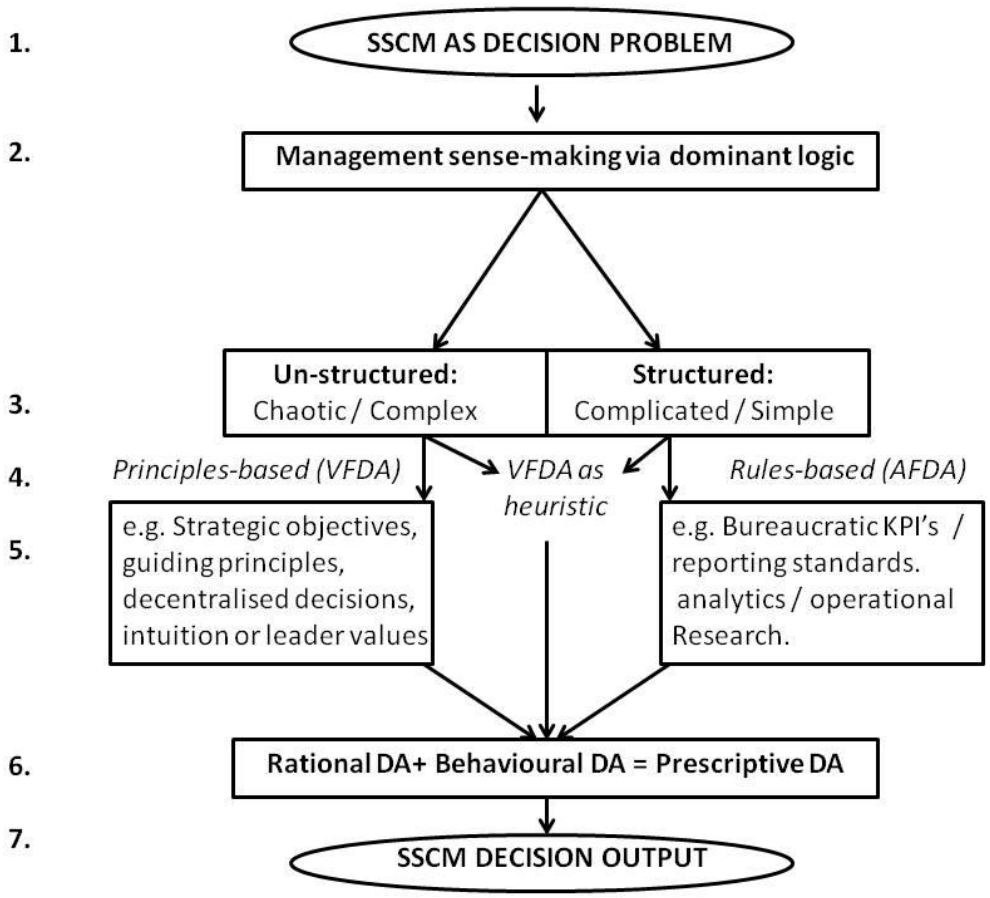

Figure 5: A consolidated model of DT concepts (source: author)

Figure 5, shows a consolidated model of the concepts described so far. Line 1 shows sustainable supply chain management as a decision problem. This is a phenomenon addressed by management, Line 2, where sense-making of the decision problem is described in terms of the organisation's dominant logic (Prahalad & Bettis, 1986). Line 3 shows DT categories of structured and unstructured contexts and the four Cynefin domains. Line 4 adds VFDA and AFDA (Keeney, 1996), including the use of VFDA as a heuristic in order to combine with Cynefin. Line 5 then lists examples of the responses given in the Cynefin framework (Snowden & Boone, 2007). Line 6 then brings back the rational and behavioural decision analysis approaches (French et al., 2009). Line 7 addresses the outcome of the SSCM process, which can be considered in terms of the effectiveness of the SSCM issue being addressed. This figure provides an overview of the concepts being investigated in the primary research, helping to inform the coding processes (described in Chapters 3 and 4).

The main priority for the research is to consider how organisational-level DL perceives the context for SSCM as structured or unstructured. As a result of this, SSCM is either treated as something to be measured and analysed via specific rules, or it is addressed as a general objective, with guiding principles used instead of rational analysis of quantitative variables. Precedent for this divide is noted in Wu and Pagell (2011), where grounded theory research is conducted into 'eco-exemplar' firms faced with complexity in SSCM. Guiding principles are found to be the way by which these firms manage. As noted above, this demonstrates the DT literature but does not reference it. A useful contrast to this is found in Kirchoff et al. (2016) who consider SSCM implementation in 'non-exemplar' firms and find various barriers that are presented in terms of the behavioural theory of the firm. However, this paper does not highlight that the behavioural theory of the firm is derived from DT and hence, by not drawing this root back from the strategic management literature to the precursory decision science literature, does not allow for as full a theoretical explanation as might be drawn.

The decision context is both an aspect of the internal DL and also shaped by the external environment a firm finds itself in. This point is further discussed in the 'attention based view of strategy' (Hoffman & Ocasio, 2001; Ocasio, 1997, 2011). It is therefore necessary to consider how external factors influence decision making. Within this thesis, this is a means to an end to address the urgent questions of PB+SF and how organisations understand their role within that wider context, and the constraints on decision making in relation. If SSCM provides a means by which to build Kleindorfer's bridge (Cohen & Kunreuther, 2007), then it is necessary to answer the problems of bounded rationality that are presented. In particular, there is an apparent contradiction between the dominance of research seeing SSCM as a structured, complicated problem amenable to metric decision analysis, and the opposite view stating that it is an inherently complex, messy and unstructured problem.

The state of the field for DT in SSCM can thus be summarised as largely constrained by a rational, normative view, with insufficient behavioural DT research. Furthermore, where there is some progressive research into the use of complex adaptive systems in SCM this is not yet well developed in SSCM and none of it addresses the interplay between the structured, simple or complicated, and the unstructured, complex and chaotic. It is this divide that is important, because in practical terms, if bureaucratic or analytic methods provide sufficient pragmatic results, then this explains their popularity. Complex methods

are similarly best used in specific contexts. Yet there is insufficient understanding of where these contexts occur, and hence, which responses are most appropriate. The Cynefin framework introduces this in terms of general management, and a contribution made by this thesis is to apply these ideas (along with VFDA) to SSCM.

A further reason why this is important, is that, as stated previously, the problems of sustainability - including as specifically defined using PB+SF - are characterised by levels of bounded rationality. For instance, there is uncertainty as to the link between the actions of a single organisation and the macro-scale social or environmental impacts. There are also behavioural constraints that affect decision making, based on the influences and constraints at the level of individual firm decision makers such as managers or board-level directors. Addressing Kleindorfer's Bridge means better understanding the role of an individual firm in the context of its wider competitive environment, and the barriers and opportunities available to organisational level decision makers. A better empirical understanding of this context can then inform theory development in SSCM, and by considering existing theory in tandem with this research, can enable theory elaboration. The results of such work are new ways of understanding SSCM and the extent to which firms are capable or incapable of acting to address issues of PB+SF.

The next section describes a pilot study conducted at a cross sector level that tests the assumptions of the conceptual background thus far. This then provides the formulation of a conceptual framework described in Chapter 3, along with discussion of research design and methodology.

Cross-sector pilot study showing contrasting DL for SSCM

As part of the case selection and process of gaining access to companies, cross-sector expert opinion was gathered that provides useful insight into corporate sustainability action and SSCM. These informants represented cross-sector views that was sought to establish the extent of or awareness as to the difference represented by different sectors in relation to SSCM. Access to organisations who would become potential case studies was one objective, but it in the gathering of the later data and also the reflection back on the initial theory, two polar contrasts are demonstrated.

The first informant of this 'pilot study' is a former financial director now working on corporate reporting at trade association for multinationals (Organisation A). The second is a director at an international SSCM services company (Organisation B). Codes in brackets refer to quotations provided in the qualitative data set provided in Appendix B at the end of this thesis. These interviews provide additional insight into the nature of different sectors but also demonstrate two polar positions around SSCM, illustrating the two positions shown in the summary diagram of decision making shown in .

Organisation A: Multinational Trade Association (structured mindset).

The organisation represents a large number of different sectors, and has long been actively engaged in the topic of sustainable and responsible business. The position of the director, and the organisation, is that clear rules-based processes, anchored in clear metrics, echoing the same structures as accountancy regulations, are vital if sustainable and responsible business practices are to result in substantive change.

Yet they found that looking across a range of sustainability and CSR reports from a wide range of publicly listed companies, the lack of this foundation in reporting and the wide variety of formats and approaches used does very little to assist in practical change. They argue that firms are thus strongly engaged in symbolic sustainability rather than substantive sustainability where reporting has a significant public relations element, oriented around firm-advantage, and is disconnected from a measurable sense of contribution to macro-scale environmental or social targets (A.3.1).

Within corporate reporting, mainstream financial economic disclosure...you have measures and data...internal decision making tools which are based on...management accounting techniques...That then gets wound up quarterly, half yearly or annually through generally accepting accounting practices into pre-defined and prescribed financial statements...it's comparable and it's referenced...grounded and documented in legislation or professional standards..." (A.6.2) (Sustainability reporting expert and former CFO)

Through their analysis across corporate reporting on sustainability and responsibility, the informant emphasises that the lack of professional standards for measuring sustainable and responsible business is a major barrier to reducing negative impacts via SSCM. Corporate reporting does not show relevant KPIs with sufficient context about the business to provide relevant oversight to external parties such as investors. Furthermore, the informant argues that all voluntary (non-regulatory) sustainability reporting standards that have recently been developed and deployed to meet the apparent customer demand for them, such as the Global Reporting Initiative (GRI), Sustainable Accounting Standards Board (SASB), International Integrated Reporting Council (IIRC) etc., are all insufficient because they lack the essential qualities of corporate reporting established in the accountancy profession.

The informant strongly emphasised that transforming business operations to deliver sustainability requires clearly defined rules. In other words, corporate reporting for sustainability demands a structured, rules-based standard with precise, unambiguous and regulated metrics. Such standards will then inform decision support systems within companies, relevant regulators, investors and associated analysts. This is not the situation at present. Instead, sustainable and responsible reporting frameworks are accused of being ineffective because they are principles-based not rules-based.

"*anybody that practiced corporate reporting saw [these] as probably a backwards step because [they were] principle based and it didn't give you any rules as to how to go about doing it... from an accountant's perspective it was a nightmare...business reporting is very much rules based. It's based on legislation in terms of external disclosure, it's based on accounting rules - that have been developed over 150 years - that are clear and provide guidance.* " (A.6.1)

"*what we have today with integrative reports and the sustainability reports is that once you scratch the surface, there may not be anything in it that's actually day-to-day management.*" (A.6.3)

Hence, the challenge that SSCM is hard to embed into operational procedures by having clear metrics and associated performance management, is demonstrated at a central and fundamental level in corporate governance. Management accounting practices should be integrated into SSCM to enable effective decision making. The primary research detailed in the next chapter provides in-depth case studies to explore the extent to which this phenomenon is apparent in the implementation of SSCM.

The position that SSCM must be amenable to a rules-based dominant logic underlines the importance of accountancy in enabling sustainable and responsible business activity. Scholarship and practice around Operations Management, Management Science and Operational Research rely on clear metrics and KPIs. This position demands that SSCM works with measurable factors that are both simple and significant. PB+SF provides a simple selection of criteria, which aligns with the principle of sufficiency in decision modelling, whereby a parsimonious treatment is best. However, the potential for this in practice is countered by evidence from the second expert informant, as follows. Together these two positions illustrate the typology provided by the Cynefin framework, as incorporated into the conceptual framework in this thesis.

Organisation B: SSCM Service Provider (unstructured mindset)

The second cross-sector informant is an expert in SSCM via work auditing sustainable and responsible criteria in international supply chains. The informant works with a large number of multinational corporations, helping them to understand the nature of their international supply chains, the related ethical/social and environmental performance, and subsequent risks.

A wide range of categories for SSCM include environment, labour rights, health & safety and practices such as corruption, bribery etc. (B.3.1). A very high degree of pluralism is also seen across the different world markets, with varied terminology and cultural attitudes (B.3.2, B.3.4).

There is a degree of influence toward standardisation around some major multinationals. The legislative context of their head office (i.e. in the UK or US) can influence certain standards used (B.3.5). The relative market share of some companies in their sector can also provide influence over the types of standards applied. Cargill in agriculture, Li & Fung in textiles, Tetra-pak and a number of others in FMCG packaging, etc. (B.4.1) are market leaders so their SSCM policies can shape those of many others.

Although this may help drive simplification towards structured, rules-based logics, detailed discussion about specific SSCM initiatives reveals high levels of complexity. The textile industry cannot achieve the quality and provenance standards of, say, the European food sector, as there is no equivalent to the pass or fail on food safety in textiles (B.4.2). On instances such as child labour, there is no common definition as to what exact age a worker is no longer a child. In some places it is 14, in some places 16, in other places it is lower (B.4.2). These issues are related to the different national contexts at play in globalised supply chains, and can cause problems in relation to consumer expectations in markets such as those in the developed West.

> *"there is a huge gap between the complexities of the topic area and the consumers understanding, which means that it is a challenge... every company will have child labour somewhere in their supply chain. That is a fairly acknowledged fact, but if you said that to a consumer, what would they think of that? Do they understand that sometimes they don't know where the stuff comes from?*" (B.4.2)

> *"There is so much variation...Working hours is another one. There's hugely complex pieces about living wage, local law, international law, etc." (B.5.1)*

Informant #2 also argues that certain global supply chains have significantly low levels of transparency. Bounded rationality is thus a factor where visibility is low and where definitions are unclear or ambiguous. Even in industries where there has been strong attempts to audit worker conditions, various strategies may be employed to mislead auditors. Falsification of compliance to SSCM requirements shows a form of bounded rationality where data is available but is inaccurate.

Legislative and governance around this must develop further to counter false compliance, and appropriate levels for a given standard must be established according to local context. The picture for any given company or for sectors as a whole, when dealing at an international scale, is thus inherently complex (B.3.2), and this complexity then represents a further source of bounded rationality affecting SSCM decision making.

The interview centred on sectors the informant had high volumes of work relating to, including agricultural commodities and textile manufacturing, where impacts in the PB+SF model are primarily social. However, similar issues are present in seeking to establish environmental data in international manufacturing using life cycle analysis as a decision tool for SSCM.

The informant highlighted the presence of bounded rationality and inherent complexity in international supply chains. This provides a strong contrast to the previous informant above (Organisation A). Interestingly, the structured, rule-based requirement outlined by Organisation A is an example of a normative, rational decision model. It refers to what ought to be the case, or the process that ought to be applied. By contrast, Organisation B refers to the reality of what happens in practice. This is an empirical account, describing the reality of how things are in practice.

Hence, the normative position represented by Organisation A is that sustainable and responsible business - and hence SSCM - needs simplification and standardisation. This would mean positioning the responses to the issue into Cynefin domains 1 or 2 (Figure 2). However, the empirical reality described by Organisation B is that supply chains and thus SSCM are characterised by bounded rationality in the form of uncertainty, ambiguity and complexity. The distinction between these two is therefore considered as a major barrier to the effective implementation of SSCM policies that will have a meaningful impact on SD. This therefore reflects the approach taken to answering the research questions 2 and 1, respectively. RQ2 asks how firms face barriers in their SSCM initiatives and RQ1 asks how those initiatives relate to PB+SF.

Chapter 3: Research method and design

The two initial informants in the cross-sector pilot study described above demonstrate the divide between the normative and the empirical perspectives in decision analysis introduced in Chapter 2. The first illustrates the DL of structured, rule-based, normative decision making. The second, the empirical reality of global supply chains and the unstructured context present in SSCM implementation.

The divide between these two positions illustrates a paradox of sustainability. In order to best meet the macro-scale environmental goals imposed by PB such as climate change, rules-based decision making may be essential. Accurate capturing of data at national and corporate levels, and related actions to reduce impacts in line with the rational, structured metrics of PB, clash with bounded rationality. This is caused by lack of good data, lack of categorical definitions and inherent complexity in supply chains.

The potential paradox of decision making in SSCM is illustrated by the pilot study's conceptual sample of two cross-sector organisations and their relative, polar, perspectives. This underlying tension is illustrated by the Cynefin framework. One approach is for coercive command-and-control rules and regulations. These rules require clear, unambiguous metrics and a standardised legal framework to enable fair comparison and internal management.

On the other hand, SSCM may not be amenable to this rational decision making logic, and rules are very difficult to establish or make effective, due to bounded rationality. Instead, complexity may imply that de-regulation and the decentralising of decision making to smaller units, such as via catalytic rather than coercive regulations, will better ensure responsiveness and effective innovation. The lack of good data may suggest a need for greater disclosure, as, for instance, the US 2012 Dodd-Frank Act clauses on conflict minerals in the supply chain or London Stock Exchange rules for mandatory disclosure of carbon footprint data, have introduced. These require firms to audit suppliers and publish data relevant to PB+SF impacts but do not require any action beyond disclosure of data.

Responding to complexity may suggest alternative approaches, such as making disclosure voluntary and having the market influence performance by rewarding firms that are more transparent, rather than forcing transparency on everyone and encouraging gaming of the system to mask actual performance. This suggests a distinction between regulatory drivers that are coercive - seek mandatory compliance to a given specified level - verses those that are catalytic - where incentives are given, such as tax penalty, but it is up to firms to decide if the incentives justify particular levels of investment in response to the financial incentive created by the imposition of a tax.

The command-and-control versus emergence positions clearly illustrate the divide in the Cynefin framework between a structured context (domains 1 and 2) and an unstructured context (domains 3 and 4). These two poles of control via structure, and emergence via unstructured complexity or chaos, are core to a question of how sustainability outcomes via PB+SF can best be met. This thus informs the nature of the implications of the research: What advice should be given to companies or to regulators? How much should be imposed, and how much should be left to self-organise? Are catalytic policies better than coercive ones as they permit emergence rather than control? Can a mixture of these two be considered?

These are big questions, and the first step of the research is to consider how companies' attempts to implement SSCM encounter these issues as defined by the DT framework described above. This is absent from current literature. While the divide between control and emergence is a central topic in Choi et al. (2001) and supply chains are described as complex adaptive systems in Carter et al. (2015), the Cynefin framework shows that under certain situations the context may be amenable to structured analysis or categorisation. However, this literature on the structure of the decision context does not relate to the topic of SD, besides early examples in the DT literature, such as French and Geldermann (2005). Meanwhile, VFDA and other heuristic processes can provide simpler ways to come to decisions, even if these may not be 'optimal'. Values-based decision making is a different approach from the quantitative 'alternatives-focus' and provides a bridge to ethical considerations. While not commonly included in SCM research, an ethical dimension can be considered a key part of sustainable and responsible business activity via SSCM.

An issue for the primary research design is therefore which of the factors described above appear to be present in real-world attempts to implement SSCM policy. The level of apparent complexity, the degree to which the context is treated as simple, and the use of values or principles as short cuts for decision making, are therefore all central concerns in exploring this issue.

The goal is to understand the extent to which organisational decision making around SSCM is able to forge a bridge between the micro and the macro - referred to here as Kleindorfer's Challenge (Kleindorfer et al., 2005). The PB+SF framework is taken to define a normative lens for SSCM - it is what companies ought to be focussing their efforts on. The PB+SF framework is also under-represented in the SSCM literature, though calls for the consideration of PB in management research was made in Whiteman et al. (2012) and the PB+SF framework was defined by Leach et al. (2013) for UNESCO as a contribution to updating the UN's policy foundations for sustainable development. The research in this thesis therefore seeks to contribute to this gap, particularly in SSCM.

Applying the DT model of prescriptive decision analysis to SSCM offers a potentially useful pragmatic output for the research. This involves providing an empirical description of the characteristics and context of a firm, including their dominant logic in relation to SSCM and other factors influencing the delivery of SSCM policy. This is the behavioural, empirical, micro-scale, descriptive component of the prescriptive model. Adding the normative element of the prescriptive model, using the macro-scale of PB+SF, means assessing the two next to each other. This means putting any specific firm into a relationship regarding their SSCM and their potential contribution to meeting the PB+SF sustainability challenges. The difference between the two produces the prescriptive stage as an output.

Knowing the empirical context of a firm, then its normative context with PB+SF, enables a consideration of the difference, which may help organisations in understanding the extent of the potential role they have in relation to their supply chains. Hence, their organisational decision making around SSCM, can be best determined, whether at the operational, tactical or strategic levels.

Conceptual framework and research philosophy

Shields and Rangarajan (2013) describe a conceptual framework as a 'plan of action' for a research project (ibid. page 2). Particular types of research are suited to particular plans, with the formal hypothesis being an established conceptual framework for research that seeks explanatory proof. Other forms of research and their related frameworks include exploratory, qualitative research, that does not aim to create outcomes that claim to be capable of prediction.

The research conducted here is very much in the exploratory mode rather than classical hypothetico-deductive method. Indeed, the very nature of the Cynefin framework as a methodological model as well as a management decision making tool, highlights a typology of what can be known or is knowable as a result of a structured scientific model that is amenable to quantitative measurement and linear modelling - and unknowable and unpredictable outcomes as a result of unstructured complexity or chaos. This distinction reflects an approach that builds on the argument against classical positivism introduced by the mathematics of chaos and complexity. As such, a quantitative approach is not ideal at this stage, and instead a more exploratory approach that looks at where quantitative approaches or more qualitative principles-based approaches to decision making are used.

A summary of the previously stated rationale for the primary research is as follows:

- The concept referred to here as Kleindorfer's Challenge is about how to build a bridge between micro and macro in order to effectively meet sustainability through organisational management processes. In respect of SSCM it refers to the extent to which organisational SSCM processes can meet the goal of SD.
- PB+SF are taken to be a necessary condition for SD, so PB+SF is taken as a normative lens for SSCM. Firm and supply chain characteristics provide a descriptive lens.
- Firm characteristics:

    As part of case selection

    - PB+SF link in the SC

- Firm has an SSCM policy (all are international firms with a strong UK presence)

As part of investigation (aspects that are not known in advance)

- The DL for decision making in organisational culture (using Cynefin and VFDA)
- Descriptions of the characteristics of the SC
- Actual extent of the links between the firm (micro), its SC (meso) and PB+SF (macro)
- Any other aspects that emerge during the research that are relevant.

- Hence, the primary data seeks to explore firms to find out how well they are implementing SSCM, given the contexts provided by PB+SF at the macro scale, DL at the micro scale and the SC as a bridge between the micro and meso, to macro scales.
- Developing effective SSCM requires understanding the nature of the scale of the PB+SF impacts in the SC, which is related to the nature of knowledge of the SC and how this is put into practice via organisational decision making. Hence, the Cynefin framework provides a means to understand knowledge in relation to SSCM and PB+SF, and VFDA provides a means to understand the extent to which organisations may act in the absence of available knowledge and bounded rationality.

Figure 6 shows a model of the PB+SF impacts in the upstream and downstream supply chain. Three linked criteria are shown. The first is the degree of impact, in other words the significance of the scale of the impact resulting from that tier of the supply chain (labelled, tier 1, tier 2 and tier n, in addition to the impacts of the focal firm). The second is the degree of visibility. This is the extent to which the focal firm is aware of the tiers in their upstream or downstream supply chain and the PB+SF impacts resulting from their activities. This visibility is a measure of knowledge. By definition, the extent of this knowledge is affected by the degree of bounded rationality. The Cynefin framework therefore captures the extent to which the degree of impact in the supply chain (at the network rather than dyadic or internal level) are known already, are knowable with additional data collection, or are unknowable, such as due to lack of clarity over what measures of sustainability are required. The third criteria is the degree of influence the focal firm has over its supply chain. Some

firms may have a strong position relative to their suppliers or customers and so be able to better influence SSCM. Others may have a weak position and so their ability to make decisions (thereby resulting in action) is more limited.

In order to consider the effectiveness of SSCM policy, it is worth examining the extent to which these three criteria are present in real world examples of the implementation of SSCM policy. The effectiveness in meeting PB+SF criteria relies upon organisations being sufficiently knowledgeable of their supply chains and sufficiently knowledgeable of sustainability issues to be able to develop effective SSCM policies.

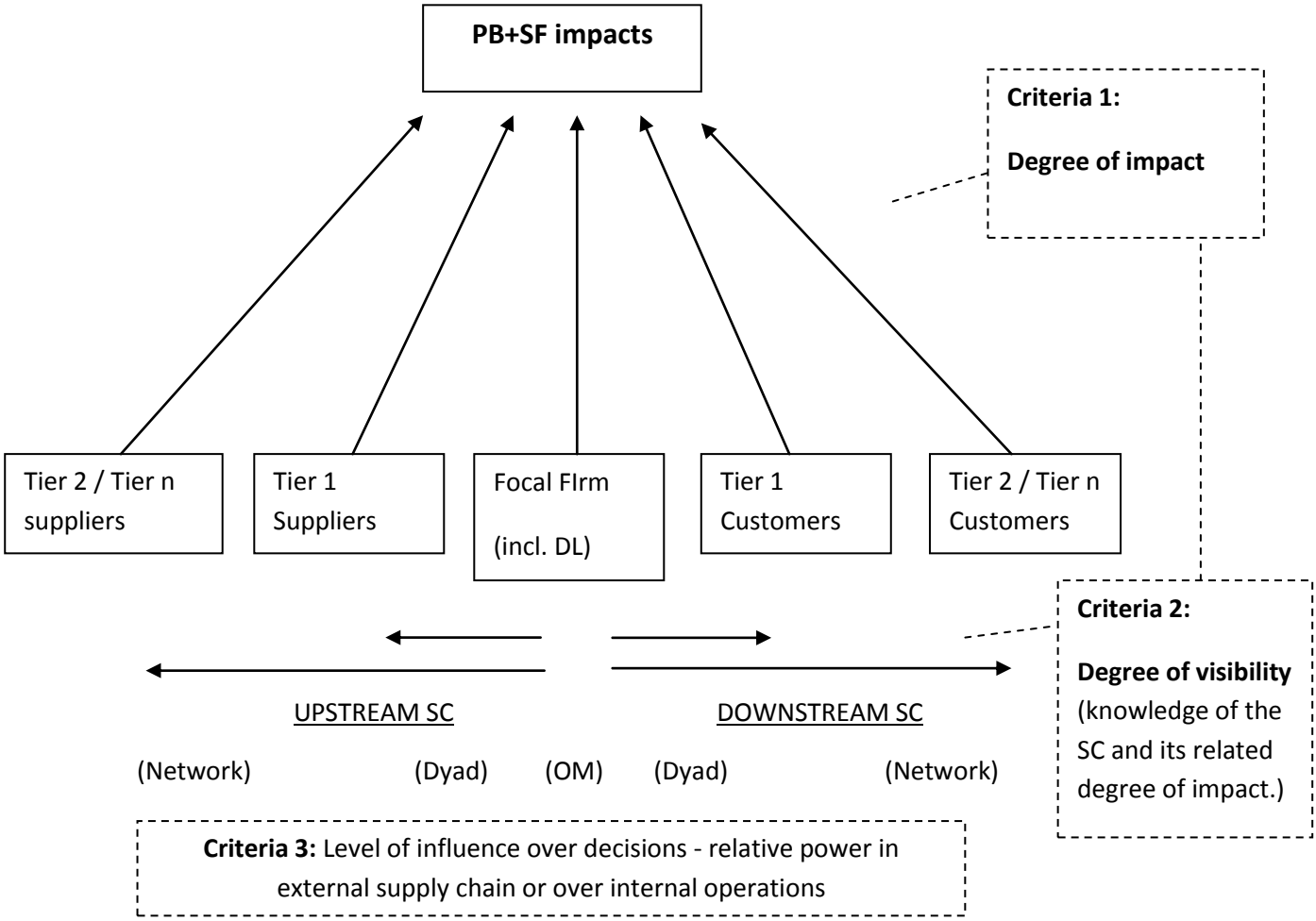

Figure 6: A PB+SF view of SSCM

As discussed in the next chapter, the research approach is for in-depth qualitative case studies. These use semi-structured interviews to seek answers to four questions in relation to the above model.

How is sustainability described within the organisations and how does this relate to PB+SF issues?

This seeks to find the definition of SD adopted and the respondents knowledge about PB+SF issues in their own operations, their supply chain or their related sectors. This provides the data for the relevant parts of the conceptual framework summary above.

How are SSCM initiatives being undertaken within the firms?

This asks what is actually done, what efforts are made to transform the SD impacts in the SC via SSCM policy and actions. Further probing on this issue reveals the drivers and barriers for implementation of SSCM.

How is the dominant logic in terms of decision making for SSCM described?

This is not a question that can be explicitly asked, but is derived from answers by probing the nature of decisions made about SSCM and aspects of the organisational culture, values, use of rules, metrics, and so forth. How the organisation understands and reacts to its context, as an aspect of its own organisational culture, help answer this question.

What additional concepts and issues emerge from the data collection?

Finally, the research process described in the next chapter, is neither seeking to generate novel theory via grounded methods, nor is it seeking to test the validity of existing theory via a large scale evidence set. Instead, it follows the process of theory elaboration via case studies. This is intended to allow data that emerges from the research to shape the conceptual framework in tandem. This is an iterative and reflexive process, described by Graebner, Martin, and Roundy (2012) as 'cooking without a recipe', Sinkovics and Alfoldi (2012) as 'progressive focussing', and Dubois and Gadde (2002) as 'systematic combining'. Full description of the method and relevant philosophical foundations are presented in the next chapter.

Returning to the central research questions stated in Chapter 1, the four questions above shape the nature of data collection needed in order to answer the underlying theoretical questions:

RQ1: How do firm's SSCM policies relate to PB+SF in practice?

RQ2: How does DT help explain barriers to meeting PB+SF via SSCM?

Aligning the research method with the theoretical context

Dubois and Gadde (2002) point to the importance of aligning the theoretical foundation with an appropriate research design. Studying SSCM using DT requires a research method that is suited to the inherent characteristics of this topic. As noted by Golicic, Davis, and McCarthy (2005), discussing the conventional approaches to logistics research, certain research paradigms may not be well-suited to the topic. These resonate with the issues raised in the discussion of DT and the Cynefin framework and divide between the normative and descriptive approaches,

> "*Logistics scholars agree that logistics and supply chain management are steeped in the positivist paradigm and the past research is primarily normative and quantitative...At the same time, the business environment in which logistics and supply chain phenomena are located is becoming increasingly complex and less amenable to using just a quantitative approach. In order to accurately describe, truly understand and begin to explain these complex phenomena, research streams should include more studies using qualitative methods.*" (ibid. page 16.)

Qualitative research is thus justified for SSCM, and also well-suited for considering the Cynefin typology. One of the main qualitative methods is case study research, which is the approach adopted here. A definition of this is provided by Barratt, Choi, and Li (2011):

> "*We define a qualitative case study as an empirical research that primarily uses contextually rich data from bounded real-world settings to investigate a focused phenomenon...The intent is to build and extend theories...and to explore and better understand emerging, contemporary phenomena or issues in their real world setting*" (ibid. page 329)

The alignment between philosophical issues around research method, the theoretical perspective of Cynefin (a typology of knowledge and uncertainty), DT and the characteristics of SSCM are thus clearly provided by this approach.

As shown in the literature review there is a distinct set of issues around SSCM and DT that are relevant to the nature of knowledge. These include the idea that sustainability contains

a fundamentally ethical component, and thereby requires a different approach than the conventional, impartial, disinterested, objective scientific method.

Interestingly, the PB+SF framework is a useful contribution to the debate on sustainability as it offers a contrast to interpretivist approaches to sustainability research. As noted by Markman and Krause (2016), and described at the start of this thesis, in practice, sustainability suffers from plural and contested definitions; progress towards meeting macro-scale environmental goals, such as reducing the accelerating increase in atmospheric greenhouses gases, does not seem apparent despite many years of discussion (Whiteman et al., 2012). PB+SF provide relatively clear, objective metrics that are of central importance to the crisis of sustainability. In addition, SCM research is increasingly argued to involve complexity (Choi et al., 2001; Golicic et al., 2005; Pathak et al., 2007). Adding the additional demands of sustainability to SCM to form SSCM may also, *sine qua non*, entail complexity (Matos & Hall, 2007).

However, the focus here is not on studying complexity theory methods in SSCM, as in complex adaptive systems research (Choi et al., 2001; Pathak et al., 2007) but of the whole meta-level analysis provided by the Cynefin framework. This acknowledges the pragmatic limitations in seeking to model complexity or chaos, given that under certain circumstances, structured approaches are sufficient.

Under many circumstances, and especially given the predominance and effectiveness of the management accounting perspective on metrication as the basis of management, and managers' desire to simplify situations so as to control them (Snowden & Boone, 2007), to only focus on complexity may be to ignore those situations where order prevails. As French et al. (2009) describes it, the Cynefin framework provides a model of both the simple and the complex.

As such, this requires an appropriate research method that explores the specific context of individual firms to understand the structures and rules that shape their approach to SSCM. Rather than going out to seek whether there are structured or unstructured problems, the research takes the approach of asking companies about their activities around sustainability in their supply chains, and then determining if these are structured or unstructured or how they are otherwise acknowledged in management practice.

The example of critical realism can be usefully considered here, as it is an abductive method that seeks to establish underlying causality of phenomenon that cannot be perceived directly but must be inferred from observation. Causal models are developed during the empirical data collection, which is shaped by the initial theoretical framework. Iteration between theory and data progresses as hypotheses are tested, and subsequent data collection seeks to push further to establish a viable account of the underlying causal factors (Rotaru, Churilov, & Flitman, 2014).

At the heart of this research is the question of how decision theory may help elaborate theory around SSCM practice. As a sense-making framework, Cynefin refers to how issues - in this case SSCM issues - are perceived and acted upon. However, the research must consider the effectiveness of Cynefin as an explanatory model, and examine the proposition of French and Geldermann (2005) that SSCM issues are inherently complex and unstructured.

We can draw a link between the epistemological issues at play in both the research design and the topic in question. It is entirely correct that decision theory, being concerned with the nature of, presence of, or boundaries to knowledge as an essential part of how decisions are made, should overlap with epistemology, the philosophy of knowledge. The philosophy of science, which seeks to reconcile what is known or knowable via epistemology with the objective or ontological physical world and the attempt to determine patterns or structure underlying its apparent operation, is also fundamentally relevant to this subject. Cynefin was firstly devised as a typology for knowledge management, particularly in relation to complex IT projects, before being adopted by DT scholars.

Pauwels and Matthyssens begin their discussion on achieving a strong structure for case study research by noting that the scientific recording of the subjective accounts provided by qualitative research is about determining causality (ibid. page 3). Causality is the basic relationship sought by scientific inquiry. However, as they note, referencing the role of complexity as a barrier to simple determination of cause and effect,

> "*causal complexity implies that cause/effect relationships are arranged in networks...effects may not result from unique causal paths (equifinality)...Assessing causality is [therefore] essentially a retrospective matter. As such, explanation is*

retrodictive...[and] contextualisation is a key characteristic of causal assessment." (ibid. page 4)

The Cynefin Framework therefore serves as a model both for decision theory and the philosophy of science for the reasons outlined above. As such, it again demonstrates alignment between theory and method, and also provides an original methodological contribution for qualitative research, as well as an original theoretical research contribution in relation to SSCM. Having established this as the appropriate conceptual framework for the research, the next section describes the process taken to ensure a high standard of qualitative research.

Building a strong structure in qualitative case study research

A strong account of how to meet the challenges of multiple case study research is provided by Pauwels and Matthyssens (2004). A codification of the case study process is provided in order to create 'methodological anchors', in addition to those provided by Yin (2008) and Miles and Huberman (1994). These are derived from a large scale analysis of case study research papers and presented using the analogy of a building consisting of four pillars and a roof (see Figure 7: A strong structure for case study research. Diagram by author illustrating Pauwels and Matthyssens (2004)., below). The absence of any of the four pillars will fail to keep the roof up. The four pillars are:

Pillar 1: Theoretical sampling, Pillar 2: Triangulation, Pillar 3: Pattern matching logic, Pillar 4: Analytic generalisation. The roof is validation by juxtaposition and iteration. Each is described in turn, followed by how it has been addressed in the research.

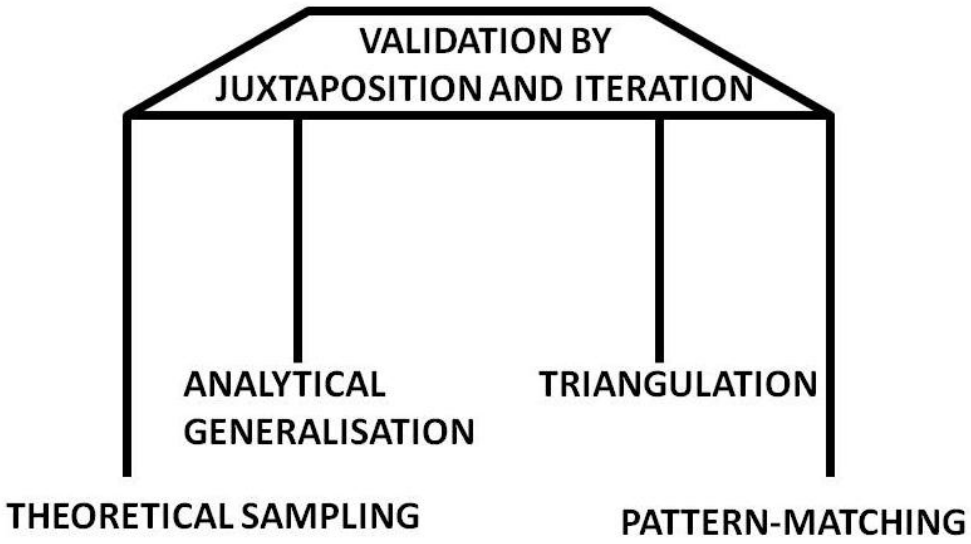

Figure 7: A strong structure for case study research. Diagram by author illustrating Pauwels and Matthyssens (2004).

Pillar 1: Theoretical sampling (selection of cases that will demonstrate theoretical issues)

Theoretical sampling in qualitative case study research is significantly different from the sampling logic of quantitative research. Pauwels and Matthyssens (2004) put forward an argument for this that contrasts with that of Yin (1994), who says that multiple case studies are preferred to single case studies because there is a higher potential for replication and higher external validity. Instead, conceptual sampling logic in case studies must be distinguished from the random sampling logic used in statistical analysis, such as large-n surveys . The nature of qualitative research is not to select cases on the basis of statistical sampling to establish universal principles. Instead, to quote Miles and Huberman (1994),

> "*We are generalising from one case to the next on the basis of a match to the underlying theory, not to a larger universe. The choice of cases is made on conceptual grounds, not on representative grounds.*" (ibid. page 29).

Sampling logic in quantitative research rests on the assumption that a sample is representative of a whole set. A contrast between qualitative case study research and quantitative survey research is the inverse proportionality between the size of the sample

and the number of variables. Case study research is not based on the notion of random sampling to determine universal commonalities, but rather to understand differences and idiosyncratic characteristics. Indeed, as described by Eisenhardt (1989), case study research is necessary when the phenomenon under investigation is not well understood,

> "*...the sampling of cases from the chosen population is unusual when building theory from case studies. Such research relies on theoretical sampling (i.e., cases are chosen for theoretical not statistical reasons)...they may be chosen to fill theoretical categories and provide examples of polar types...it makes sense to chose cases such as extreme situations and polar types in which the process of interest is 'transparently observable'.*" (ibid. page 537)

As Pauwels and Matthyssens (2004) describe it, the reason for choosing to conduct multiple-case studies is to seek variance.

> "*The only argument to switch from single to multiple case study research...is to create more theory-driven variance and divergence in the data, not to create more of the same...In theoretical sampling, the investigator deliberately selects both typical and a-typical cases...Ideal type cases, however, are not identical but polar cases.*" (ibid. page 5)

Yin (1994), by contrast, argued that choosing two similar cases could serve to validate the findings and thus the extent to which they could be generalised. This could be considered a form of triangulation, or data validation, discussed in relation to Pillar 2, below. The rationale for conducting case-based research is to determine as rich a picture as possible of the variables that influence the phenomenon in question. As further described by Dubois and Araujo (2007), case-based research seeks to

> "*progressively construct the context and boundaries of the phenomenon under investigation, as theory interacts with methodological decisions and empirical observations. The research object, its boundaries and context are often emergent outcomes of the research process.*" (ibid. page 171)

In order to break out of a quantitative research methodology best suited for the testing of existing theory via a large statistical sampling, case-based qualitative research should aim to

explore without too strong an indication of the variables that are being sought. The cases selected in this thesis therefore demonstrate a diversity of characteristics, the importance of which only becomes apparent as the research progresses.

There is a common argument, introduced by Glaser and Strauss (1967), that qualitative research should continue until the point of 'saturation' is reached, where the addition of extra cases ceases to produce such a high degree of novelty and contrast. The potential for this is inevitably constrained by the resource availability of any given research project, as discussed by Mason (2010). However, in this thesis, the point of saturation is established at 5 cases, each with a varying number of organisations interviewed. Various additional parties in a supply chain are also included, such as third party experts on sectors, their supply chains and relevant sustainability issues, plus customers or suppliers who are included as informants for triangulation but not as representatives of organisations as the unit of analysis.

Case selection by theoretical sampling

Two criteria for case selection use theoretical sampling derived from the conceptual framework at the end of Chapter Two. These are that the firm must have an SSCM policy, and that the firms must be representative of the PB+SF issues in Table 3. A third criteria is related to the initial brief for the research to involve UK-based companies. The fourth criteria is polar sampling iterated from one case to the next on the basis of novel characteristics emerging from the investigation (Eisenhardt, 1989; Eisenhardt & Graebner, 2007). This contrasting of key variables from the previous case contributed to achieving conceptual saturation. Each is briefly described below with supporting data tables.

i) Each company must have an existing SSCM policy.

This excludes companies who have no knowledge of sustainability or are otherwise not engaged with the topic. Here, the firm-level definition of sustainability is open, so can include social or ethical responsibility, as well as environmental issues. However, all companies included all three, often under the abbreviation SEE (Social, Ethical, Environmental). As the research progressed, it was clear that the number of years that the policy had been in place (the maturity) was different for each firm, and this became a notable polar attribute.

ii) Each case should explore a different part of the PB+SF framework.

The initial case selection rationale was on the basis of sectors representative of the PB+SF framework. The cases, their sectors and the associated PB+SF topics are as follows:

- Case 1: Conflict minerals in electronics and extractives supply chain
- Case 2: Phosphate pollution from household detergents (FMCG)
- Case 3: Habitat loss and the food supply chain
- Case 4: Greenhouse gases in the transport supply chain
- Case 5: Greenhouse gases in buildings and electricity generation

Rather than explore one PB in detail, seeking a wide range across the PB was seen as something absent from existing research, and necessary to examine the contrasting characteristics of the different PB(+SF). A more detailed breakdown of the link between firm, sector and PB+SF issue is shown in Table 14 and Figure 8. While the initial selection of case studies reflects the full spread of the three main and critical environmental impacts noted by the planetary boundaries model - species extinction from land-use change, nitrogen/phosphate pollution from fertilizers and detergents and greenhouse gas pollution from energy use - it is the last of these that is subject to the greatest level of analysis. In part this is because of the higher awareness, alignment with economic benefit due to energy efficiency and nascent regulation driving change. While the first two critical planetary boundaries - species loss (PB1) and nitrogen & phosphate (PB2) - are explored, barriers encountered in the supply chains for cases 1, 2 and 3, that cover these plus the SF framework, limited the potential. Cases 4 and 5, looking into greenhouse gases, were able to provide far greater insight into SSCM and additional relevant concepts.

As can be seen in Figure 8, the SF impacts and PB1 and PB2 are less represented than PB3. The research explores why this is so, but notably, all firms consume energy, and so have a link to climate change via their greenhouse gas emissions. In addition, the source of the emissions themselves takes place within the UK, in vehicles, buildings and power stations, whereas the impacts of SF and PB1 take place overseas (specifically, in developing countries). PB2 is a UK impact, and this has relevance for the nature of this case, as is discussed in the Findings, below. It is also important to note that the dotted line indicates that these connections are indicative not categorical as firms have a variety of projects

relating to SSCM and these are changing. Case organisations can readily add projects that involve, for instance, supplier development initiatives in developing countries that provide positive impact on SF. They may also have more SSCM initiatives than were discussed in the data collection phase, not least since the data was collected over a two year period, and may not necessarily have captured a complete account of all relevant issues, currently, in the past or that have since been put into planning or delivery. Examples of specific SSCM initiatives that help examine theory are outlined in the relevant sections of the Findings Chapter. The formation of the cases and the organisations within them is described towards the end of this chapter.

PB+SF criteria	**SSCM Case Studies**	**Case Organisations (SIC Code)**
SF: Human rights, labour rights. PB1: Species extinction	Case 1: Electronics & Extractive supply chain	Org 1.1 Electronics company (71.12/1) Org 1.2 Extractives Trade Association (09.9)
PB2: Phosphate pollution	Case 2: Detergents	Org 2.1 FMCG firm (20.4)
PB1: Species extinction PB2: Nitrogen pollution PB3: Greenhouse Gases (all)	Case 3: Food supply chain	Org 3.1 Restaurant (56.10)
PB3: Greenhouse Gases (transport)	Case 4: Banking & Logistics supply chain	Org 4.1 High Street Bank (64.19/1) Org 4.2 Logistics company (53.20)
PB3: Greenhouse Gases (buildings and electricity)	Case 5: Construction and Electricity Generation supply chain	Org 5.1 Construction Contractor (41) Org 5.2 Construction Products Manufacturer (24) Org 5.3 Chemicals Company (20.59)

Table 14: Case studies by PB+SF and main organisations included

iii) Each company is a UK based international firm

As this research is funded by a British Government Research Council, the studies are of firms based in the UK. An additional reason for this rationale is that familiarity with UK legislation substantially assists the level of technical detail that can be discussed with informants. The main companies chosen are shown in Table 14, along with their UK Standard Industry Codes

(SIC). This can enable repeatability of case selection or expansion of the sectors covered in future research. The cases selected are outlined in more detail below. Each is a major sector of the UK. Other major sectors of the UK economy not included, but which again could be included in an expansion of this research, are pharmaceuticals, automotive, aerospace and public sector (including defence, healthcare and education). However, the spread of cases provided is broad enough for the conceptual structure at the heart of this research to be meaningfully considered.

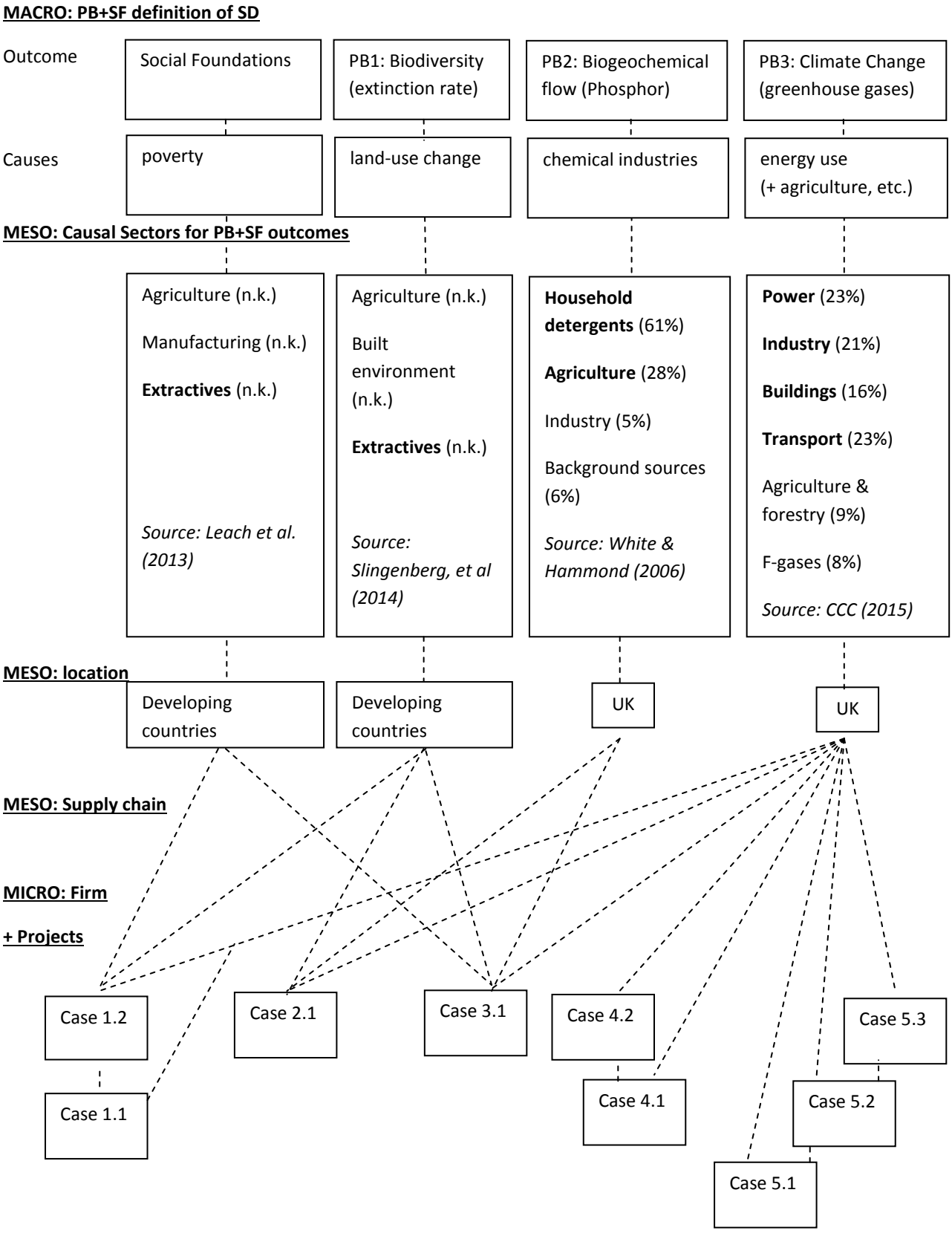

Figure 8: Macro PB+SF, through Meso supply chains & locations to Micro firm and projects. Bold refers to sectors included in the primary research.

note: these relationships are general, not specific to actual projects.

iv) Each company should contrast with previous ones according to the logic of polar sampling

As companies were contacted and interviewed, certain characteristics that were not known prior to the interviews were found to be relevant to the iterative conceptual modelling. The cases and case organisations are presented broadly in chronological order. During the interview with Org 1.1 it was clear that their SSCM policy was very new. They had a relatively low level of knowledge and were largely reactive to external demands. The next organisation interviewed was for Case 2, and here a company with a more mature approach to SSCM and deeper understanding was sought. Here, both the maturity of their SSCM policy, and their pro-active stance, were significant polar contrasts.

By the time the 3rd case was underway, it was noted that all previous cases had been for relatively small firms, and so a significantly larger firm was sought out, particularly one that was relevant to PB3. Ahead of Case 5, it was noticed that the previous cases included a large number of service companies, so a heavy manufacturer provided a valuable contrast. Finally, in looking at the actual scale of the PB+SF impacts, only Org 1.2, which was a trade association representing a sector, rather than an organisation studied in its own right, had substantial impacts. Tracking the upstream supply chain throughout Case 5, Org 5.3 provided a contrasting large scale positive PB impact via its role in enabling high volumes of carbon-free electricity.

Polar attribute	Case 1		Case 2	Case 3	Case 4		Case 5		
	Org 1.1	Org 1.2	Org 2.1	Org 3.1	Org 4.1	Org 4.2	Org 5.1	Org 5.2	Org 5.3
	Hightech	Extractives	FMCG	Food	Banking	Logistics	Construc	Manuf.	Chem.
PB+SF	SF+PB1	SF+PB1	PB2	PB1+3	PB3	PB3	PB3	PB3	PB3
#1			Maturity of SSCM						
#2					Org size				
#3								Manuf.	
#4									Scale of impact

Table 15: Case selection using polar attribute sampling

Pillar 2: Triangulation (reduce risk of bias via use of multiple sources of evidence)

The second criteria or essential pillar in Pauwels and Matthyssens (2004) architecture is triangulation. This refers to the use of multiple sources of data to counter potential bias or misunderstanding. For example,

> "*triangulation during data collection can be performed by interviewing various respondents on the same topic (synchronic primary data source triangulation), by interviewing the same respondent on a particular topic more than once (diachronic primary data source triangulation), as well as by the combination of primary and secondary data sources.*" (ibid. page 6)

For the research presented in this thesis, all three forms of triangulation are conducted, with multiple interviewees within a single organisation or multiple interviews with a single person, and the use of secondary data such as corporate publications or interviewing experts. A full list of the data collected in this thesis is shown in the Findings Chapter, in Table 20.

Additional data sources used for triangulation included public reports, corporate policy documents, including employee manuals, and speeches from senior staff and chief

executives. Further data was gathered by meeting informants with expertise in issues facing sectors, especially in relation to SSCM. These included specialists in trade associations, consultancy & other analyst services, and government.

Pillar 3: Pattern-matching logic (determine an explanation of causation)

The third criteria or essential pillar is pattern-matching logic. This describes the conceptual model sought as an output from the case study research. Such models concern the relationships between variables.

> "*Pattern models are described as chains of process propositions. These process propositions consist of hypothesised relationships between abstracted events.*" (ibid. page 7).

Inferential pattern coding (Miles & Huberman, 1994) is a developed form of this process. The coding of thematic concepts from primary data (specifically, interview transcripts),

> "*functions like a statistical 'factor', grouping disparate pieces into a more inclusive and meaningful whole.*" (ibid. page 58).

Conceptual codes derived initially from the conceptual framework were tagged throughout the multiple case study data and patterns and relationships then grouped and described through models of relationships. The main approach to this taken is recursive abstraction where the interview data is coded by summarizing the core meaning of the quotes into themes, and then analyzing the relationship between themes and other data, such as characteristics of the case study companies (Parboteeah & Jackson, 2011). The main description of this is in the Findings Chapter. The in-depth semi-structured interviews were recorded, transcribed, made anonymous and coded, using the techniques outlined in Saldaña (2012), Miles and Huberman (1994) and Pauwels and Matthyssens (2004). In particular, conceptual coding and descriptive coding are adopted to cover the theoretical concepts of DT and the descriptions of firm characteristics and context, as shown in Figure 5.

In this thesis, Table 17 shows the pre-specified conceptual codes and descriptive codes, and Table 18, shows the important concepts that have emerged from the interview data. This then leads to the formulation of a conceptual model as a major output from the research.

The total volume of data included and the total number of cases aims to achieve saturation. This is described by Eisenhardt (1989) and Yin (2008) as the point at which additional data does not increase the volume of insight. For instance, in coding additional interviews no new codes are added as the existing code list covers the topic fully.

The exploratory and iterative nature of the case studies also meant that each case is also subject to ever deeper exploration. Barriers in the visible horizon of Cases 1, 2 and 3, including difficulties in accessing their supply chain, contrast with Case 4 and 5, which are much larger and go deeper into the supply chain. This also is an illustration of the principle that exploration of supply chains should explore that which is most conceptually relevant and interesting (Eisenhardt & Graebner, 2007).

The progress of the research here also found that rather than predetermining a structure for the whole research programme that sought an equivalent volume of data from each case, instead the exploratory process saw the volume of data grow incrementally per case. In Case 5, the greatest proximity to saturation has been achieved. In part, the depth of research into the supply chain was being driven by the need to understand the drivers and barriers to greenhouse gas reduction in buildings and electricity generation, which appeared to be well demonstrated in this case.

As the research concerns the contextual factors influencing SSCM across different sectors, the focusing and bounding of the data being collected must balance between a 'loose design' and a 'tight design' (Miles & Huberman, 1994). In a tight design, clear definitions serve to enable the description and analysis of relationships between variables. In the first instance, these are the pre-specified conceptual codes. In the loose design, the constructs are not well defined in advance; these are the emergent codes, and are an important part of bringing forth relevant concepts from the data collection to enable elaboration in the emerging theoretical model, rather than solely testing for the presence of given pre-specified concepts and their relationships to each other.

This balance means that novel and surprising data can inform an iteration of the conceptual framework in line with the principles of abductive theory elaboration. This is in contrast to theory testing where data is compared against a pre-specified set of concepts in order to determine correlation, which is the mainstay of quantitative research. Or, at the opposite end, the grounded theory approach where theory may be derived solely from a set of empirical data. As discussed at the start of this chapter, the approach taken here is properly suited to the nature of the theoretical goal of synthesizing SSCM and DT through techniques of theory elaboration via case studies. This process is also outlined in, for example, Ketokivi and Choi (2014). Further discussion on the barriers to multi-tier supply chain access are described later in this chapter. The output of the pattern matching processes is provided in the Cross-Case Analysis chapter and following discussion.

Pillar 4: Analytic generalisation (practical application and comparison with existing theory)

In addition to the three earlier pillars, the final pillar is analytic generalisation. Here, having established a conceptual model from the data, showing an apparent relationship between relevant variables, it is necessary to determine what lessons can be learnt from this that are more widely applicable. Validity of the model as a description of phenomenon, is compared and contrasted with existing theory. As Pauwels and Matthyssens (2004) describe it,

> "*The outcome of this analytical generalisation may indicate incompatibility with extant theories, which requires additional research, or overlap, which indicates that the 'new' mid-range theory is nothing more than a (partial) rephrasing of an existing theory.*" (ibid. page 7)

Analytic generalisation therefore requires a further literature review of relevant theory. This review process has been partly incorporated into Chapter 2, and is augmented in the discussion chapter and following Implications.

The Roof: Validation by juxtaposition and iteration (potential for falsification)

The final element of Pauwels and Matthyssens methodology for case study research is the roof, which refers to validation by juxtaposition and iteration. Here,

> "*validation is the ongoing deliberate creation and examination of possible sources of (in)validity. Sources of invalidity may emerge from (1) juxtaposing data, extant*

> *literature and the emergent theory, and (2) iteration between case selection, data collection, data analysis and comparison with extant theories.*" (Pauwels & Matthyssens, 2004) [page 8]

As such, the validation process occurs throughout the conception and conduct of the research. The selection of cases and consideration of theoretical relevance are considered in tandem in an iterative manner. The initial concepts and emergent concepts discovered within the primary data prompt additional literature reviews because important ideas emerging from the data need to be referred back to existing theory. The question of whether the resulting conceptual model is novel or already extant is examined in relation to theory. Given that SSCM is a relatively nascent subject for research, the area of synthesis suggested by the literature review (Chapter 2) is thought to prompt novel research outputs. To help show this, the thinking is presented as it unfolds through the presentation of the cases in Chapter 5: Findings. This is in line with the principle of 'progressive focusing' (Sinkovics & Alfoldi, 2012; Stake, 1995), described in Figure 9.

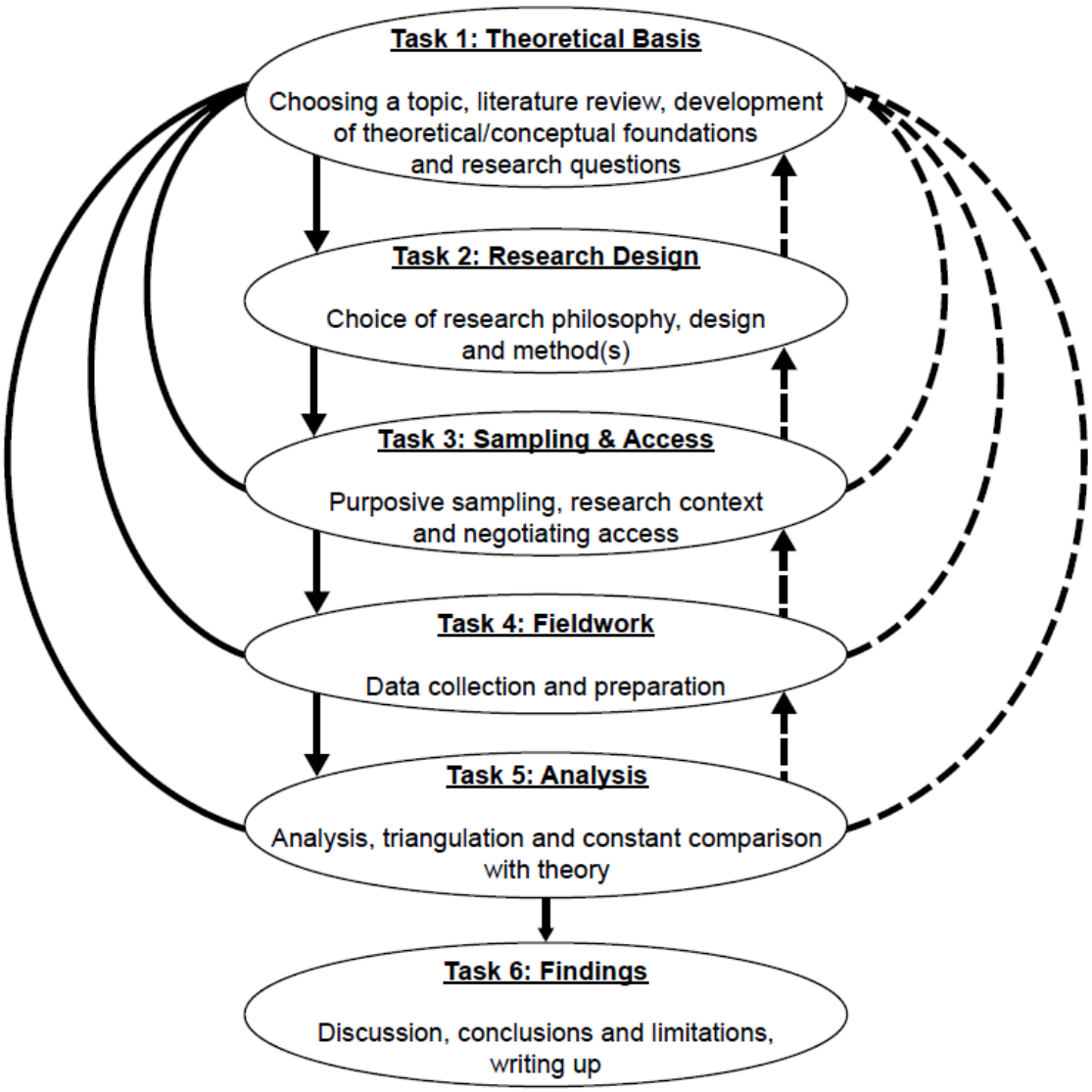

Figure 9: The circular research process for qualitative theory elaboration research using progressive refinement. Source: Sinkovics & Alfoldi (2012)

The roof of the methodology is supported by the four other pillars, so for instance, triangulation or theoretical sampling may suggest additional or alternative sources of data be added. This was conducted alongside the triangulation process, particularly in relation to interviewing additional companies that were not included as organisations to study in respect of the DL and how this affected their SSCM. As shown in Table 20, some of these additional organisations included customers and suppliers who provided juxtaposing examples that helped provide validation.

A critical consideration in this process is the potential for falsification of theoretical propositions. This is a vital part of the scientific process. If a proposition is not potentially falsifiable, it risks being a pseudoscientific proposition, incapable of validation and therefore not a valid scientific proposition (Hospers, 2013). As part of the polar theoretical sampling in the case selection, the potential for falsifiability of the data from one case is a key influence on the selection of the next and the questions asked of the various informants.

Interestingly, Pauwels and Matthyssens (2004), note that,

> "*While validation-through-iteration may look like a totally chaotic and unplanned process of jumping back and forward between case selection, respondent selection, data collection, analysis and assessment against extant theories, it is a critical instrument to dynamically construct a valid theory-creating process.*"(ibid. page 8)

This is familiar in terms of the unstructured domain of the Cynefin framework. This too reminds one of the nature of qualitative case study research as a form required where quantitative analysis is not suitable. As mentioned previously, quantitative analysis is best suited for a structured problem, where the gathering of metric data enables the creation of a conventional scientific model defined by the linear relationship between variables. This can be determined by numerical analytic methods. If the phenomenon is complex, contested or ill-defined, then these techniques will produce results of limited usefulness. This shows how this particular research methodology is aligned with the theoretical perspective taken, which Dubois and Gadde (2002) argue is an essential requirement of a valid research design.

Qualitative research process

This section describes the process of conducting the research and how the data was gathered. In addition to the theoretical validation approach of Pauwels and Matthyssens (2004), Miles and Huberman (1994) provides a thorough account of the process that qualitative research should follow and these provide a description of the research process:

- Data Capturing
- Processing Data Prior to Analysis
- Data Reduction
- Data Display
- Conclusion Drawing and Verification

Data capturing

Data was collected over a two year period. A variety of professional networks were used to establish contact with senior managers involved in their organisation's SSCM activities. In total, 46 interviews were included in the study. As shown in Table 20, roles included those leading on SSCM practices such as board-level officers, division directors and environmental and health & safety managers.

Interviews were between 45 minutes and 2 hours in length, with some informants interviewed on multiple occasions. The total volume of recorded data is estimated at around 52 hours. In addition, meetings were observed to gain deeper insight into how particular processes influenced decision making, including meetings between companies and their customers and suppliers, and between different departments and subsidiaries in a firm.

As mentioned in relation to triangulation above, additional data on companies' sustainability practices and organisational culture was obtained from annual financial reports and sustainability/CSR reports, corporate policy documents, including employee manuals, and speeches from senior staff and chief executives. Further data was also gathered by meeting informants with expertise in issues facing sectors, especially in relation to SSCM. These included specialists in trade associations, government, consultancy and other analyst services.

The primary empirical data collection was based on audio recordings of interviews. As mentioned above, secondary data for triangulation includes company publications, news coverage relating to the organisation and the social and environmental impacts involved in their operations, those of their supply chains and the wider sector to which they belong, etc.

Given the nature of the research method described above the data collection from in-depth interviews with practitioners is semi-structured. The specific technique applied is that described by Vaughan (2013) as semi-structured elite interviewing. At the start of the interview, the researcher establishes their credentials as a peer. Here, the researcher's former experience as a business journalist and as sustainability director for a consultancy firm makes this approach possible. The rapport established enables deep and frank discussion.

The researcher's many years experience in interviewing senior managers means both being able to focus on the concepts related to the initial conceptual framework (Cynefin, VFDA, PB+SF and the SC) whilst also giving the informant opportunity to bring forward thoughts that they see as relevant to the topic being discussed (namely SSCM and decision making).It also means that themes can be tested, by probing the answers given, looking for contradictions between statements, asking for reiteration or additional examples, and trying to make sure that the interviewee doesn't succeed in not answering the question, either deliberately or by rambling.

Table 16 provides examples of the questions asked. However, it is important to note that the semi-structured nature of the interview is resistant to structured display of questions and answers. As described by Vaughan (2013),

> "*With semi-structured interviews there are generally no set or fixed questions. Instead, the researcher, following a review of relevant literature, generates a list of topics or themes that are to be discussed with the interviewee.*" (ibid. page 107)

The advantage of this approach is its flexibility and responsiveness, enabling the interviewee to introduce themes that are of central importance and for the interviewer to probe the answers as relevant. The disadvantage is a potential for weak validity and reliability, and weak replicability by other researchers. As the attributes of the interviewer are central to the narrative data produced, the qualitative researcher as interviewer is essentially the

'scientific tool' of the research, and as such this contrasts qualitative social science, with quantitative physical or mechanical science.

All interviews were conducted under conditions of anonymity. This has enabled highly candid insights, but requires that any data enabling a firm to be identified (including general information such as market capitalisation, approximate number of employees, size of market share and more specific facts such as market positioning or product types) has had to be kept from publication in this thesis.

Examples of questions asked via semi-structured elite interview technique	Theme
How would you describe the company and where it is at, at the moment? What is the structure of your organisation? Describe how you address sustainable and responsible business in your supply chain management.	Descriptions of organisational characteristics
Can you describe the decision making bodies that influence company policies on sustainability internally or in the supply chain? Are there particular ways that decision making is done? How are people held accountable for their decisions? Is decision making authority formal or informal? Centralised, or decentralised?	Descriptions of organisational culture relating to decision making
What aspects of sustainable and responsible issues in your operations and supply chain are simple to understand, and just need processes to be put in place and followed?	Structured - simple
What aspects of sustainable and responsible issues in your operations and supply chain involve lots of complicated variables so require expert analysis?	Structured-complicated
Which ones are too complex to easily understand and control? Is it viable to leave these issues to sort themselves out, or decentralise decision making to suppliers or logistics providers? Can managers act on their own judgement/intuition, or do they need to provide mathematical proofs before they can act?	Unstructured - complex
Are there some aspects of sustainability and social responsibility in the supply chain that are too uncertain or chaotic to be understandable and controllable?	Unstructured - chaotic
Was there a particular policy that influenced that investment decision? What do you think about regulations on climate change, are they influencing decision making? Are you involved in influencing forthcoming regulations?	Rules, PB
Please describe how your company understands or responds to sustainability and corporate social responsibility. Do you use particular systems for managing sustainable and responsible issues in your supply chains, e.g. third party systems or bespoke internal systems? What variables / metrics do you identify and use as Key Performance Indicators?	Definitions of SD issues (formal/informal)
What do you see as the biggest challenges and biggest successes or opportunities in your SSCM? How much visibility or awareness do you have of the wider supply network? Have you looked across all of those suppliers and seen where's the real major impact in terms of the environmental impacts? Or the social impacts? To what extent do you talk to your suppliers about their suppliers? What is your involvement with or impressions of Scope 1, 2 and 3 measurement? Do you need to guard against double counting if you are reporting on carbon emissions, or do you use it more as an internal tool rather than for external disclosure?	Awareness of SD / PB+SF in Supply Chain
To what extent are investors big influences on your decision making, or does influence or pressure come from other places, like customers, regulators, clients?	Other relevant topics emerging from the data

Table 16: Example questions from semi-structured interviews

Processing data prior to analysis

Audio interviews are converted into in vivo written transcripts, made anonymous and coded according to the definitions in Saldaña (2012) of descriptive coding, conceptual coding and causation coding. Recursive abstraction is used to derive codes from the in vivo data with consideration given to processes of establishing causal foundations from interview data in operations and supply chain management in Rotaru et al. (2014). The descriptive coding covers the basic characteristics of each firm, its supply chain and its definitions of SRB. The conceptual coding is based on the framework of concepts shown in Table 17 (pre-specified codes). This enables recording of instances of the Cynefin framework, which Kurtz and Snowden (2003) refer to as 'Cynefin narratives', plus evidence of values-focussed decision making (Keeney, 1996). Conceptual coding (Saldaña, 2012) is determined as pre-specified concepts derived from the theoretical framework and emergent concepts novel to the data. These then form abstracted themes whose causal relationships can be built into pattern models according to the principles of inferential pattern coding (Miles & Huberman, 1994) mentioned in Pillar 3 above. Finally, causation coding is used to capture addition relevant experience of the process of implementing SSCM. To quote Saldaña,

> "*Causation coding is appropriate for discerning motives...belief systems, worldviews, processes, recent histories, interrelationships, and the complexity of influences and affects.*" (Saldaña, 2012) (page 165).

This enables the capture of other elements that the informants deem is important or which the researcher sees as significant, emerging from the semi-structured nature of the interview. These are shown in Table 18.

#	Category	Description	Code	Concept Area
1	Org characteristics	basic descriptions of organisation	Org-desc	Org Characteristics
2	Org SC characteristics	descriptions of supply chain	SC-desc	Org Characteristics
3	Org characteristics	definitions of sustainability & responsibility	SD-Def	Org Characteristics
4	SSCM initiatives	Management SSCM policies and actions	SSCM	Org Characteristics
5	Descriptions of external impacts on environmental sustainability	External descriptions of environmental impacts associated with the supply chain, especially planetary boundaries (PB)	SC-PB	PB+SF
6	Descriptions of external impacts on social sustainability	External descriptions of social foundation impacts associated with the supply chain (SF)	SC-SF	PB+SF
7	Dominant logic for decision-making (Cynefin)	sense-making: uncertainty (cynefin 0)	Cyn0	DT
8		sense-making: simple / bureaucracy (cynefin 1)	Cyn1	DT
9		sense-making: complicated / analysis (cynefin 2)	Cyn2	DT
10		sense-making: complexity / emergence (cynefin 3)	Cyn3	DT
11		sense-making: chaos / action / non-action / paralysis (cynefin 5)	Cyn4	DT
12	Dominant logic for decision-making (VFDA)	Organisational values or principles affecting decision making	DL-VFDA	DT

Table 17: Pre-specified codes

#	Category	Description	Code	Concepts
1	*Drivers*	The initial prompt or motivator for SSCM actions	*Dri*	
2	*Barriers*	Factors that slow or prevent certain SSCM actions	*Bar*	
3	*Influencers*	External groups seen with actual or potential influence on organisational decision making	*Infl*	
4	*Stance to SSCM*	Pro-active /conviction, or reactive/compliance	*Stance*	
5	*Alignment*	Alignment between economic benefit and social & environmental benefit	*£:Sust ratio*	
6	*Evidence*	Evidence-based statements on sustainability	*Evid*	
7	*Ownership*	Influence of ownership (private owners vs. shareholder investors) on decision making logic	*Inv.*	
8	*Morality*	Moral decisions (versus legal, economic decisions)	*Moral*	
9	*Payback period*	Payback calculations for SSCM measures built on a structured dominant logic.	*Payback*	
10	*Competitiveness*	Macro-economic and legislative context as influences on SSCM decision making	*Macro-econ*	
11	*Substitution*	Evidence of substitution of harmful impacts (eco-effectiveness) rather than efficiency reducing the scale of impacts	*Eco-effective*	

Table 18: Emergent codes from interview data

Data reduction

Summaries of main themes and reflections were written immediately after each interview to capture the researcher's thoughts and impressions of the interviewers and areas to investigate further or seek triangulation for. Coding was conducted via repeated re-reading of the interview transcripts over a long period to isolate the relevant concepts and variables.

At relevant points in the Findings Chapter references are provided to a reduced set of the transcript data provided in Appendix B. Readers may wish to review this Appendix before reading the Findings chapter.

Data display

Having determined the relevant initial concepts (Table 17) and variables emerging from the case data (Table 18), a series of different diagrams and tables were experimented with and adapted in order to best capture and display the data (see various tables in Chapter 4 and 5). Data is also presented in narrative form in order to preserve the rich detail of the context. As noted by Barratt et al. (2011),

> "*For single-case studies it has been suggested that researchers present a detailed narrative supported by quotations from key informants and other forms of evidence...For multiple case studies this challenge becomes more critical and difficult. It requires a careful crafting and presentation of the data to make the outcome self-evident to the readers. The use of tables and visual displays is often promoted as the way to convey and summarise the rich empirical evidence within case studies...*" (ibid, page 331)

The crafting of data display in the Findings Chapter is firstly in a predominantly narrative form, structured according to the three main themes, plus emergent concepts. The three themes are:

- Description of sustainability within the organisation and how this relates to PB+SF issues
- Description of how SSCM initiatives are being undertaken.
- Description of the dominant logic regarding decision making for SSCM.

The following Cross-Case Analysis Chapter then provides tables and figures as ways to show the underlying factors found and the relationships informing the creation of theory elaboration.

Conclusion drawing and verification

Miles and Huberman (1994) define a set of processes for this stage, including noting patterns between codes and organisational characteristics, making contrasts and comparisons between different characteristics, noting relationships between variables and seeking conceptual and theoretical coherence. This corresponds with the description of the pillars and roof in the approach of Pauwels and Matthyssens (2004) as mentioned above.

The following section discusses the particular relationship between qualitative research and theory.

Discussion on case study method and theory elaboration

The following section discusses the methodological nature of qualitative case study research as a basis for theory elaboration. A useful description of this process is provided by Sinkovics and Alfoldi (2012). Like the iterative stage of Pauwell and Matthyssen's validation process, this highlights that the qualitative research process is not a linear and predictable progression from problem to data collection to solution. Where the linear hypothetico-deductive method developed as a core scientific method for quantitative research to test theory, instead, Sinkovics and Alfoldi (2012) describe the 'messiness' of qualitative fieldwork as,

> "*a set of interpretive activities that seek to understand the meaning behind actions and behaviours, and rely heavily on the researcher as a unique interpreter of the data...We acknowledge traditional conventions...but call for the more wide-spread recognition of the non-linearity that is typical of real-world qualitative research. In particular, we consider the merits of formally adopting a 'progressive focusing' approach, which entails a systematic narrowing and refinement of the research focus during fieldwork.*" (ibid. page 818)

This is a theme seen in prior development of the qualitative case study method. Building on the work of Miles and Huberman (1994), as Dubois and Gadde (2002) describe,

> *"The original framework is successively modified, partly as a result of unanticipated empirical findings, but also of theoretical insights gained during the process."* (ibid. page 559)

This process is shown in Figure 9, where rather than discrete, linear 'stages', the research process consists of 'tasks' which can be returned to repeatedly through the process. This provides an illustration of the iterative aspects of Pauwels and Matthyssens (2004), and is an accurate reflection of the research process conducted in the fieldwork for this thesis. Although the research involved cyclical processes, as a document is an inherently linear output, there has been a need to express the research in a sequential way.

The implications this has for the nature of scientific reasoning and thereby the contributions to theory made by the research are highly relevant. To quote Sinkovics and Alfoldi (2012),

> "*we observe a tradition of describing qualitative research methods as either inductive or deductive...with papers positioned as deductive in the majority...In contrast, our experience suggests that qualitative findings often evolve continuously via the interaction between theory and data, often through a cyclical process [of] progressive focusing...*" (ibid. page 823)

'Progressive focusing' is a term coined by Stake (1995) and is similar to 'systematic combining' (Dubois & Gadde, 2002, 2014) or 'cycles of deliberation' (McGaughey, 2004). The movement between theory and data enables the alternative, middle-way logic of 'abductive reasoning'. This dates from the philosophy of pragmatism developed by Peirce (1905), and Sinkovics and Alfoldi (2012) define it as follows:

> *"Abductive reasoning is a pragmatic approach which involves using existing theoretical explanations to make inferences about data, and accommodating surprising or anomalous patterns by modifying the existing theory, with the ultimate aim of finding the most plausible way to explain what is happening."* (ibid, page 824)

Pragmatism does not seek the goal of absolute truth, but only a temporary result that provides useful explanation. Ketokivi and Choi (2014) identify this aspect of abductive reasoning in their discussion of the underlying scientific rationality in case research as an important method of inquiry. Case research is seen as a duality of being,

> *"situationally grounded, but at the same time, seeking a sense of generality...Being situationally grounded means one remains empirically disciplined and pays heed to contextual idiosyncracies already in the data collection phase. Seeking a sense of generality in turn involves an attempt to transcend the empirical context and seek broader theoretical understanding through abstraction.*" (ibid. page 234)

Case research can be both quantitative, based on measurable quantities, or qualitative, concerned with meaning and interpretation. It can be concerned with theory creation, where generalities are derived from empirical specifics, or theory testing, where propositions derived a priori from existing theory are tested against specific empirical

evidence. Or, thirdly, it can be concerned with theory elaboration. This is described as follows,

> "*Theory elaboration...is similar to theory testing. The primary difference is that the researcher does not seek to test the logic but to elaborate it. While the researcher may be able to apply an existing general theory, it may be the case that the context is not well known enough to obtain sufficiently detailed premises that could be used in conjunction with the general theory to deduce testable hypotheses. Also, the researcher may wish to explore the empirical context with more latitude and serendipity...There are many ways in which theory can be elaborated: one can introduce new concepts, conduct an in-depth investigation of the relationships among concepts, or examine boundary conditions*." (ibid. page 236)

If there were a fully formed theory of SSCM or SSCM and DT, then perhaps a quantitative model could experimentally test the veracity of this theory. Indeed, quantitative studies within SSCM may be found to concern the validation of relationships between two variables that are either so specific and detailed that the results are not widely applicable or especially revealing. In some extremes quantitative research in business and management studies can provide robust validation of relationships that are almost self-evident *a priori*, so at risk of being essentially tautological. This issue is discussed at length in Bell and Thorpe (2013).

Likewise, novel theory generation for SSCM and DT is not completely necessary, as relevant theory is not non-existent. What C. Carter and Rogers (2008) refer to as 'middle theory' is the case for SSCM. There is no great need to reinvent the wheel by calling forth new theoretical constructs from primary data only to find they echo previous work. The approach taken here is therefore abductive and is built on considering existing theory and elaborating the theory in light of the data. As argued by Ketokivi and Choi (2014),

"*successful theory elaboration hinges on the researcher's abilty to investigate the general theory and the context simultaneously, in a balanced manner.*" (ibid. page 236)

This builds on work such as Yin (2008), Eisenhardt (1989), Dubois and Gadde (2002), Pauwels and Matthyssens (2004) and Miles and Huberman (1994), each of which formalizes

case based research as a legitimate research methodology. Significantly, Ketokivi and Choi (2014) conclude that abductive case research contrasts with other approaches because,

> *"a rigorous case researcher allows all theoretical predispositions and emerging theoretical insights to remain challenged by the data...[Meanwhile]...Serendipity entails remaining open to be surprised by the data and, once encountered, to make sense of these surprises through disciplined analysis.*" (ibid. page 238)

The approach taken in this thesis is therefore to take the general theory of DT, SSCM and PB+SF, and consider it in light of the specific contexts via case research. Two sets of concepts are thus outlined as those pre-specified prior to data collection and those emerging from the data.

Unit of analysis

The pre-specified and emergent concepts help identify organisational characteristics that are significant influencers on the decision making processes associated with SSCM. The behavioural influences on decision making can thus be considered alongside rational, normative factors. The approach taken here contrasts with research such as Hahn et al. (2014), which examines internal conflict and dispute as to whether firms should adopt sustainable or responsible business practices. A further type of firm would be those that actively lobby against these policies. Instead, the focus here is on firms that have adopted SSCM, but in terms of the unit of analysis, the focus is on organisations rather than individuals. Considering this issue during case selection meant requiring firms that could be assumed to have a homogenous and uncontested dominant logic, in contrast to those where such logics are contested internally. This was found to be particularly evident in large corporations, particularly where there were two or more distinct product divisions (clothing and food, or household products and pharmaceuticals, for instance). The interviewees in each organisation are in senior roles where they can be said to be speak for the organisation as a whole in terms of their SSCM policy. Job titles are detailed in Table 20.

There is a body of research on managerial cognition based on the idea that organisational decisions are all ultimately made by individuals, even in group decisions (Barr, Stimpert, & Huff, 1992; Eggers & Kaplan, 2013; French et al., 2009; Hodgkinson & Healey, 2011). This

echoes moral philosophy such as that of Jean-Paul Sartre (1956) that responsibility resides at the level of the individual, which is noted by Joullié (2016) as one of the philosophical foundations of Western management thought.

However, the unit of analysis in this thesis is the level of an organisation and its wider context, with the dominant logic being an attribute assumed to be possessed by a firm. The assumption is that the decisions that individuals face are shaped by the internal dominant logic of the organisation and the perception of the external environment. The questions are about how the organisational culture shapes decision making, not how individuals face decision making issues. Personal values are therefore excluded here, although this is a significant area for research.

This thesis is ultimately concerned with trying to understand how organisations might be able to affect positive change in the meeting of the objectives of sustainable development. The means to address this is by exploring the nature of simplicity, complexity and control in SSCM. Decision making by definition requires that a decision maker has the authority to put a decision into action, and hence, decision making is about understanding the nature of control. What the Cynefin framework and previous parallel contributions (see Table 10) do is to show where the limits to control may be.

Sustainable development, which, by definition, PB are assumed to be a necessary condition for, suggest a need to take control of an out of control system. However, the presence of bounded rationality in the form of uncertainty or ignorance about basic data, or complexity, poses the possibility that progress on sustainable development is more likely to occur through emergence than control. Do any firms appear to have control over their SSCM in a way that can make a substantial contribution to PB, or, in this thesis, PB+SF.

As shall be discussed in Chapter 4 and 5, this includes the competitive context, the position in the supply chain and relative strength or level of influence therein, and the regulatory, reputational or other stakeholder or institutional context. Therefore, whilst the primary data is interviews with individuals in organisations, plus secondary data in the form of documents etc., the unit of analysis is the organisation as a whole in the context of its supply chain.

A further point on the unit of analysis is that it relates to the organisation and its key decision makers in relation to its supply chain. The supply chain is also considered in relation to its connection to PB+SF impacts. There is thus a multiple level of analysis inherent in the research. Carter et al. (2015) argues that SCM research should conduct more multi-level theorisation, saying, "*investigations that employ single-level theorizations potentially restrict our understanding of complex SCM phenomenon and systems.*" (ibid. page 93). While they provide a typology of different scales as individual, team, function, organisation and supply chain, the research in this thesis extends this range to also consider sectors (the horizontal in addition to the vertical of the supply chain) and then the social and ecological scales.

A degree of multilevel theorization is thus inherent in the attempt to address the challenge of 'Kleindorfer's Bridge' (Cohen & Kunreuther, 2007) addressing the divide between micro-scale organisational level action and macro-scale social and ecological impacts. In this thesis, the focus is to consider the barriers to such a bridge presented from the perspective of organisational decision makers within a given organisational dominant logic.

Case formation and the organisations included

The remainder of this chapter describes the cases selected, how they were selected on the basis of PB+SF, plus an overview of the data collected, and potential data that was not pursued. Continuing from the research provided in Chapter 2 on the links between sectors and PB+SF, the micro to meso to macro level analysis shown in Figure 8, the next section further elaborates the link between individual firm SSCM activities and PB+SF outcomes. A fundamental aspect of the research is that the cases outlined are exploratory. Sampling is designed to be theoretical and iterative, rather than providing comprehensive coverage of, say, the UK economy. The following section describes each case in relation to the meso scale of sectors and supply chains and the macro scale of the PB+SF categories for sustainable development, and the related rationale used. Thereafter, the organisations forming each case are described, including their specific supply chain relationships. Finally, limitations encountered to data collection are described.

Case 1: Social foundations and Biodiversity in electronics and extractives supply chain

(PB+SF focus = creation of upstream negative impact)

The first case was selected as providing a powerful example of the social and environmental impacts that can result from new industries. Electronics, whilst one of the most profitable and rapidly growing industries in history, has been criticised for a range of dire social and environmental impacts in the supply chain. The metals and minerals used to make micro-chips and other components of electronic devices include many that are extracted via crude, labour intensive practices in developing economies in artisan conditions, some of which include human rights abuses, use of child labour and environmental problems (Reinecke & Ansari, 2014).

The recent high profile of 'conflict minerals' has revealed a major social challenge for international development priorities and associated environmental impacts. PB impacts include the (criminal) hunting of primates for bush-meat in Central Africa driving increased risk of extinction (Nellemann, Henriksen, Raxter, Ash, & Mrema, 2014). One of the greatest social impacts has been how the rapidly growing demand for these minerals fuelled conflict, particularly in the Congo (Le Billon, 2013). Downstream, labour rights and human rights are also seen as potentially problematic in the labour intensive assembly plants. Also, the sector generates large volumes of downstream e-waste, substantial volumes of which have been dumped on developing countries such as Ghana and Nigeria (Nnorom & Osibanjo, 2008). These impacts in the developing world are all directly linked to the rapid growth of a new market sector in the developed world.

In the USA, legislation on transparency regarding conflict minerals has prompted the electronics, automotive, jewellery and other industries, to demand greater transparency about its sourcing. As such, organisations are required to gain greater knowledge about their ultimate supply chain. The success or otherwise of this initiative is controversial, but the change prompted by the legislation is driving a change towards SSCM (Reinecke & Ansari, 2015). On this basis, the electronics sector and its supply chain is identified for the first case study in this thesis.

Case 2: Phosphate pollution from detergents (FMCG supply chain)

(PB+SF focus = abatement of downstream negative impact)

One of the surprising aspects of the PB framework is that while greenhouse gases have a high profile as an environmental issue, the impact of artificial nitrate and phosphate flows has been almost wholly invisible as an issue in environmental campaigning or business and management research. The mining of phosphor and artificial processing of nitrates (from atmospheric nitrogen via the Haber-Bosch process) are central to the creation of fertilizers, which have enabled the huge growth in human population in the 20th century (Rockström et al., 2009). As shown in Table 4, phosphates have also been used in detergents and both phosphor and nitrogen are vital feedstocks for many other chemical processes.

Where Case 1 focussed on upstream supply chain impacts, here it is the downstream waste that links PB to firm activity. Nitrates and phosphates discharged to water courses have an impact on ecology, such as eutrophication of rivers, lakes and tidal estuaries and the growth of toxic blue-green algae. These impacts damage bio-diversity and also create health risks for people. This artificial biogeochemical flow has occurred at a volume that is having a highly disruptive impact on nature and is classified as a critical PB where level of pollution is higher than that which the natural environment can cope with and maintain stability (Steffen, Crutzen, & McNeill, 2007; Steffen, Richardson, et al., 2015). Phosphates were added to detergent as a water softening aid so the associated environmental impact on downstream waterways appears out of scale with the benefits.

Within the Fast Moving Consumer Goods (FMCG) sector phosphate-free detergents have been developed on the grounds of being more eco-friendly (2.1.3.1). This suggests a significant attempt to address this planetary boundary issue so was investigated as the second case. FMCG firms are also a major feature of modern consumer society, so the attempt to reduce their environmental impact is a worthwhile area to explore. In the example of detergent, historically, soaps were made from animal fat with whale oil being a particularly lucrative source. Increased exploitation of petrochemicals in the 1920s provided a huge expansion for detergents. The FMCG sector is thus built on the growth of the fossil fuel sector, in terms of both raw materials for manufacture and packaging, and the fuel to transport these mass-produced goods to markets.

Case 3: Habitat loss from the food supply chain

(PB+SF focus = abatement of upstream negative impact)

The social and economic importance of the food sector is well-captured by the aphorism, "*no society is ever more than three meals away from anarchy.*" Uninterrupted supply is an issue of national security. Globalisation of food commodities has been a source of wealth creation, facilitated by global logistics. However, the resulting land-use changes and greenhouse gas emissions from agriculture and associated logistics have a significant environmental impact.

The food sector acts across all of the critical PB, as the user of phosphate & nitrates for fertiliser, driving species extinction by habitat loss in developing economies, and greenhouse gas emissions from farming and transport. The social impact is more complex, with the economic benefit of world trade potentially enabling social progress, but with a degree of variation and contextuality (Kenny, 2012). Produce grown in East Africa for export to the West, for instance, may provide valuable financial flows and employment throughout the supply chain, that is an important enabler of social and economic development according to the international development indicators in the PB+SF framework for sustainable development (Sellahewa, 2010).

The scale of demand to meet basic need for a rising world population is a fundamental human right at the core of sustainable development. Future development, ranging from the organic movement to bio-tech and genetic modification show how contested the concepts are, hence an example of complexity in sense-making. Food issues are also subject to particular psychological bias due to cultural and instinctive reactions around hygiene and disgust, adding to the perceptual characteristics of this issue and hence the role of bounded rationality (Curtis & Biran, 2001).

Case 4: Greenhouse gases from transport and the services supply chain

(PB+SF focus = abatement of downstream negative impact)

Mechanised transportation is one of the main foundations of the modern world, enabling ever greater global supply chains. Halldórsson, Kotzab, and Skjøtt-Larsen (2009) thus

describe supply chains as a major contributor to un-sustainability. Hence, logistics is an important sector in light of greenhouse gas pollution and climate change (PB3). However, as noted in Sellahewa (2010), from a sustainable development perspective there is considerable ambiguity because global trade is also the enabler of economic activity, which is a primary way in which communities in emerging economies can be lifted out of poverty (Kenny, 2012).

At the UK level, transport is almost exclusively powered by fossil fuels. Besides the CO_2 emissions that vehicles emit directly to the atmosphere from their exhaust, there is also particulate air pollution (incl. NO_x and carbon monoxide) that has a dramatic health impact (DEFRA, 2015). Air pollution, global warming, and indeed, traffic accidents, are all negative impacts resulting from modern transport.

The impact of greenhouse gas pollution from transport can be regarded here as a downstream impact resulting from the distribution of goods ahead of their consumption. Clearly, transportation occurs at all levels of a supply chain, both upstream and down. Going back up the chain as far as extraction also involves greenhouse gas pollution, such as from flaring at oil wells and gas fields, and leakage from gas pipelines, etc. However, the sector explored in this case is logistics services and the means by which it seeks to reduce its impact.

Case 5: Greenhouse gases from buildings and electricity generation

(PB+SF focus = abatement of upstream negative impact)

In economic terms, construction and real estate are a major component of the national economy, providing a central investment opportunity for speculative capital, and creating the facilities needed for other economic activity to take place, offices, factories, shopping centres, cinemas, etc. Besides buildings, civil infrastructure and transport networks are all delivered by the construction industry. The construction supply chain therefore begins with the extraction of raw materials (notably for steel and concrete).

In terms of PB, buildings are the source of greenhouse gas pollution, via direct CO_2 emissions from gas-fired heating systems, and indirect CO_2 via the electricity consumed for cooling, lighting and the activities related to their use. Buildings are highly varied in their

uses, but energy-efficient design including improved insulation, better glazing (or shading) and various technical systems, can reduce the operational energy demand of the building and thus its associated carbon footprint. In some cases, onsite renewable energy systems provide a clean energy source to substitute indirect emissions via the National Grid.

Where Case 4 concerned the management of greenhouse gas emissions from transport, Case 5 examines those associated with buildings. There are two elements to this. There are those associated with heating buildings via direct combustion of fossil fuels. Gas central heating, where the greenhouse gas methane is burnt onsite to heat water, is the typical energy source for buildings in the UK.

Then there are those associated with the use of electricity within a building. This is generally an off-site source, and thus refers to the greenhouse gases associated with power stations. The mix of large-scale energy technologies at a national level is central to the relative performance of these, known as the carbon intensity of grid electricity. Table 6 shows the rate for different countries.

Off-grid micro-generation and grid-connected micro-generation are examples where building owners add energy generation technologies, such as solar photovoltaic panels, or combined heat and power units that burn material such as wood or waste to generate heat and electricity. This can reduce the demand that a building has from the national grid. However, acknowledging the greenhouse gases associated with the manufacture, delivery and connection of these micro-generation technologies, and their larger, grid-scale versions, is part of a necessary calculation as to the effectiveness and payback periods for these technologies as sources of greenhouse gas abatement. Processes of life cycle analysis are an important part of this assessment (Guinée, 2001; Lim & Park, 2009).

Two strands to the final case exist in relation to buildings and greenhouse gases. The first is the thermal efficiency of buildings. Improving the level of insulation and amount of daylight entering a building can reduce the demand for heating and so lower its associated greenhouse gas pollution. This is common practice for certain types of new building in the UK as a result of regulatory reform of the construction and planning sectors from 2006 onwards to take sustainable development into account. Certain levels of thermal performance have become mandatory for certain types of buildings.

As with alternative electricity production technologies, any greenhouse gas generated with the production of materials needed to reduce the energy demand ought to be considered as well in order that there is a net reduction in greenhouse gases. As such, life cycle analysis of the materials used in constructing a building must also be considered.

The second strand relates to electricity consumption, which at the level of an individual building is set against the national carbon intensity of the electricity supply. For the products used in construction (steel frames, glazing, brickwork etc.) the associated manufacturing techniques can demand a high consumption of electricity and so the associated greenhouse gas footprint is a significant and relevant aspect of the overall attempt to address the performance of a building in terms of greenhouse gas pollution.

The UK construction sector has had more than a decade of regulation helping to improve performance and advance sustainable development. Some large manufacturers of construction products are also subject to the EU Emissions Trading Scheme (EU-ETS), and others by the UK Energy Savings Opportunity Scheme (ESOS). Both of these aim to drive reduction in energy consumption through efficiency gains using the catalytic influence of a carbon tax, assigned per mass of CO_2 produced per year by the organisation's direct and indirect emissions.

Selection of organisations with each case.

Case 1

The first organisation is an established and highly profitable designer of components used in consumer electronic devices including smart phones. The firm expressed a strong interest in SSCM. As the interview found that a major aspect of the firm's SSCM policy was related to conflict minerals, data triangulation was established via an interview with an extractives trade association (Organisation 1.2). This revealed significant insights into the difference between the DL in the electronics and extractives sectors and so is included as a second informant organisation.

Organisation 1.1 Electronics Designer

The electronics company has offices around the world, employing highly skilled engineers who design the components. Manufacturing and subsequent testing of these is outsourced to fabricators in the Far East. These are high precision operations, taking place in ultra-sterile conditions, with low numbers of highly-qualified machine operators. The components are then sent onwards to assembly plants, also in the Far East, where they are brought together with hundreds of other components and sub-assemblies to form the consumer product, which is then shipped to retailers on behalf of the Mobile Phone OEM. The assembly element is labour intensive and so the supply chain has developed in countries with a large workforce and low labour cost, notably China.

Figure 10 shows that as a component designer, no physical product flows through the Electronics company (Dashed line = contractual relationship from the focal firm. Solid line = supply contract and physical flow of material.). Instead , it merely provides specifications to the fabricator, and has a contractual relationship with the fabricator, assembler and OEM. Immediate downstream impacts include social factors relating to working conditions at the assembler. Upstream impacts highlighted by NGOs and regulators occur higher up than Tier

3 shown here, at the point of raw material extraction, which passes through a number of markets before being purchased by a materials supplier.

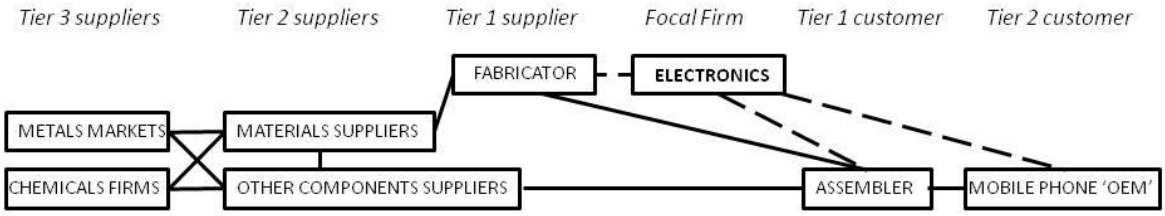

Figure 10: Supply chain for Case 1

Organisation 1.2: Extractives Industry Trade Association.

To provide triangulation and juxtaposition, a trade association representing the extractives industry, with an expert perspective on conflict minerals and SSCM, was interviewed. This data is taken to represent the sector as a whole rather than a single company. Despite this difference in the level of analysis, a useful contrast is provided on the nature of companies in the extractive sector. Significantly, the decision making culture in this sector is in marked contrast to that in the engineering dominated culture seen in the Electronics Company, and as later cases show, manufacturing companies more generally.

Case 2

Organisation 2.1 FMCG manufacturer

The second case explores a firm that demonstrates strong ethical and environmental practices and promotes products on the basis of their low impact (2.1.4.2). A pro-active SSCM policy is seen as part of the culture of the organisation. This includes collaborating with large, mainstream suppliers to encourage them to develop greener alternatives, such as in packaging or in product ingredients (2.1.4.1) (Figure 11). They also engage in capacity building initiatives with smaller suppliers and customers (such as distributors and retailers), to help encourage greater energy efficiency in their operations such as via grant schemes (2.1.4.3).

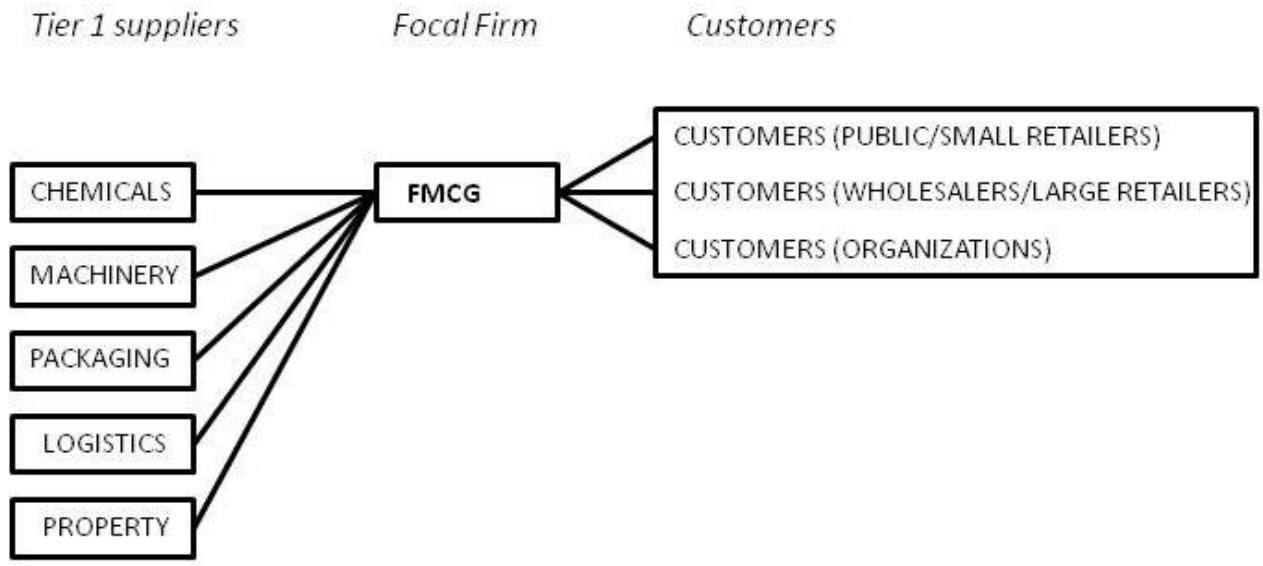

Figure 11: Supply chain for Case 2

Case 3

Organisation 3.1 Restaurant

The focal firm in this case is a high street restaurant chain. It is an international company, linked to globalised supply chains, with a high volume of throughput. However, it is also aware of its role in this wider supply chain and to a small, but growing, degree concerned with looking ahead at its future sustainability and provenance. Dependency on large agro-business upstream and macro-trends relating to global supply and demand has prompted attention as to possible future changes, particularly for Tier 2 suppliers of feedstock (especially soya) to Tier 1 livestock suppliers.

Other SSCM initiatives address downstream impacts relating to food waste disposal passed to charities (for food that is still fit for consumption, or to anaerobic digestion energy plants where they contribute to generation of 'bio gas' that can replace fossil gas, so is a form of greenhouse gas mitigation'). In contrast to Case 1, where the SSCM initiative was run by a board-level director, and Case 2 where the whole company was fully engaged with SSCM, here there is only a small middle-management team driving SSCM activity. They operate with the full support of senior management, but do so in relative isolation. They are

passionate about the issues and are aware of current debates in sustainability, including PB, but the level of awareness in the wider firm is very low (3.1.3.1, 3.1.3.2). Both the agricultural sector innovation project, food waste bio-gas schemes and charity donation, and other work, such as energy efficient innovations for kitchen plant, such as extractors, are all scalable across multiple firms if successful.

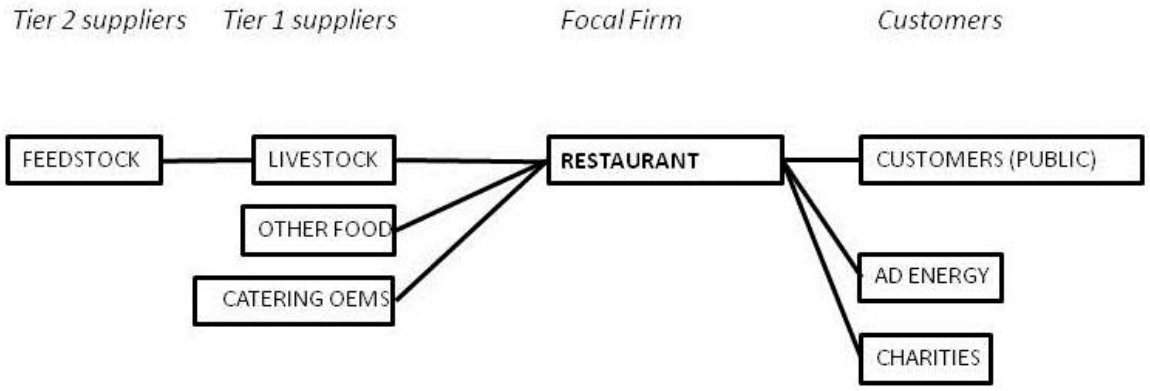

Figure 12: Supply chain for Case 3

Case 4

Organisation 4.1 Bank

Case 4 consists of two companies in a dyadic supplier relationship, a bank and their logistics services supplier. Both are far larger organizations than in any of the first three cases. The bank (Org 4.1) has significant numbers of staff dedicated to SSCM issues across multiple divisions of the group. Both firms are also representatives of different service sectors, finance and transport. The relevance to PB is that the transportation sector represents a significant proportion of a national carbon footprint. The experience of this SSCM initiative to cut carbon from transport thus offers insights scalable across the wider transportation sector, including the political, economic and technical barriers.

The bank has a large supply chain and procurement team, more than 100 staff strong, involved in dealing with strategic suppliers across typical category areas such as advisory services, security, IT services (including the cash machine network) and logistics. Besides

numerous strategically important suppliers there are more than ten thousand suppliers considered too small to be managed by the supply chain department, procured at a local level.

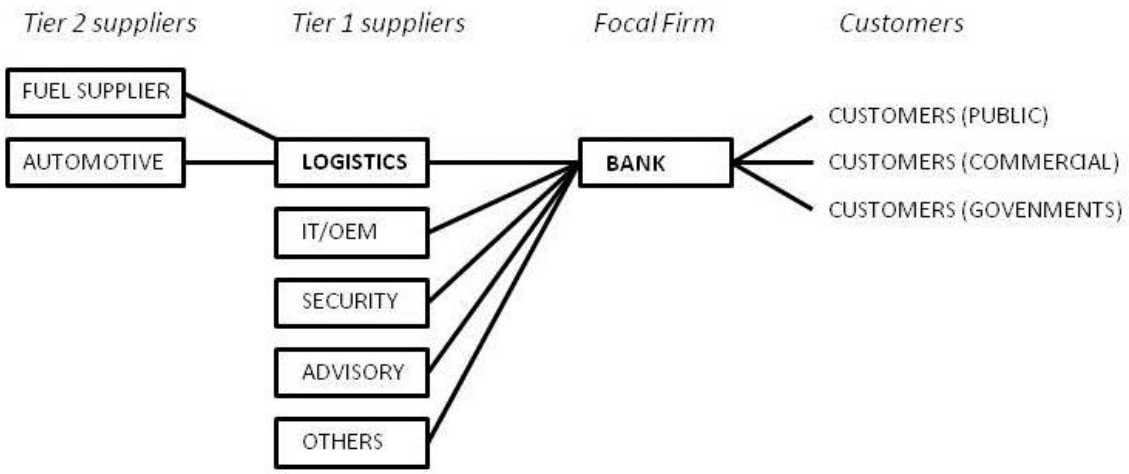

Figure 13: Supply chain for Case 4

Organisation 4.2 Logistics Services Firm

The firm is a major international logistics services provider. They have been responsible for running the delivery network for the Bank (4.1) for many years. The firm also supplies logistics services to numerous other sectors, including high street retailers. Fuel is the second highest expenditure of the firm after workers salaries. Besides relationships with fuel suppliers, including the running of fuelling stations for their fleet, the firm also procures a certain volume of vehicles from automotive suppliers per annum, but since the financial crash of 2008, assets have been kept in operation for longer.

To provide triangulation, a trade association representing the logistics industry, with an expert perspective on carbon reduction and developments in the automotive sector, was interviewed. This contribution validated responses from Org 4.2 but was not regarded as providing insight into a different sector as with the trade association in Case 1, Org 1.2.

Case 5:
Construction sector and electricity generation supply chain

The final study looks at the construction sector, which is identified as a major source of industrial emissions (such as in concrete and steel) and via the way that buildings consumer energy, which can be affected by the way they are designed. This project sought to examine the supply chain and operational impacts by looking at the construction project for a particular new building designed to a high standard of 'eco-design'. The contractor hired to build the building is Organisation 5.1, and in addition the client who commissioned the building, and the architect firm hired to design it, are interviewed (see Table 20).

Insights from the performance of the building itself are readily scalable to other new build and refurbishment projects. Yet, as with previous cases, taking a singular focus on the carbon footprint of the building in isolation is similar to that of the carbon footprint of a firm in isolation. Instead, the footprint of the whole supply chain must be considered, and so the relative carbon footprint of the construction materials that went into the building are relevant too.

Construction projects involve a very large range of materials from a wide variety of suppliers, depending on the design specifications. Organisation 5.2 is a large manufacturer of construction products. The most detailed investigation was possible here with multiple interviews with a wide range of staff. In addition, customers and supplier meetings regarding SSCM policy and two internal working group sessions on SSCM were also attended.

Having identified that the largest aspect of the manufacturer's environmental impact was that associated with their electricity supply, interviews were then conducted with their energy supplier, with triangulation and juxtaposition provided by an alternative large customer. The full form of this case is shown in Figure 14.

At the time of the data collection, a change in electricity supply contracts was underway, and a contested area for definitions of sustainability was seen in the first supplier's use of nuclear electricity as a source of low-carbon power. While this difference was accepted by the alternative large customer (a rail network company), it was not addressed by the construction products manufacturer (5.2) due to regulatory and economic barriers. As such,

the opportunity to establish a carbon-free manufacturing process was effectively prevented by regulatory barriers. The status of nuclear power as a source of carbon-free power has become a controversial point by the result of the wind, solar and biomass industry aligning with environmental campaign organisations that were first established as anti-nuclear organisations. The evidence base for the link between the role of nuclear power and the relative carbon performance of an economy is shown in Table 6.

To better understand the related regulatory and sociological issues behind this apparent barrier, the third part of the case concerns a chemicals service supplier, Organisation 5.3, into the first electricity company. This chemical company provides services related to the supply of nuclear fuel that enable the supply of large volumes of carbon-free electricity around the world. However, the contested nature of this definition of sustainability and related institutions such as the legislative context and public understanding, make this a highly salient issue for behavioural and rational decision making around SSCM. Whilst the manufacturer (Org 5.2) has the potential to take carbon out of its supply chain, there are external constraints to their doing so that involve both external influence on decision making and bounded rationality.

Organisation 5.3 is included as a case company because their policies on sustainability inherently involve addressing these issues of contested definitions. Plus, their impacts are substantial in relation to PB to a far greater extent than previous cases. Thirdly, as a chemical engineering firm operating in a highly regulated industry the dominant logic established is strongly rules based. But it has to engage with the values of the communities where it operates. This draws a relevant polar contrast to various attributes established by previous cases. It thus forms a keystone case for the research, illustrating a point of saturation. The following section gives a fuller description of each organisation in Case 5 and its context.

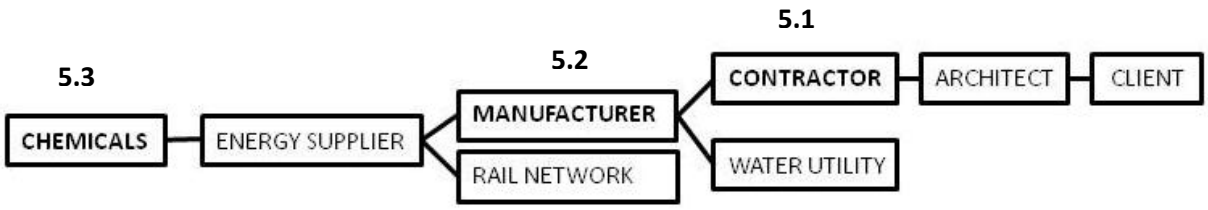

Figure 14: Supply chain for Case 5

Organisation 5.1 Construction Contractor

The construction sector supply chain is distinct from that of a linear manufacturing process. It is similar in some ways to the electronics designers supply chain in Case 1. The architect is the building designer, who plays a creative and co-ordinating role, working with the client to determine the characteristics of the building and the associated technical specifications and regulatory compliance. This design and technical specification is then passed on to the contractor who will build the building, in the same way that the fabricators in Case 1 manufacture the electronic components. In this case, the same architect was then hired as a sub-contractor to the contractor to advise throughout the following stage during the build process. This often helps ensure projects stay within budget and schedule, especially when innovative designs or technologies are incorporated.

This particular project was also built using the BREEAM eco-building standard. This involves some material specifications as well, and so the architect plays a role in specifying particular products, although it is the responsibility of the contractor's quantity surveyor (similar to a purchasing manager in manufacturing). Significantly, the actual purchasing of materials is largely the responsibility of sub-contractors, who are the specialists in building the various different components required by the particular design (foundations, glazing, mechanical services, plumbing, etc.). This is because there is less waste from breakages etc. when the cost of these materials is factored into the subcontractors fee (5.1.2.1). The contractor therefore acts as a project manager for a building project, bringing together a diverse number of sub-contractors according to the needs of a job, and being responsible for delivering it to budget and schedule. In Figure 15, the dashed line indicates relationship based around exchange of information rather than materials (solid line).

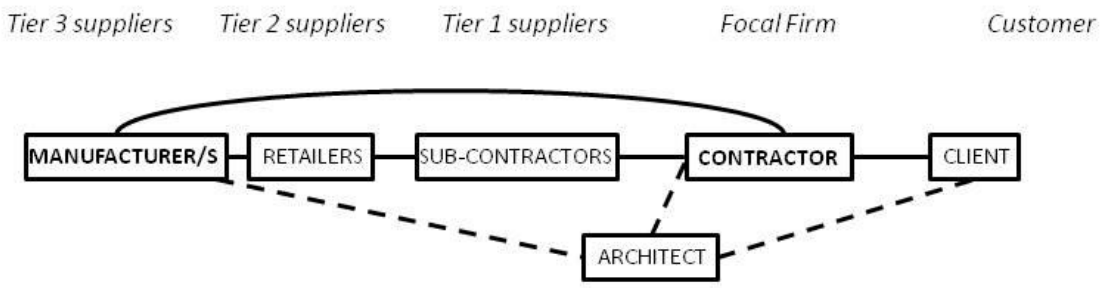

Figure 15: Supply chain linking Org 5.1 and 5.2

Organisation 5.2 Construction products manufacturer

The firm is a large, international manufacturing company with a number of facilities in different countries, and competing in global markets. Its upstream supply chain includes specialist chemicals and some commodity providers, but the inputs of the business are also subject to a high degree of vertical integration (where it owns extractives operations) or closed loop recycling, where it reprocesses materials rescued and reprocessed from building demolitions and a wide range of other waste streams (5.2.3.1). Downstream, its customers include the contractor and subcontractor sectors (as in part 1 of this case), who procure either in bulk direct from manufacturers or via retailers. A second large customer type are volume house builders and infrastructure companies, such as water utilities and transport network providers. In Figure 16, bold indicates organisations that were interviewed.

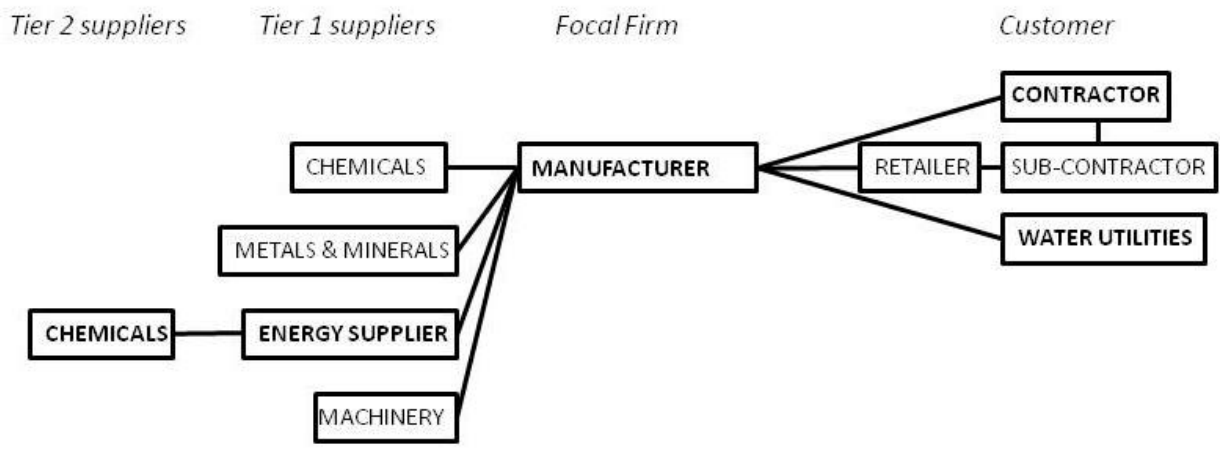

Figure 16: Supply chain linking Org 5.2 and 5.3

Organisation 5.3 Chemicals services for electricity generation

As the largest environmental input into the manufacturing firm is found to be their energy supply, the case continued on this upstream branch of their supply chain. As this stage of the supply chain is outside of the construction industry, the economic and PB+SF context is restated. The electricity generation sector is an important part of the challenge of reducing greenhouse gases driving the planetary boundary of climate change. Decarbonising electricity generation is a precursor to then decarbonising transport and heating, via substitute technologies running on electricity, such as battery electric or hydrogen vehicles, and electric heating & cooling systems.

As noted in Table 6, alongside hydro power from mountain reservoirs, the largest current source of carbon-free electricity is nuclear power. Org 5.3 provides essential chemical processing services enabling around 30% of the global nuclear sector. For a single company, this impact on PB is clearly substantial and orders of magnitude greater than that provided by any other case (Kharecha & Hansen, 2013). The firm's customers are the electricity generating companies, who are large utilities. Whilst Org 5.3 is a supplier to the electricity sector and holds a nuclear materials licence, they are formally part of the chemicals industry, as opposed to the energy industry, and so are referred to as such in this thesis.

The customers of Org 5.3 purchase materials for processing directly from suppliers in the extractives industry. Org 5.3 is therefore a service provider, rather than a manufacturer as

they do not own the materials that are processed and then sell them on to the utilities (5.3.3.3, 5.3.4.1). It is also notable that a by-product of the nuclear fuel processing is sold into the plastics industry. Figure 17 shows the supplier relationship, where dashed lines indicating contractual relationship and solid line indicating movement of material (or electricity in the case of customer to consumer)

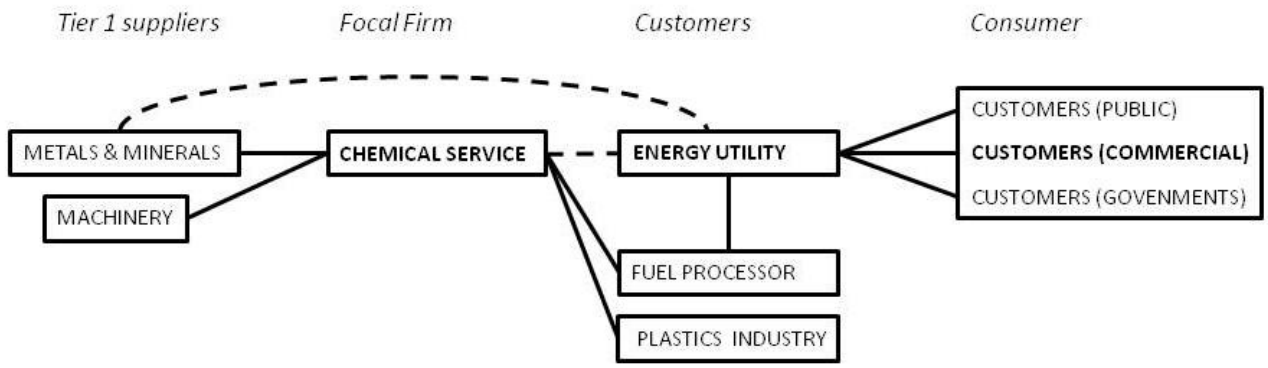

Figure 17: Supply chain for Org 5.3

Limitations to data collection

According to the research methods outlined earlier in this chapter, a number of conditions for data collection were called for. Firstly, multiple sources of data to enable validation via triangulation, juxtaposition and iteration (Pauwels & Matthyssens, 2004). These are outlined in Table 20. Secondly, an ideal case should demonstrate multiple tiers in a supply chain beyond the dyadic relationship of a single buyer and single supplier (Miemczyk et al., 2012). This would help reveal the extent to which the firm had a visible horizon that extended to the point of the PB+SF impact.

As noted by Seuring (2008) and Miemczyk et al. (2012), there is a shortage of qualitative case study research in SCM that includes multiple tiers of a supply chain. However, it was found that while in Case 5 substantial investigation of multiple tiers was possible, and in Case 4, a dyadic relationship across two tiers was explored (including a triadic collaboration), in other cases there were significant barriers to this. The exploratory and loose nature of the research design thus showed that firms can have varying types of barrier

to supply chain transparency beyond the immediate dyadic relationship with suppliers (demonstrated in Cases 1, 2 and 3). These limits to visibility are shown in

Table 19.

#	**Barrier to multi-tier data collection**
Case 1	Geographical distance, commercial sensitivity
Case 2	Commercial sensitivity
Case 3	Commercial sensitivity
Case 4	None: Focal firm was keen to promote the dyadic partnership
Case 5	None: Clear links up and down the supply chain due to the nature of the sector

Table 19: Barriers to multi-tier data collection

In Case 1, the Electronics company had no contact further upstream beyond its first tier suppliers. They felt that the Tier 1 suppliers would be reluctant to disclose the identity of the Tier 2 suppliers for reasons of commercial sensitivity and to prevent the risk of their being cut out as a middleman. This is presumably a common issue in certain supply chains. Access to the Tier 1 suppliers as interview subjects was also difficult given they were all based in the Far East and the main contact between these suppliers and the Electronics company was made only during one annual visit. Interviewing by email was not considered as an acceptable way to gather interview data. Furthermore, as the SSCM policy was a very new one, prompted by legal changes, there was considerable bounded rationality and also very limited decision making.

Contact with the lead customers downstream, the consumer-facing OEMs, was also considered, but whilst the Electronics firm was the single design supplier of a key component, this component was just one of many in the final product and the main SSCM impact was found to be not through the design of the component, but from the sourcing of the materials used to make the product, or the assembly of the product, neither of which the electronics firm had control over. Access to other organisations in this supply chain was problematic, however, triangulation was established via a trade organisation providing expert insight into the upstream supply chain and the issue of conflict minerals and sustainable development more broadly. As the DL in the extractives industry was very

different, this was included as a case organisation, although contract with a specific mining company was not undertaken. In part, as initial contacts made were then subject to internal restructuring programmes, limiting availability. Secondly, because the nature of conflict minerals in the supply chain, and thus the example of SF impacts, is linked to artisan miners rather than large mining corporations.

In Case 2 and Case 3, the interviewees would not provide details of their upstream suppliers and enable access. In Case 3, where commercial sensitivity was cited, it is was later found that the nature of the discussions they were having with their suppliers over an SSCM initiative were subject to some co-incidental circumstances regarding confidential material that had prompted unnecessary suspicions with a resulting impact on the nature of communication. Such issues are common in the reality of inter-organisational relationships.

By contrast, in Case 4, a triadic relationship was explored (though the third party, an IT company, was not deemed relevant to include as a case organisation), and in Case 5, it was possible to explore multiple tiers including alternative customer types. Case 5 involved a large number of organisations, including customers and suppliers along many tiers of the supply chain, representing more of a network-level investigation. As mentioned above, not all organisations involved are classed as case organisations, merely as additional informants and sources of validation through triangulation.

In conclusion, whilst Miemczyk et al. (2012) call for multi-tier research, this thesis has identified some likely common barriers to doing this through deep-dive case study research. These can also be considered alongside the notion of the visible horizon as an element of supply chain theory in C. Carter et al. (2015) (

Table 19). Issues were also found in the selection of cases on the basis of the planetary boundaries framework. Although providing a fresh approach to SSCM a deeper understanding of some of the boundaries only took place as the research had become quite advanced. Notably, insight into the Nitrate and Phosphate boundary (PB2), was improved by the research, where existing knowledge in the nature of greenhouse gases (PB3) enabled more effective analysis. While discussions were held with a major supplier of chemicals to the agricultural sector, this did not develop into an additional organisation to be included in a case due to a change in staff at the company.

It was also found that as a PB, its impact in the West is less than in developing countries, where some farmers overuse fertilizers to increase output, but with greater risk of soil exhaustion and greater downstream environmental damage. Governments in many countries are aware of these issues and seek to address them, notably in China, which has become a very large consumer of fertilizer (Huang, Huang, Jia, Hu, & Xiang, 2015; Li et al., 2015; Liu & Qiu, 2007). The PB2 issue was thus seen as less relevant for the UK focus of the research.

Similarly, the biodiversity / species extinction boundary is linked to agricultural supply chains and the land use policies of national governments and global agricultural commodities. Greater insight into these was gained as a result of the investigations in the research, but from a more basic starting point than greenhouse gases. The international context required for understanding land-use change impacts also made research into the supply chain more difficult as this would involve links into commodity traders and associations concerned with issues of habitat loss.

Again, contact was made with an import broker, and with experts in sustainable issues in agriculture, but these did not bring forward organisations that could fit in with the existing case organisations. The link between land-use change, such as deforestation, resulting in the habitat destruction driving species extinction, is a substantial and problematic aspect of PB+SF. The nature of global agricultural demand for food and link to supply of land has important characteristics. It is closely linked to national land-use policies, established by government with a varying degree of control, and to the nature of demand. It also has seasonal fluctuations due to weather, and can be subject to price volatility. This context is under-explored in this thesis.

An issue around the role of Extractives in meeting the SF needs was also encountered early on, but the significance of this only became apparent later. As an example of commercial alignment, it contrasts with the role of public sector provision in basic social needs such as health and education. Again, there is a wider interdisciplinary context into governance and political science that was considered beyond the scope of the focus on DT and SSCM. Each of the limitations encountered becomes a starting point for potential future work, which is returned to in the final chapter.

Org No.	Organisation	Data type	No. of interviews
1.1	Electronics Company	SRI Advisor interview Chief Financial Officer interview CSR Manager interview	3
1.1	Electronics Company	Sustainability and CSR reports	
1.2	Extractives Trade Association	Sustainability Director Interview	1
1.2	Extractives Trade Association	Annual report	
	Miscellaneous: Media and NGO	Miscellaneous	
1.1.2	Customer OEM	Responsible procurement report	
1.1.3	Electronics Trade Association	Responsible procurement reports (conflict minerals)	
2.1	FMCG Company	HR Consultant interview Managing Director interview	2
	FMCG Company	Technical specifications publications Consumer-brand related publications Company history publications	
2.1.1	Rival FMCG Company	Director of Sustainability lecture	
2.1.2	Other rival FMCG Company	CEO lecture	
	Miscellaneous: Media and NGO	Miscellaneous	
3.1	Restaurant Chain	CSR Director interviews (x4) Energy Manager interview	5
3.1	European research project	Alternative protein feedstock reports	
3.1	Miscellaneous: Media and NGO	Miscellaneous publications	
4.1	Bank	Regional Director discussion Health, Safety and Environment Manager interview Supply Chain Director interview Sustainability Programme Manager interview (x3)	5

4.1	Bank	Sustainability policy Sustainable procurement policy Annual report	
4.2	Logistics Company	Account Manager interview Head of Environment interview	2
4.2		Company environmental presentation	
4.3	Logistics sector trade association	Sustainability policy manager interview	1
4.3	Logistics sector trade association	Policy documents, technical briefings	
4.4	Automotive sector expert	Academic automotive sector expert interview	
5.1.1	Client	Deputy Director of Estates interview Project Manager interview	2
5.1.2	Architect	Architect and environmental assessor interview	1
5.1	Contractor	Sustainability Manager interview Regional Director interview	2
5.1	Contractor	Company values document	
5.2	Construction Products Manufacturer	Commercial Director interview (x4) Operations & Supply Chain Director interview Regional Sales Director interview (x2) Regional Sales Manager interview Energy Buyer interview (x2) Operations Manager interview Process Manager interview Process Manager interview	13
5.2	Construction Products Manufacturer	Annual report Sustainability report	
5.2.2	Water Utility (customer)	Category buyer interview Sustainable supply chain manager interview Customer-Supplier meeting	2
5.2.2	Water Utility (customer)	Sustainable procurement report	
5.2.3	Electricity Supplier	Account manager interview (x2)	2
5.2.3	Electricity Supplier	Marketing documents	
5.2.4	Rail operator (Alternative electricity customer)	Sustainability consultant	1

5.2.4	Rail operator (Alternative electricity customer)	Sustainability Report Government policy documents	
5.3	Chemicals Company	Chairman interview Communications Director interview	2
5.3	Chemicals Company	Marketing documents	
A	Multinational Trade Association	Sustainability reporting expert	1
A	Multinational Trade Association	Annual reports Sector-specific reports	
B	Multinational Responsible Sourcing Firm	Managing Director SSCM services interview	1
B	Multinational Responsible Sourcing Firm	Annual reports Sector-specific reports	
			Total = 46 interviews, 35 people

Table 20: List of primary and secondary data gathered.

Chapter 4: Findings

This chapter serves to describe the data gathered on a per case basis. The following chapter then provides cross-case analysis. Each case is described using the structure of the three central issues, the organisational description of sustainability and how it relates to PB+SF, the SSCM initiatives being undertaken, and the dominant logic for decision making. Emergent concepts appearing from the case data are then provided. The formatting of this chapter includes bracketed references to numbered sections of the accompanying abridged selection of the primary interview dataset provided at the end of this manuscript in Appendix B. The reader can refer to these to see the supporting evidence in a wider context.

Case 1: Org 1.1 Electronics Designer

Description of sustainability within the organisation and how this relates to PB+SF issues

The annual report and the interviews cover a broad range of areas included in their definition of sustainability and corporate responsibility. This includes philanthropic work with local communities, which is employee oriented, and supporting training for teachers in STEM subjects, which aligns with long-term strategic interest (due to falling levels of take-up of electronic engineering courses, in favour of areas like software engineering). Risk, resilience and business continuity planning is also included as an SRB issue. Some awareness of ethical/moral issues in the ultimate supply chain is mentioned in the interviews but the focus is primarily on legal compliance.

In terms of the environmental impact of its supply chain, the company described the electronics business as a dirty industry (1.1.1.1). Their strategic focus on quality answers this in that high quality suppliers should be best at pollution control (1.1.4.7). An additional, prominent focus in company literature was on cutting their energy consumption. This is both for the operational carbon footprint of their offices, and cutting the energy demand of the components for their customers. This was justified as an environmental benefit by helping reduce downstream energy and carbon of the end products in use (1.1.3.1).

However, the total volume of this benefit and the scale of this in perspective to anything else is not provided.

The approach taken to SSCM initiatives is linked to engineering performance management (1.1.2.1) and although work was underway to integrate GRI and UNGC standards to improve investor relations, their main driver for SSCM is to meet customer requirements for corporate social responsibility (CSR). These social aspects were the main reason why this case was selected, and these became the immediate topic of conversation in the first interview, unprompted by the researcher.

Description of how SSCM initiatives are being undertaken.

The main means by which the firm SSCM is through their supplier contracts, and the degree of influence is extremely limited (1.1.4.1). Although the firm has strong strategic partnerships with suppliers, based on the need for long-term capacity building to ensure suppliers can meet future demands for expansion in business, influence over how suppliers operate and visibility beyond Tier 1 is extremely limited. The focal firm is only able to specify on the basis of technical performance of materials, not how they are delivered or where they are sourced from (1.1.4.5). The Tier 1 firm is under no obligation to reveal their Tier 2 suppliers, in part for reasons of commercial confidentiality. The SSCM policy is therefore limited to merely passing on the downstream customers' legal requirements for disclosure over the use of conflict minerals into their supplier contracts (1.1.4.2, 1.1.4.3, 1.1.4.4).

However, collaboration is well established and has led to efforts to substitute gold with copper. This has negligible impact on performance but is not a conflict mineral, making disclosure easier, and is cheaper, hence has an economic benefit. This substitution to a non-regulated alternative with additional cost benefit shows a firm-focussed benefit, but side-steps the issue of conflict minerals as one requiring a societal-focussed benefit. Notably, other companies in this sector have engaged in the issue as one where they can seek to address the social (Soc) impact via CSR work with organisations such as trade associations, government organisations and non-governmental organisations.

Example SSCM Projects	Stage	Drivers	Barriers
1: Internal KPIs aligned with investor standards such as GRI and UNGC.	Well established	Strategic interest in attracting finance	None noted
2: Supplier contracts require disclosure of conflict minerals.	Well established	Customer requirement, driven by legislative change	No capability to monitor compliance (bounded rationality data availability?)
3: Supplier collaboration to eliminate the use of conflict minerals, such as the substitution of copper for gold.	In development.	Reduce cost of compliance, and cost of product.	None noted

Table 21: Example SSCM Projects Org 1.1

Description of the dominant logic regarding decision making for SSCM.

The firm has an organisational culture that is dominated by electrical engineers. 75% of the employees are engineers, and this reflects in the mindset and attitude of the firm. The nature of the relationship with the supply chain is repeatedly described in terms of contractual compliance. CSR is also seen as a challenge in this regard. The obligations being pushed by the powerful OEM customers to consider issues beyond the traditional commercial aspects of a contract is a challenge for the company (1.1.4.1). As the Finance Director describes,

> "*One issue that I've got is when I look at my organisation, it's not in the DNA to do CSR. Of the group or the individual*." (1.1.8.1)

The CSR manager echoes this view, highlighting the challenge of implementing something as holistic as CSR into a mindset that is fundamentally mechanistic and reductionist (1.1.8.2). This shows that the culture of the organisation is dominated by an engineering mindset. This is also reflected in the approach to supplier relations regarding SSCM. It is merely something to be factored into the contracts and compliance is expected.

The firm has recently moved from the central domain of the Cynefin framework (domain 0: uncertainty) to make a notably simple and bureaucratic response (domain 1: simple-structured). The expectation is for suppliers to be contractually required to comply even though no auditing of compliance is possible (1.1.4.1, 1.1.4.2, 1.1.4.3, 1.1.4.4). This SSCM

process is therefore limited to an administrative procedure. Similarly, signing up to external standards such as the UNGC involves an essentially bureaucratic process (1.1.4.4).

There is no mention of values as forming part of any decision making processes in the company, although the board member interviewed is clearly driving the issue within the organisation. They recognise ethical obligations and potential reputational risks to the whole electronics sector due to working conditions elsewhere in the supply chain. The interest and the potential to do more in the future is clearly there, yet the actual actions put in place are limited (1.1.9.2, 1.1.9.3). The firm is also unaware of activities relating to these issues elsewhere in the sector, particularly those coordinated by some of the major trade associations in this sector (1.1.9.4).

Emergent concept: Role of external influences on the SSCM decision making process

The firm's main driver for SSCM is a strong reaction to changing customer requirements, themselves imposed as a result of coercive legal change. This has pushed the focal firm to act as a proxy, forwarding the requirements over conflict mineral disclosure down the supply chain. Because they do not have the means or incentive to check this compliance, their attitude, at least in the short term, is merely to de-risk their legal liability by being able to claim that they had obligated their suppliers to be compliant. The approach is simple and bureaucratic, although the conflict minerals problem itself is complex and unstructured. The approach taken is therefore *de minimis* and reflects a rules-based, compliance response rather than a values-based, conviction response. Decision making on SSCM is thus constrained by this external influence. Regardless of the internal DL, specific SSCM issues are imposed from outside and it is this that has shaped the SSCM policy.

Summary

- Organisational definitions relating to SSCM are energy efficiency of products in use, local community philanthropy, STEM subject strategic philanthropy, compliance to conflict mineral laws, harmonisation of internal metrics with UNGC and SRI standards.
- Firm SSCM policy on conflict minerals is primarily reactive and indirect.

- On philanthropy it is strategic and proactive, but not related to conflict minerals.
- As such the firm activities on PB+SF, with a focus on Soc, are weak.
- Reasons for weakness appear to be due to a lack of knowledge and weak position in the supply chain.
- Lack of knowledge may constitute an instance of bounded rationality.
- Dominant decision making logic is structured and simple with no use of values for decision support.

Case 1: Org 1.2: Extractives Industry Trade Association

Description of sustainability within the organisation and how this relates to PB+SF issues

In terms of definitions of SRB and SSCM, these are reported as highly heterogenous with a wide variety in the extractives sector between pro-active companies, reactive ones and inactive (or even counteractive) ones (1.2.3.1, 1.2.3.2, 1.2.3.3, 1.2.3.4). However, as a result of the Dodd-Frank regulations, their focus has narrowed in on conflict minerals to the relative exclusion of other sustainability issues (1.2.4.2).

This suggests that, as seen in the Electronics Designer, a wide perspective on the whole life cycle - or ultimate supply chain - is rapidly displaced by a specific and singular focus if prompted by a new regulatory driver. The de facto definition of sustainable or responsible business (SRB) practices that influence SSCM are therefore provided by the specific definitions of regulation. This is an act of sense-giving on the part of the legislators. Definitions become imposed, for good or ill. Conflict minerals are those ores that make gold, tin, tungsten and tantalum, but these are not exclusively mined in the 'conflict areas' of Central Africa, which the regulation seeks to address. Nor are alternative supplies from elsewhere in the world necessarily sustainable or responsible. This has been pointed out by campaigners highlighting social and environmental impacts of mining elsewhere.[3]

The definition affecting the extractives sector and its customers are both, a legal, and rather limited, definition (such as over conflict minerals), and then also a broader definition as perceived by campaigners and other stakeholders. Here we see a clear example of the contested nature of definitions affecting SSCM.

This is described not only as a divide between companies following regulatory definitions and campaigners, but one that is a living issue with organisations in the extractives sector. 'Responsibility' is also not something taken to have a strict definition. There is no legal definition, and the notion that there should be one standard applying universally is problematic (1.2.3.3). Various companies in the sector are signed up to GRI, but here what is disclosed - in annual reports - is what is materially relevant to the company (1.2.3.4). The

[3] http://www.theguardian.com/environment/2012/nov/23/tin-mining-indonesia-bangka
http://www.theguardian.com/environment/2013/apr/25/samsung-tin-mines-indonesia-child-labour Last accessed 22.01.2016
https://www.amnesty.org/en/latest/news/2016/01/child-labour-behind-smart-phone-and-electric-car-batteries/ Last accessed 22.01.2016

issue of what is materially relevant is a legal term relating to the provision of evidence in a court of law (only what is materially relevant to the case at hand may be presented). In addition, parts of the industry are creating their own standards to which they can self-certify, further highlighting the plural and contested nature of definitions in the sector.

Description of how SSCM initiatives are being undertaken.

The interviewee describes there as being three main drivers for SSCM in the sector:

- The investor community. In particular, big banks and sovereign wealth funds such as that of the Norwegians, but others also.
- Customers. In particular, brand managers focused on reputational risk.
- Strong NGOs, who push companies directly, especially the high value, public-facing brands such as mobile phone companies (1.2.7.1). Alongside this they also push the companies themselves and the investor community and the legislators (1.2.4.3).

What happens in response to this is highly context specific. For instance, the extractives industry is very active in developing mines in emerging economies. These can be areas subject to recent political change, enabling multi-national corporations to enter countries to develop the extraction of resources. Examples from recent years include Central Asian countries such as Mongolia or Khazakstan. This can involve extensive development of social infrastructure, such as education and healthcare facilities. These are often where there is an absence of provision by the sovereign government. Such social provision can enable the health and personal development of a local workforce to staff the mining operation, and to assist in community relations. The extractives industry may therefore play a significant role in delivering social goals in the PB+SF framework. However, if a proposed mining operation becomes cancelled, the companies are under no obligation to provide the social infrastructure a local community may have been expecting (1.2.6.1).

Description of the dominant logic regarding decision making for SSCM.

The extractives industry is fundamentally unstable and unpredictable. The prospecting of resources is a highly speculative activity, with a wide variety of risks. Commodity prices can be volatile and from this the justification for a mining project can be rapidly negated as the return on investment becomes too lengthy or too risky (1.2.5.1, 1.2.6.1).

This suggests that the fundamental nature of the context in which the industry operates is unstructured. There is no ready calculation that can predict the outcomes of an operation because of the underlying factors causing dynamism in the sector. Whereas the consumer electronics industry is fast-moving, with products having a short life span in the market and rapid evolution of designs in response to consumer demand, much of the underlying technology is stable. Micro-processors get incrementally smaller and more powerful, but largely follow reasonably predictable trends.

The mining industry by contrast has huge infrastructure costs, new sites can take a long time to develop, and can be upset by unstable prices or other sources of risk. While it is not categorical that manufacturing is a solely structured undertaking and extractives are solely complex, the description provided here, suggests the relative power of the two types of Cynefin domains for each of these two sectors. There may be an issue of scale here of course, where both electronics and mining are reliant on engineers, but mining (like construction) is more context-specific and has to respond to more changeable external factors.

Interestingly, the identification of an unstructured decision context accompanies an unprompted demonstration of a values-focussed, principles-based approach to decision making in the sector. The Trade Association promotes sustainable development principles that members can implement, which are explicitly principles and not rules because of the contextual nature of operations in the sector. The over-riding values are to maintain the profitability of the enterprise, so whilst there is a principle of advancing sustainable development, this is not a requirement (or rule) as it depends on the context of any given project and the underlying viability of it, which is dynamic (1.2.6.1).

The sector navigates through potentially volatile or unstable contexts by maintaining a focus on the values of maintaining profitability. All firms should act in this way, but it is notable that it emerges as an explicit topic of discussion in this case with the extractives industry. For more stable industries, profitability may be maintained by considering alternatives and making a rational decision on the ones that maximize returns. If such rationality is hampered by a higher degree of unpredictability, then a focus on objectives rather than alternatives is key to decision making in such unstructured contexts.

Emergent concepts: Alignment between economic and social & environmental outcomes

A central concept emerging from the discussion with this interviewee is that of the alignment between social and environmental benefits for communities, and the economic benefit to a mining company. The way that commercial organisations make decisions is that the economic benefit to the firm takes primacy over the environmental or the social benefit to the natural environment or the public. A challenge of sustainable development is thus in engaging firms to act on anything that is not within their direct economic interest.

As discussed with the interviewee and triangulated with publicly available data on extractive industry operations, extractives companies may often operate in developing countries where there is little or no public health or education provision, or limited modern infrastructure, such as roads, water or electricity. As such there may be a strategic interest for the firm in providing this, but this is always secondary to their primary economic interest in extracting materials for sale to world markets. Where these interests align it is possible to be a significant driver for change. This is shown by mining companies being the largest funders of disease eradication and treatment in Sub-Saharan Africa, for instance, and various similar examples.

Summary:

- Organisational definitions relating to SSCM are well integrated into established international development criteria as described by the Soc aspects of the PB+SF framework. These include provision of health and education in poor communities where mining and quarrying operations are established. This meets the strategic

objectives of both developing a skilled workforce and establishing a social licence to operate by gaining trust and local community buy-in.

- While the corporate extractives sector is a very large producer of greenhouse gas pollution the location of these emissions may take place in developing world economies where per capita emissions are very low. Energy efficiency gains, notably from the use of onsite diesel generators to power mining operations are sought by parts of the industry.
- Sector SSCM policy is largely proactive and direct but has been forced to focus primarily on conflict minerals due to the recent regulatory driver.
- The corporate extractives sector appears to demonstrate highly strategic approach to SSCM.
- Firm activities on PB+SF, with a focus on SF, are likely moderate, but these results are not conclusively established by the research. Secondary data for triangulation establishes that the carbon footprint of extractives companies is substantial (within the top ten per cent highest emitters on the FTSE100 share index and many times higher than the remaining 90%).
- While the sector as a whole has substantive impacts, this aspect of the case was not taken further as the link with conflict minerals and resulting international development criteria was neither readily apparent nor easily accessible.
- Inherent unpredictability in the sector, driven by commodity price volatility, provided a demonstration of bounded rationality due to complexity.
- Dominant decision making logic is unstructured and complex with strong evidence of values and guiding principles for decision support.

Case 2: Org 2.1 FMCG Manufacturer

Description of sustainability within the organisation and how this relates to PB+SF issues

The firm has a published set of environmental criteria which it uses to rate product performance. This acts as both an internal design tool but also as an external marketing tool. Various external standards and certifications are also incorporated. However, regarding an evidence base in relation to the environmental criteria, such as scale of the problem of toxic chemicals in the home or the environmental impact of detergents on aquatic systems, the reaction was a little uncertain or evasive (2.1.1.1, 2.1.9.1).

The notion that incumbent products have negative health impacts because of the toxicity of the ingredients is a serious claim, but is it one that is fair and well supported? It certainly meets the prejudice of the target consumers, but unless they can show substantive environmental impacts then this can be accused of being mere symbolic environmentalism. In theoretical terms, if values are being used as a heuristic then given that heuristics can produce the wrong answer or give otherwise sub-optimal answers, then eco-values used as a short-cut in decision making, may come to the wrong outcomes in light of insufficient evidence to make rational weighing up of options and outcomes.

The problem the firm faces is that it's not that their claims are not valid, just that there is no evidence that they are. When challenging the director about the claim that non-environmentally friendly cleaning products cause toxic build up in homes that can be harmful, his response is to say that it is not easy to prove scientifically (2.1.9.1). Scientific evidence on the harmful impacts of indoor air quality does exist, and cleaning products are one of the sources, but the main recommendation is to ensure good ventilation.

The firm plays a role as a catalyst for change in the sector, but as the next section shows, achieving reduced impacts at the macro-scale, requires action and co-ordination at a level higher than that of the individual firm. A further driver of the firm's serial innovation strategy may be seen in the development of legal instruments to address the very issue of phosphate pollution as an urgent planetary boundary issue. Since 2012, the European Union has introduced a series of rules (the EU Water Frameworks Directive) that mandate water

utility providers to filter out all phosphates from rivers and sewage systems in order to reduce environmental impact. At the time of writing, implementation of the Directive had not been completed across all member states, but was in those key countries where the FMCG firm operated.

Secondly, phosphates have been phased out of the incumbent detergent products since the 1990s in the USA, and by law in Europe from 2016.[4] Most companies in the sector now aim to phase-out phosphate-based detergents globally too. The result is thus that the issue of phosphate pollution from detergent is being addressed at the regulatory level, where it can hopefully have a beneficial impact on the natural environment as a result of all companies responsible being affected.

Phosphate-free detergent is therefore no longer a point of differentiation for the FMCG firm, and it should thus come as no surprise that it has since shifted its attention to other forms of environmental issue related to the wider supply chain of the sector.

Description of how SSCM initiatives are being undertaken.

The firm's published literature makes many clear statements about the sustainability performance of their operations. It also mentions that they source much of their ingredients from the conventional raw materials, chemicals and packaging industries. The characteristics of their supply chain and SSCM policies are thus important in considering the overall footprint of their products.

Positive aspects of SSCM are that their interest in innovation has established relationships that encourage those suppliers to innovate in environmentally friendly ways. The suppliers treat the focal firm as an interested customer for potential eco-innovation (2.1.4.1, 2.1.4.2). Company publications also point to their success in helping improve recycling of product packaging, working with very large companies in the sector to increase levels of reclamation. In addition, they assist smaller suppliers and downstream parties such as distributors and retailers in ways to improve their performance (2.1.4.3).

[4] http://www.hse.gov.uk/chemicals/index.htm Last accessed 22.01.2016
Waste water treatment in the United Kingdom – 2012 Implementation of the European Union Urban Waste Water Treatment Directive – 91/271/EEC, DEFRA, HMG.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69592/pb13811-waste-water-2012.pdf Last accessed 01.07.2015

Example SSCM Projects	Stage	Drivers	Barriers
1: Assisting Eco-efficiency in SME Suppliers and Distributors via grant schemes	Well established	Long-standing company strategy to assist alternative retail channels	Not discussed
2: Trailing innovative products by suppliers - e.g. alternative packaging.	Well established	Serial Innovation Strategy	Not discussed
3: R&D to substitute Tier 1 feedstock away from agricultural commodities towards synthetics	Research concluded, now in development phase.	Serial Innovation Strategy	Technical scalability, consumer values.

Table 22: Example SSCM Projects Org 2.1

However, the SSCM initiatives themselves have only thin ties to PB+SF issues. Whilst they play a small part in helping to improve the energy efficiency of their suppliers and hence their resulting carbon footprint, the overall scale of this is small and the main impact of the firm is from the post-consumer environmental impact of their product. Notably, the use of mainstream chemicals suppliers means upstream impacts are not strongly influenced, though such suppliers will themselves likely be active in considering environmental performance. The nature of regulation on water utilities as well as all other detergent manufactures means the downstream impacts is also less significant.

Description of the dominant logic regarding decision making for SSCM.

Interestingly, a collective decision making process throughout the firm (2.1.6.1) is well-established. This is both a means to ensure that decisions are in line with the values of the organisation but also as a reflection of a heuristic approach in contrast to the use of expert, structured analysis to aid decision making (2.1.5.1). The firm is thus acting in the unstructured-complex Cynefin domain (domain 3). where involving stakeholders, makes the decision making more decentralised.

The Cynefin domains relate to how a decision is perceived, but here the approach is a pragmatic consequence of the small scale of the operation, and of the strategic importance of values-alignment. Larger organisations may be able to perceive their environments as

more structured, even if complicated (domain 2), as they have the resources to perceive and analyse complicated structure or to impose it. The use of values as a central part of the culture of the organisation justifies the inclusion of this case despite its small scale. Values are so central to the organisational culture that it strongly affects the hiring process, and hence the DL by which decisions are made. As the director describes, the firm exemplifies,

> " *the values of 'I want to improve the world, I want to provide better solutions'*." (2.1.3.1)

> "*As a values-based business, we recruit on the basis of 'will people be able to fit in and add to our culture and work, and adopt and support our values... the idea is that everyone in the team is fostering, and working to drive, those values* "(2.1.6.1)

The firm is extremely interesting as an example of a firm that is a true-believer in the environmentalist cause, to the point that it states it can over-ride the prerogative of economic sustainability first, if it helps improve better environmental outcomes (2.1.9.3).

> "*if we were being only commercial, actually we shouldn't do that because it means we have to sell our product for 25p more, and obviously the consumer has to pay for that somehow, but we think it's the right thing to do...[and] that's exactly where the brand wants to be.*" (2.1.9.3)

In fact, this price increase is an instance of product quality, except that the quality that the consumer is concerned about is the environmental impact of the product. Maintaining credibility as a pioneer of change thus depends on the serial innovation strategy. The reason for this is that the evidence on the contribution the firm makes in relation to the macro-scale environmental challenges are not clear stated anywhere in the firm's marketing communications.

Emergent concepts: evidence-based sustainability statements

The firm presents an image, in often emotive language, as to the cleanliness, healthiness and environmental responsibility of the products, but little clear evidence is forthcoming. While low levels of certain chemicals are stated on various product declarations, it begs the question as to the extent to which the alternative to such chemicals are in fact dangerous.

This highlights the role of rational vs. behavioural factors in decision making and the impact of emotional, psychological, cultural and institutional factors in the sustainability topic. These forms of perception within key stakeholder groups, such as consumers, are significant influencers on the delivery of SSCM policies.

Returning to the initial PB+SF issue of phosphate pollution, a further driver of the serial innovation strategy may be seen in the development of legal instruments to address this very issue. Whereas evidence on toxic health impacts appears unclear, the evidence on phosphate pollution is clear. Indeed, it is identified as a planetary boundary precisely because of the level of evidence of its effects. Such evidence has led to regulatory change via rules such as the EU Water Frameworks Directive.

Summary

- The firm has a pro-active environmental strategy, initially based on a strategy of values-alignment with a specific market segment.
- While the products are low impact, the intervention of downstream regulation on pollution control and across the whole detergent sector on removing elements that cause those impacts (specifically PB2: phosphate pollution) have an impact on that strategic proposition.
- Supplier capacity development is evident with smaller firms in the supply chain, and the firm is known as a good customer for eco-innovation products by larger suppliers
- Dominant decision making logic is unstructured and complex with strong evidence of values and guiding principles for decision support.

Case 3: Org 3.1 Restaurant

Description of sustainability within the organisation and how this relates to PB+SF issues

The major source of clear definitions of sustainability come from regulations, notably on energy consumption and carbon emissions (3.1.3.3), and regulations on food waste disposal can also be argued to be fundamentally environmental. However, an important aspect of the firm's approach to sustainability and responsibility comes from their organisational culture. This puts a strong emphasis on personal values, and hence sustainable and responsible business is seen as being in line with the existing culture as 'the right thing to do' (3.1.5.4). Being responsible to customers and to employees extends easily to being responsible to society or the natural world. This values-led approach is central to the decision making logic discussed below.

In terms of evidence of making any contribution to PB+SF impacts, the firm is aware that its own environmental footprint is negligible in comparison to those of its upstream suppliers, but it does have a good understanding of what those impacts are. Major names in Big Agro, who the firm supplies from, are also reasonably transparent about their impacts given that they are large corporations governed by a mature regulatory framework and shareholder disclosure requirements. The firm is aware of their relatively small status and weak buyer power (compared with competitors for the same supplies such as supermarkets) but seeks to contribute to solving macro-scale sustainability goals by engaging openly with others in the wider sector and supply chain.

Description of how SSCM initiatives are being undertaken.

The first SSCM initiative was to improve the sustainability and responsibility of food waste disposal. Operational practices were changed so that rather than throwing away food, produce still fit for consumption would be donated to charitable organisations with kitchens, and the remainder sent to energy companies who create bio-gas via anaerobic digestion plants. This is then burnt to generate a source of heat and electricity with a lower carbon footprint than conventional gas. The economic benefit from doing this was less important to the firm than the sense of it being the right thing to do (3.1.5.4).

A second major upstream SSCM initiative has been prompted by rising awareness of long-term economic sustainability of the firm linked to environmental issues. The firm has a high strategic dependence on its Tier 1 suppliers in the livestock sector, and in turn the dependence of those suppliers on the Tier 2 agricultural feedstock suppliers to that livestock, notably in wheat and soya.

The 2013 European horse-meat contamination scandal revealed the exposure that the firm had to competition, particularly from major supermarkets, as supplies were squeezed for UK 'Red Tractor' certified meat. Awareness of the weak position the restaurant chain had to larger buyers prompted consideration of future vulnerabilities to Tier 1 and Tier 2 suppliers, with the rising demand for wheat and soya. As future demand rises faster than supply (plus potential problems facing future crop yields due to climate change) a future price spike is anticipated that could quickly knock out the business; particularly given its strategic position is low cost. Secondly, the firm's values are explicit about being socially responsible and the environmental impact of soya farming is well understood. Another consequence of rising demand is that it continues to drive deforestation. Developing alternative feedstocks is therefore an example of a supply chain transformation programme based on innovation. This aspect of the SSCM strategy is a pro-active response based on awareness of future vulnerability present in the extended supply chain (3.1.4.1).

Example SSCM Projects	Stage	Drivers	Barriers
1: Downstream food waste disposal	Well established	Current food waste disposal regulations in Scotland & Wales.	Internal operations management practices
2: Supplier and other stakeholder engagement to explore more sustainable substitute Tier 2 feed stocks for the Tier 1 livestock suppliers	Research and engagement phase	1. Risk mitigation prompted by perception of future vulnerability 2. Internal values to act in socially responsible way, hence cut CO_2 in supply chain	Regulatory, economic and consumer acceptability.
3: Research and deployment of energy efficient lighting, heating and catering OEM (cookers, grills, fridges, etc)	Research and trial deployment where available and affordable	Energy efficiency regulations, cost benefits	Technical, economic and behavioural (internal resistance to change)

Table 23: Example SSCM Projects Org 3.1

Description of the dominant logic regarding decision making for SSCM.

It is notable that a number of mentions are made to the effect of the organisational culture on decision making. Part of the culture of the firm is that branch managers have a relatively high degree of autonomy and encourage a strong sense of common purpose amongst the staff, which helps create the atmosphere of the restaurants, which is a key part of their appeal. Staff are encouraged to socialise together and form tight inter-personal working relationships (3.1.8.1).

This is relevant to the Cynefin framework in that this level of decentralised decision making is akin to the response found in the unstructured-complex domain. In part, regional managers are responsive to the local context of their patch and order stock according to their guesses on what demand is likely to be. This is a level of local knowledge and informed

judgement or guess work. Also, this culture is apparent in central office, where there appears to be a resistance to excessive focus on metrics.

The dominant logic is therefore a principles-based one, shaped by the unique and strategically important aspects of catering as a service culture. Atmosphere in restaurants, shaped by a family-friendly approach, is maintained by having a strongly centralised organisational culture but that decentralises decision making responsibility to branch managers. This culture is also notably set against a rules-based one (3.1.5.3).

As the CSR Manager describes it,

> "*No one is saying to me, 'where's your compliance monitoring'. No one is saying we need to go through loads more boring processes, that move us extremely slowly and just gets us a figure at the end of a year's work - and then we don't know what to do with that figure.*" (3.1.5.2)

Such process would be typical of the structured-simple domain, where bureaucratic processes such as targets and compliance are the basis for decision making. The organisational culture seems to accept that building a structured decision model to justify the benefit of SSCM projects would not be worth the effort. A value-judgement is made that it is a right and sensible thing to do, and then the green light is given, and the CSR Manager is told to make it happen. Simple cost analyses are undertaken, but these support decisions rather than dictate them, which proves highly significant in the context of uncertainty and ambiguity found.

This approach is capable of dealing with ambiguity, validating Keeney's VFDA idea. It also shows an integrated and responsive organisation, where consensus is established via internal dialogue. Demarcation between functional silos is discouraged and a sense of collective purpose is central to the organisational culture (3.1.8.1). This illustrates an appreciation of emergent order in contrast to the command-and-control bureaucracy of older, larger organisations and so supports the Cynefin framework as an instance of unstructured-complexity (domain 3).

> " *we could say to ourselves, how are we going to cut our energy use in the next year, in the next 2 years, 3 years. What's the equipment available today, and then you can*

start doing some metrics. Clearly, not a bad way to do it. Or another way you could do it is to say, the government has set a carbon reduction target of an 80% by 2050, the world will look very different. Let's assume we have got to get there. There's no choice. What do we need to do today to start that journey." (3.1.6.4)

Further indications of the interplay between a values and principles-based decision making approach and structured rules-based approaches are seen in the relationship with regulations. While there are regulatory barriers to some SSCM projects, engaging with regulators on pilot projects is seen as counter-productive. Risk aversion and lengthy processes inherent in regulatory bureaucracies is perceived as a barrier to innovation. So the firm prefers to take its time to build up its own capabilities and relationships rather than being forced into a position of making structured, rational justifications whilst the situation is still ambiguous.

A further example of decision making culture being based on the fundamental nature of the sector is found in the upstream Tier 2 agricultural suppliers; farmer's supplying into large agricultural processing and distribution companies. This is a dominant logic that expects unpredictability.

" *farmers..are probably being quite realistic...they are saying about climate change, 'yeah temperatures go up and down. It's cyclical. China are buying loads at the moment. Who's to say what will happen next year.'*

(CSR Manager) (3.1.5.1)

Emergent concept: Influence of ownership / investor type on dominant logic.

The main emergent concept to come from this case was a realisation about the link between the dominant logic and company ownership. The restaurant has a strong principles-based, or values-focussed, decision culture, and is a privately owned and not publicly listed company. Privately-owned companies able to develop principles-based, values focussed decision cultures, appear able to better tolerate conditions of uncertainty and ambiguity, as shown by the unstructured domains of the Cynefin framework. This prompts the question as to what extent such firms are better able to advance SSCM, if uncertainty and complexity are commonly present.

Summary

- The case demonstrates a strong principles-based DL, including a strong resistance to a rules-based DL.
- The CSR team is very well versed on PB+SF issues, and seeks eco-innovation via supplier development, even when their influence is weak.
- Part of the firm's DL means that it tolerates ambiguity in a business case if the outcome intuitively aligns with the values. As such, SSCM initiatives that have an uncertain financial benefit, or a financial cost, or a very small financial benefit are tolerated if the outcomes seem to be the right moral choice.
- This is likely to be a direct consequence of the firm remaining in private ownership rather than being owned by public shareholders who would impose a different DL.
- Internal employee engagement is a significant barrier, partly because the values-based culture and decentralised decision making contrasts with central command and control.

Case 4: Org 4.1 Bank

Description of sustainability within the organisation and how this relates to PB+SF issues

Decision making around sustainability and responsibility resides in various places in the organisational structure. At the highest level it relates to corporate governance. There are board-level committees that oversee strategic decisions plus additional risk committees that provide a second opinion on certain decisions. A group-wide sustainability team feeds into these committees and acts as a mediator for internal and external stakeholders (4.1.7.1). Topics covered range across lending policy, employee pay (from living wages for cleaners to executive bonuses) and philanthropy (4.1.3.1). Both stakeholder theory, and the theory of Creating Shared Value are explicitly mentioned (4.1.7.2) . This represents perhaps the most advanced conceptualisation of sustainable and responsible business practice of any of the firms interviewed in this research.

At the internal operations level, SSCM is handled by a supply chain team who operate a comprehensive set of key performance indicators around sustainability, which relate to corporate reporting requirements, such as under the CRC and ESOS regulations, GHG Protocol Scope 1 and 2 reporting, etc.

Description of how SSCM initiatives are being undertaken.

Areas of SSCM include energy reduction in real estate and logistics, and local sourcing such as for corporate catering and staff uniforms. This example provides a good story in terms of local economic benefit that aligns with the marketing needs of the firm. Whilst reduction in the footprint of real estate construction, refurbishment and facilities management has shown positive results, the main story discussed was that of redesigning the logistics provision, which significantly reduced the carbon footprint of the firm. This is described in more detail in the second part of this case (Org 4.2) below.

The relationships with suppliers to advance SSCM is perhaps the best out of all the cases considered in this research. SSCM is a topic in monthly and more strategic quarterly meetings with key suppliers, and the contract management staff include it in their processes (4.1.6.1). Seeking values-alignment into supplier selection decisions is a major concern and

is a sign of a progressive approach to SSCM, but it is subject to context. Some parts of the business are more cost-sensitive than others, so cost prioritises over SRB performance (4.1.6.2). So while there is a new focus on the sustainability impact of the bank's operations, this has to be tempered by what remains within the acceptable economic performance, in particular in relation to critical suppliers. This is a major point of discussion in the cross-case analysis in Chapter 6.

Example SSCM Projects	Stage	Drivers	Barriers
1: Redesign of logistics network	Well-Established	Declining productivity of the network	Overcome at Tier 1, technical and economic barriers at Tier 2, see Org 4.2 section below.
2: Sustainable and responsible procurement guidelines, e.g. prioritising local suppliers (textiles, catering, etc.)	Well-established	Sustainability and resilience strategy as result of critical incident (Financial crisis)	Some cost sensitive areas of the business must prioritise cost of S&R issues (economic misalignment).
3: Reducing operational carbon footprint of real estate	Well-established	Carbon reporting and cost of energy.	Relationship to branch closure plans (downsizing).
4: Energy industry investments	Discussion only	Profitability, ethics	Economics, regulations

Table 24: Example SSCM Projects Org 4.1

Description of the dominant logic regarding decision making for SSCM.

There a number of aspects of the Cynefin framework clear within this firm (Figure 2). Firstly, there are numerous bureaucratic procedures, including for SSCM (4.1.3.2) (domain 1). There is also a considerable resource for operational research where extensive analytic modelling is undertaken, which is the structured-complicated Cynefin context (domain 2). However, there is also a large degree of uncertainty, which is illustrated by the central zone of the Cynefin diagram before a clear response has emerged.

The unstructured-complex domain (domain 3) is also clearly present. As a large organisation with many different divisions, merged and acquired companies within it, there is a high degree of internal complexity (4.1.5.1, 4.1.5.2, 4.1.5.3, 4.1.5.4). There are also various

instances where multiple actors are involved - government, industry, customers, etc. and a clear internal transformation initiative to decentralise decision making.

In the wake of the 2008 Global Financial Crisis, bailout by the UK government to prevent collapse (along with numerous competitors) resulted in massive reputational damage. This crisis and collapse in trust prompted a series of changes in the decision making culture of the organisation. Firstly, a very strong rules-based culture was imposed. Then, centred on the need to re-establish a strong sense of purpose in doing the right thing for customers and society, a principles-based approach has been introduced (4.1.6.3).

While this helps drive much of the SSCM and other SRB activities, it is acknowledged by one of the interviewees that contributing to beneficial social and environmental outcomes will have little or no effect on rehabilitating the reputation of the bank. The image of the firm and the wider sector is simply too badly damaged, but they must still carry on as to not do so would add to the reputation that the bank is irresponsible. These culture change initiatives are also difficult to implement in the face of internal resistance and mindsets, yet the attempt to do so is very interesting.

The desire to change from a rules-based to a principles-based decision making culture is a surprising finding in the research as this was not known before meeting the firm. Central to the nature of the principles-based culture (or dominant logic) is that it devolves decision making responsibility over certain things. Whilst there remains a high degree of hierarchical authority over many decisions, the intention is to create greater understanding of customer and societal reactions to actions and this is informed by a focus on values (4.1.6.3, 4.1.6.4). This devolution of responsibility clearly sits within the complex-unstructured Cynefin domain (domain 3).

A further clear example of the unstructured-complex domain is seen in relation to auditing Scope 3 GHG emissions in the supply chain (4.1.5.1). The interviewees are circumspect about progress on this, but as supply chains are complex, it follows by definition that the attempt to map and audit the environmental footprint of those supply chains is also complex (4.1.5.1). Under requisite decision modelling, the attempt to determine the significant SRB impacts in the supply chain should be to focus on the ones that are a) large,

b) clearly visible and c) practical to change. This assumes SSCM should be about internal operational improvement rather than auditing in order to report to external parties.

Emergent concept: moral decision making versus economic decision making in SSCM.

A major concept to emerge from this case is the challenge presented by the interplay between rules-based decision making and principles-based decision making. The question of the decision making culture itself emerged unprompted at the very start of an interview with the Supply Chain Director, and yet pursuing this topic suggested an implicit contradiction in relation to sustainability outcomes and the nature of morality in decision making. In relation to the bank's role as an enabler of investment in many sectors of the economy, some of which attract the displeasure of the NGO community, the response is that the bank should be free to pursue economic development provided it is within the law (4.1.5.2).

> "*At what point do we pull the moral judgement? ...[campaigners] protesting at our AGM because we, as an organisation, fund [extractive industry projects]...But the reality is that local government allows that to go on and actually encourages the minerals to be taken from the land there - much to the disgust of the local communities. So actually there's no laws or regulations being broken...It doesn't make it right, but where do you draw the line of the moral decision on your clients?...we typically try to not take the moral judgement because it's harder to define what's right and what's wrong. There's an element, if it inherently feels wrong you wouldn't do it, but if all things stack up and it's reasonably accepted practice, it would probably happen.*" (4.1.9.1)

This suggests a conflict between legal compliance and moral standards or social, ethical norms. While the social norms of a campaigner may be contested by other members of the public, the bank takes a position of legality first and foremost. So while a principles-based approach is being adopted within some aspects of domestic consumer banking, large-scale commercial investment banking remains justified by a rules-based logic. This suggests, alongside the economic pressure that the bank is under, that it does not have the freedom to direct its strategy in ways that will drive transformation towards cleaner technology where the economic returns are uncertain. Major extractive firms, including in the fossil fuel

sector, continue to receive access to the bank's resources because they offer profitable returns, even if the moral case in light of the evidence of climate change suggests that this business cannot continue.

Pushing this issue further, an example is raised of where there has been a change in the lending policy of the bank in response to a moral issue. The United Nation's Guiding Principles on Business and Human Rights (also known as the Ruggie Principles)[5] have been voluntarily adopted by the finance sector. In addition, the Equator Principles[6] cover environmental and social impacts around major infrastructure investment. These are voluntary principles, adopted at the sector level, rather than coercive legal rules, and have now begun to influence major investment decisions. These have excluded companies involved in the manufacture of land-mines and cluster munitions from raising finance via the bank, even though it would be profitable for the bank to do so .

At the time of data collection, similar principles covering greenhouse gas emissions or species extinction were not advanced enough to become factors that would influence board level committees responsible for informing corporate decision making. (4.1.8.1)

> "*This is climate change. We have to deal with it and we have to accelerate what we are doing. But...we are just where the money goes. We will always be a reflection of what's going on out there.*" (Sustainability Programme Manager) (4.1.8.1)

> "*Whose job is it to go first? Do we turn off the money in order to force more rapid development in a direction which is widely agreed? Do we wait for government to do it? Stop issuing shale gas licences and put up the duty on petrol - stop mucking about? Or do we wait for the companies?*" (Sustainability Programme Manager) (4.1.5.2)

This indicates that any aspirations for radical change are constrained by the economic reality and the legal context. If something is legal, then it can be undertaken. Politicians are ideally the ultimate decision makers on what is best for a society - even if they do so badly or under considerable protest or undue influence. But as with the earlier explorations of conflict

[5] http://www.ohchr.org/Documents/Publications/GuidingPrinciplesBusinessHR_EN.pdf Last accessed 22.01.2016

[6] http://www.equator-principles.com/ Last accessed 22.01.2016

minerals or phosphate pollution, the environmental impact of fossil fuel use given its central role in socio-economic development represents a wicked problem.

The bank feels unable to act ahead of regulators, and regulators cannot act as there appear to be no commercially viable like-for-like substitutes to fossil fuels (as examined later in this case and in Case 5). So government will not jeopardize economic well-being, and has to wait until markets have developed suitable innovations to disrupt the incumbent fossil fuel sector. Meanwhile, the banking sector continues to fund expansion of the fossil fuel sector, even though planetary boundaries and other climate research shows that the majority of existing fossil fuel resources should never be used (Allen et al., 2009). However, alternative energy technologies are increasing in prominence and the bank is impartial about funding them if they have a viable economic case.

> "*...when you look at scope 3 going into our client base... we still do a lot of oil and gas lending, to the criticism of some areas of the public and NGOs...but we are also [a large] lender to renewables.* " (4.1.4.1)

There is plurality here, and as noted in quote 4.1.8.1 above, the bank essentially goes where the money is, and operates within the law.

While the internal and immediate environmental or social footprint of banking is relatively small compared to that of a major manufacturing facility or cash crop plantation, by investing in that facility or plantation and enabling its creation or expansion, the bank effectively takes responsibility for the impact. This is an aspect that has been long been picked up by campaigners, against issues ranging from free trade to fossil fuels. The link between environmental & social impacts and the wider dimensions of political economy and finance, provide an interesting subtext to the primary data.

Returning to the internal operational footprint of the firm, and the role that SSCM plays in reducing this, the second part of the case turns to the reduction of the firm's environmental footprint associated with its outsourced transport services. This centres on the implications of eco-efficiency as a common SSCM initiative and the alignment with an economic justification that results from this.

Case 4: Org 4.2 Logistics Services Firm

Description of sustainability within the organisation and how this relates to PB+SF issues

At the sector-level there are very clear definitions of environmental factors affecting logistics that are subject to legal specifications.[7] At the simplest level these include the weight of carbon dioxide emitted as a direct result of the volume of fuel consumed, the conversion factor for which is provided by Central Government according to a standardised methodology.[8] In addition, there are metrics related to local air pollution.

A major issue in the sector is that these two - greenhouse gas pollution and local air pollution - are in conflict with each other. This is evidenced by controversy over the Euro 5 and Euro 6 standards for engine design, where a focus on greenhouse gases resulted in changes to engine design that increased local air pollution (from particulates and NO_x) and vice versa (4.1.3.1). Numerous, additional industry performance standards relate to health & safety, the environmental management of fuelling stations, and so forth.

During the interviews, when pressed on further definitions of sustainability used by the firm, these were reported as alignment with mainstream investor standards for sustainability and CSR reporting, and work supporting charities. As in Case 1.1, this is an example of employee-focussed philanthropy, as contrasted with strategic philanthropy. Other social impacts identified by the government as major issues in the logistics sector, such as workplace fatalities, were not mentioned by the interviewees.

Also, in reviewing their corporate reports it was notable that the firm has a definition of 'green energy' that specifically excludes nuclear power. This definition therefore is in conflict with that of numerous scientific academies who argue that nuclear is a safe and established source of carbon-free energy. Given the urgency of decarbonising industrial economies within the timeframes prompted by climate change science, this suggests that the Logistics Firm has adopted a symbolic sustainability policy rather than a substantive sustainability policy. This is in line with a stakeholder approach involving environmental

[7] See https://www.gov.uk/government/policies/freight Last accessed 22.01.2016

[8] https://www.gov.uk/guidance/measuring-and-reporting-environmental-impacts-guidance-for-businesses Last accessed 22.01.2016.

NGOs (who take ideological positions with regard to technology), with potential institutional bias provided by suppliers such as consultants that advised on this definition.

Description of how SSCM initiatives are being undertaken.

The relationship between the bank (4.1) and logistics firm (4.2) has been one of close collaboration. It has led to the declaration of a successful outcome resulting from the major restructuring of the logistics network. This has benefitted the carbon footprint reported by the bank, and has gone on to benefit the carbon footprint of other firms served by the logistics firm. Numerous opportunities for increased efficiency exist within the commercial transport sector, but barriers currently remain for a major shift to carbon-free transport systems.

The Logistics Company has been responsible for running the delivery network for the Bank for many years. However, rapid change to the usage profile of logistics, driven by a sudden increase in the use of telephone and online banking by consumers over the last few years, has prompted substantial changes to the network. In particular, the volume of cheques needing to be processed has declined. This has meant that the productivity of the network has fallen, coming to the attention of the Logistics firm via standard KPIs. This prompted relationship building discussions with the Bank to consider likely future changes in the industry as a result of digital technology (4.2.4.1).

A close working partnership, including a triadic relationship with one of the bank's major ICT services suppliers, then resulted in significant redesign of the logistics provision. Instead of delivering paperwork, including cheques, to a small number of large processing centres, the logistics company offered the ICT provider space within a number of their warehouses, so the paperwork could be digitised and processed via a less centralised network. The consequence was a massive reduction in road miles travelled, and therefore in the fuel and resulting GHG emissions needed to service that network (4.2.4.3).

Example SSCM Projects	Stage	Drivers	Barriers
1: Redesign of logistics network	Well-Established	Declining productivity of the network due to socio-technical change.	Overcome - but a longer-term barrier was the failure to phase out cheques completely[9]
2: Introduction of energy efficiency technology and processes (aerodynamic trailers, load maximisation, efficient driving technique, engine idling technologies)	Being implemented	Carbon reporting and cost of energy. Carbon reporting and cost of energy. Reducing fuel use cuts cost and cuts carbon, so has economic alignment.	Falling price of fuel extends payback period for eco-efficiency measures, and may thus make some measures uneconomic.
3: Piloting alternative engine types	Being implemented	EU Vehicle standards, carbon reporting.	Technical performance: substitutes do not share same performance characteristics so can only replace certain applications). Financial cost of infrastructure: some alternative fuels need new fuelling stations and supply lines that are cost prohibitive and under-developed.

Table 25: Example SSCM Projects Org 4.2

While this decision was taken primarily on cost due to the increasingly ineffective or inefficient network design, there has been a corresponding environmental benefit (4.2.4.1), which the customer highlights as resulting in the reduction of their carbon footprint. The success of this meant the logistics company then offered the same service to other

[9] A cross-sector push to get government to abolish the use of paper-based cheques was successfully resisted by charities such as Age Concern and Help the Aged, who argued that many old people rely on cheques and are unwilling or unable to adopt new technology. A further recent development is the digitisation of cheques at the branch level, via cash machines, further reducing the need for movement of paper.

customers. Where commercially acceptable, it then ran a single vehicle serving multiple customers in certain high street locations, including competitors. Prior to this, parallel networks were run, providing the same service to multiple customers. Running a single service means a significant reduction in the number of vehicles on the road, and total miles travelled reduced yet further (4.2.4.3).

This has resulted in a fall in the carbon footprint associated with those operations, albeit a fall in employees employed to serve those routes also. This is an example of eco-efficiency, where waste is eliminated and the resulting reduction of consumption provides an economic benefit to the firms involved alongside a reduction in pollution.

In partnership with a trade association for the logistics industry, the logistics company has also piloted further eco-efficiency measures. These include fuel efficient driving techniques, payload maximisation, engine idling technologies and more streamlined vehicles and trailers (4.2.4.5). Both parties are keen to go further, but interestingly, as triangulated by additional interviews with a logistics trade association that the logistics company is a member of, there are wider technical and infrastructural issues presenting significant barriers to alternative engine and fuel types. New engines using low carbon or carbon-free energy sources represent a move away from eco-efficiency. As this works by reducing demand for something that is still a pollutant -essentially being less bad by consuming less - there is still a level of pollution, which may be unacceptable. By contrast, substitution of supply - changing the nature of consumption to one that is 'environmentally friendly', and is fully 'clean' - does not involve reduction in demand. This issue is discussed in more detail in the section on eco-efficiency, below.

On technological grounds, alternative energy vehicles such as battery electric vehicles are limited in their applicability; suited for urban deliveries only, not long distance (4.2.4.4). It is also not clear that the additional weight of hybrid vehicles will offset the fuel savings, given the role that weight plays in fuel economy. Further developments in low carbon engine types are thus not yet market ready (4.2.7.1).

The current best technical option for additional reduction in the carbon footprint of their transport fleet is to introduce liquid natural gas (LNG). Here, existing trucks can be converted to run on LNG fuel through an easily reversible process. This breaks the issue of

waiting for Tier 2 automotive manufacturers to develop and build alternative fuel vehicles to sufficient volume to enable a market transformation (4.2.7.1). Conversion technology breaks a lock-in effect of the existing vehicle designs, but a significant lock-in effect remains with the availability fuelling infrastructure for LNG (4.2.6.4).

Whereas petrol and diesel fuelling is ubiquitous, LNG refuelling is not, and the logistics companies can neither raise the finance necessary to build their own LNG infrastructure and networks at their depots, or have the necessary capabilities to do so (4.2.4.5). There is thus an infrastructure and financial barrier to delivering a more comprehensive decarbonisation in SSCM.

Meanwhile, battery electric, hydrogen fuel cell or synthetic bio-fuel vehicles are all potential future technologies competing to become potential solutions to a decarbonised transport system. There is uncertainty over this technological evolution, the level of lock-in for existing fossil fuel infrastructure, uncertainty over the relative carbon impact of different fuel sources (ranging from methane leaks from gas infrastructure, shale gas, tar sands, gasification of coal, etc.), or the relevant applicability of alternative modes of transport, such as rail. These barriers to substantially cutting carbon out of transport are therefore far from encouraging in terms of the PB framework.

Description of the dominant logic regarding decision making for SSCM.

As mentioned above, the metrics for sustainability are limited and clearly defined as essentially engineering metrics. At the sector-wide level, the Logistics Trade Association established a voluntary scheme to start collecting basic data on carbon emissions from operators. This was a bureaucratic process of collecting fuel consumption and business activity data. Aggregating this data and showing a year on year reduction in terms of improvement is a bureaucratic process that serves the function of demonstrating to government that voluntary emissions reductions by the industry are working. This is an example of a simple-structured model for decision making (domain 1).

By contrast, the goal of transitioning the sector towards a less polluting type of engine is very difficult, and described as a messy problem. Firstly, large logistics companies lack the

finance or capability to build alternative fuelling infrastructure. Meanwhile, the sector also includes a very large number of very small logistics companies, who struggle to invest in any sort of innovative alternative fuel vehicles or fuel saving modifications (4.3.5.1). While pilot schemes supported by government and the Tier 2 automotive sector are being rolled out, the overall context is unstructured and complex (domain 3).

It is not possible to predict what the sector might look like in the future, as there are many competing options and a lot of large scale infrastructural changes needed, involves large numbers of independent actors. Whilst order may eventually emerge, the cause and effect leading to that order will only be knowable in hindsight (domain 3).

For the large operators, the decision to invest in particular forms of infrastructure or types of fleet vehicles is based on extensive modelling of the options. This clearly takes the form of a structured and complicated context for modelling that is quite effective at giving an optimum output (domain 2). This is the standard analytical approach of an engineering firm, similar to that of Case 1. However, the way that the logistics firm takes a financial view ahead of a focus on the environmental impact reveals a major problem. This is described in the next section as an emergent concept from this stage of the research. No indication was given as to a values and principles based approach over a rules and metrics approach. In fact, the economic argument was dominant (4.2.7.2).

The dominant logic of both the bank and the logistics company appears to be that while they will enthusiastically support the objective of sustainability, including reducing their carbon footprint, they must maintain a rules-based dominant logic in relation to structured decision making over economic survival. This extends to being free to disregard possible moral implications provided their decisions remain within the law. Both firms thus demonstrate a rules-based dominant logic despite the external context that both operate in containing complexity.

Emerging concepts: Bounded rationality in economic payback calculations in SSCM decisions

Extending this notion into the topic of DT and SSCM, an issue that emerged from Organisation 4.2 was the role of bounded rationality in such arguments for alignment, and

that a consequence of this is to show that such arguments have a fundamental flaw. As the Head of Environment for the logistics company described,

> *"Our fuel costs are second behind payroll...we run a huge fleet of vehicles...we've got to think outside the box because fuel costs will continue to rise."* (Head of Environment) (4.2.5.1)

and

> *" let's stretch our thinking on this, because energy costs ain't gonna be dropping.*" (Head of Environment) (4.2.5.2)

The prediction of a constant rise in fuel price is based on an upward linear trend in fuel price over recent years. Environmentalists and others have long argued that as demand will rise faster than additional supplies are discovered, and as known resources expire, the price of oil will continue to rise, reaching the point of 'peak oil' where rising demand and falling supply will cause ever rising prices (Bardi, 2009; Witze, 2007). In reality, within two months of this interview being recorded, the price of oil dropped rapidly by 40% and continued to decline further. Recent analysis (Nov 2015) suggests that the fuel price will remain depressed until at least 2020 (IEA, 2015).

Volatility in the fuel price can be regarded as a wicked, complex or unstructured issue, but the assumption of the Head of Environment, echoing a familiar environmentalist rationale for adopting sustainability into corporate strategy, is that energy prices will continue to rise according to a simple-structured, linear trend. Hence, the dominant logic assumes a structured, linear trend in the external environment and bases investment decisions on this. The consequences of an unpredicted fall in energy prices therefore may have significant implications for firms relying on the economic justification for environmental improvements.

Besides the inevitable increase in consumption that can result from falling prices, efficiency measures intended to reduce consumption generally involve some form of initial capital expense. This then has a payback time where the reduced future fuel bill eventually passes a breakeven point and future savings become greater than they would have been without the

additional expenditure. Falling fuel prices mean the payback period suddenly becomes much longer.

Validation via triangulation for this point is provided by a discussion with an informant for Case 5.1, (5.1.1.2) that took place after the data collection for 4.2 and after the sudden fall in fuel price. Although the application is different from Organisation 4.2 as it concerns cutting carbon from buildings rather than from transport, the use of economic justification for eco-efficiency measures is the same.

Validation of this point highlights a profound flaw in the approach that many firms have to sustainability by emphasising eco-efficiency measures. If they take the economic argument first, and justify their efforts for improving the environmental performance of their operations on financial grounds, if the financial logic evaporates due to changes in the fundamentals, namely corresponding costs, then the environmental improvements will not be made. This is a serious problem in relation to the decision making around corporate action to address CO_2 as a PB issue.

In the validation discussion conducted in Case 5 (5.1.1.2) it is explained that for particular investments in capital works to improve energy efficiency, the payback expectation was seven years. As a result of the fuel price fall, it is acknowledged that this has extended to 15 years, but as there was still a payback, they were still able to go ahead. However, they also conceded that an investment decision with a 20 year payback was unlikely to be accepted. This means that the fuel price would only need to fall a little further (by about a further 12%) for all such investments in low carbon technology to be invalidated on economic grounds. Notably, since this interview was conducted the price of fuel did fall further. Even given the explanation of energy being purchased according to a futures contract, with the oversupply of oil set to keep prices low for the next five years, some investment decisions over energy efficiency will not be accepted according to rules set by anticipated financial return over a given payback period.

A number of implications follow. One is a proposition that there should not be an economic justification for cutting carbon. Instead there should be a moral justification, and this should take precedence. The affordability of this is then secondary, but the ability to tolerate either an uncertain or a negative return on the basis of cost may be a pre-requisite. Such

initiatives, even if producing no significant return, could be regarded as a 'cost of doing business' or as a contributing to an intangible asset of positive reputation for 'doing the right thing'. Certainly such justification was readily forthcoming in Cases 2 and 3, where strong values-based cultures were established, and ambiguity over level of financial payback was not seen as a problem. For the rule-bound, publicly listed logistics corporation in 4.2 or bureaucracy led public-sector client who commissioned Org 5.1, such freedom in decision making was not apparent.

Summary

The hope of decarbonisation of transport to address the planetary boundary of greenhouse gas emissions, leaves little to be inspired by in the near term. Many much touted solutions, such as electric vehicles, do not presently provide a like-for-like substitute for freight road transport. Whilst some options exist, such as compressed natural gas, the financial barriers to building the required infrastructure, even for large, fleet-based companies, seems problematic. Electric vehicles or hybrids for freight seem some way from market delivery. Modal shift to rail, is also limited in its applicability and cost benefits.

Eco-efficiency is thus regarded as the main highlight of sustainable transport initiatives, although this is far from sufficient for realistic decarbonisation.

Summary

- Org 4.1 has a large and sophisticated SSCM policy, with a large range of initiatives. Sustainability and corporate responsibility also play a significant role in corporate policy, via board level committees that can influence strategic decision making, notably on investment decisions.
- Cross-sector policy changes on SSCM issues can take a relatively long time to go from proposal to implementation
- Eco-efficiency gains via operations management and supply chain management can reduce costs, but these are also in-line with operational changes justified for other reasons (such as technological change)

- Dominant logic is in a state of transition, in some functions, in part to improve customer service. The transition from a rules-based DL to values-based DL has also been influenced by external factors, such as government intervention in the sector as a result of the 2008 financial crisis.
- Various barriers to promoting substantive transitions away from carbon-dependency are noted, including economic performance and technical availability of viable alternatives.
- The current economic performance of the firm (Org 4.1) is a strong influencer on the dominant logic and a driver for SSCM initiatives involving eco-efficiency as a means to cut waste.

Case 5:

Organisation 5.1 Construction Contractor

Description of sustainability within the organisation and how this relates to PB+SF issues

In contrast to previous cases, the sustainability element in the supply chain is more or less completely regulated. In case 1 there was a regulatory pressure introduced that was pushed up the supply chain by the OEM, but this was a far less mature regulatory system than we see in the UK construction sector. The conflict minerals regulations are much more recent. By contrast, the sustainability aspects of the UK building regulations and BRE codes - such as BREEAM and BES6001 - have been in force for more than ten years.

Secondly, the elements of sustainability covered are both quite detailed, with highly quantitative technical specifications, and comprehensive in that firms across the sector are providing information in response to the influence of regulations, including the social and environmental footprint of the ultimate supply chain. However, the directors in the organisation are aware of the gap between the level at which these interventions force performance via technical specifications, and the resulting net benefit in terms of macro environmental impact.

> "*Quite frankly, the only thing that is driving in investment in environmental is building regs and fuel prices. And fuel prices are still low. In some cases, some of the stuff is quite misguided actually...we respond to the legislation, but by and large we do not find that our customers are interested in it very much yet. As actually, the cost of energy into buildings is not very big. It's very small compared to the operational expenditure. Where you get excited people are supermarkets... Fridges were driven by compliance with regs...and petrol stations... preventing leakage and recovery of vapour. So that was reg driven...They've got PVs ...They've got biomass...Maybe 10% of them actually work...It's early adoption stuff. Some customers will drive for them, but biomass and PV are just window dressing. It's not a massive amount of impact it's happening...*" (5.1.3.6)

Description of how SSCM initiatives are being undertaken.

The SSCM initiatives in this part of the case are firstly the technical specifications from the BREEAM 'Green Guide to Materials', an online database of construction products and their related environmental performance data (www.bre.co.uk/greenguide). Secondly, SSCM involves the efforts by the contractor to ensure the safety of their sub-contractors, who are nominally suppliers (5.1.3.7). Health and Safety is a major issue for the construction sector (HSE, 2016) and there are various regulatory drivers, including the 2007 Corporate Manslaughter and Corporate Homicide Act that can prosecute directors over workplace fatalities.

Example SSCM Initiatives	Stage	Drivers	Barriers
1: Delivering to specified building regulations and BREEAM code	Well-established	Mandatory legislation	BREEAM 'a blunt tool'
2: Improving health and safety	Established	Moral imperative discussed (Legal driver present, but not mentioned in interview)	Not discussed

Table 26: Example SSCM Projects Org 5.1

Regarding the extent to which carbon reduction in the supply chain is addressed by the BRE Green Guide and BREEAM certification, this is actually very weak. BREEAM covers an extremely broad range of issues within sustainability, with flexibility as to which can be chosen by designers. This is described as,

> "*Under BREEAM if a product holds a BES certificate [responsible sourcing standard] it gains much higher credits than it does if it just has ISO14001 [environmental management standard]. There's a grading of one to eight and depending on how green your certification is for your product depends on how you score on that.*" (Architect & BREEAM Assessor) (5.1.3.5)

As with catalytic regulations, it can prompt change but does not coerce with strong penalties, as health & safety legislation or building regulations do. It is therefore important to be clear on the objectives, which in this Case is on the contribution that the construction supply chain can make to climate change mitigation, in line with carbon emission reduction to stem the planetary boundary of greenhouse gas pollution. We thus seek to explore the

link between the macro-scale PB, the firm level mechanisms (BREEAM and building regs) and an intermediate level of sector-level transformation via sustainable supply chain management initiatives.

The Green Guide is starting to push the construction products manufacturing industry towards a greater understanding of its material inputs and their associated environmental and social impacts, but this is a highly fragmented process. Companies are rewarded by points in BREEAM according to whether they have certain systems in place, not the actual performance achieved within those systems (5.1.3.3, 5.1.3.5). Therefore, it cannot be used as a measure of the actual life cycle (whole supply chain) carbon footprint of materials.

As noted by the client's estate director, the only motivation for an eco-building using BREEAM is reduced operational energy costs. Whether the building had a higher life-cycle (supply chain) carbon footprint than those savings will achieve is not relevant as these do not form costs to the building owner. This is a firm-focussed view, not a supply chain or societal-focussed view. Hence, if the carbon footprint is higher in the manufacture of the materials than are saved by the use of passive design, it is a charade to say that the building is better in environmental terms. The climate is only concerned with net carbon emissions, not how they are distributed. The question of the environmental footprint of the supply chain, or the life cycle footprint, is thus central to making a meaningful contribution to sustainability at the macro rather than firm-level, micro scale. However, there is substantial bounded rationality around the attempt to determine this.

Description of the dominant logic regarding decision making for SSCM.

BREEAM is clearly a structured-complicated decision mode . It is bureaucratic, but it is not obvious (5.1.5.1, 5.1.5.2, 5.1.5.3). The coding methodology is not open source, but requires a BRE approved expert assessor to calculate the scores, and thus determine optimum combinations of features (Cynefin domain 2). That said, it is clearly towards the structured-simple end of the scale (domain 1).

However, the Contractor clearly operates in an unstructured-complex space (5.1.5.4). Building projects are always unique. Even two seemingly identical buildings will be different because of their different locations. Every day a construction site changes, which is what makes Health & Safety so problematic. The solution for this is for people to be constantly alert to the changing and unpredictable nature of their surroundings. This nature of the work thus becomes central to the organisational culture and the type of people that are hired (5.1.5.5, 5.1.5.6, 5.1.5.7, 5.1.6.4).

> "*[Construction] projects are a series of problems that are to be solved. If it was easy to build them, you wouldn't need a principal contractor, because you just tell the subbies [sub-contractors] to turn up and send them a little list and when they should turn up. They are complex and they are one-off and that's difficult... And as soon as [people] say, 'that's the way we always do it', I want to scream and run away. As that's the last thing I ever want to hear from anybody...If you work with guys used to standards, they get irritated by the amount of change*" (Contractor, Regional Director) (5.1.5.4, 5.1.5.5)

Precisely because the highly contextual nature of construction prevents attempts to rationalise production (as is common in manufacturing operations), the mindset and approach of workers is of critical importance in the sector (5.1.5.6). The ability of people to think on their feet and make decisions quickly is vital. The right attitude is central to hiring (as in Case 2), and is supported by the organisational culture (5.1.5.6, 5.1.5.7, 5.1.8.1).

The architect has a BREEAM Assessor as part of the design team so they can balance the creative, aesthetic and qualitative aspects of design with the structured rules of the assessment that may constrain those design decisions. The benefit is that formal rules and less-formalised principles work well together, rather than be in conflict (5.1.6.1).

As the architect describes it,

> *"BREEAM is quite structured but ultimately there are opportunities for [more sustainable]design that aren't necessarily BREEAM based..." (5.1.5.1)*

And similarly, the contractor's view is,

"*BREEAM is only a tool and there's various tools out there for various different things. It's just a tick box. Things like BREEAM actually are quite misguided as well. Building regs tend to be more solid and drive performance to be what we want to get from places. BREEAM is a little bit more airy fairy to be honest.*" (5.1.5.3)

The role of a structured, bureaucratic system is therefore something that the designers and contractors accommodate as a regulatory demand (BREEAM was imposed on the sector from the top-down), but work around its demands in order to meet the fundamentally unstructured nature of work in the sector.

Interestingly, a withering critique was provided by one of the contractor's senior directors of the damaging effect that a rules-based culture can have on organisations. A series of stories were told about a major client who made central use of the balanced scorecard in their organisation, to great loss (5.1.6.2, 5.1.6.3) (Their assessment of the company was - some months later - validated by public announcements as to their falling performance). This is an important point in terms of understanding the issue around the relative stability and predictability, or complexity and unpredictability of the working environment. It relates back to many of the points raised throughout this thesis, going back to the conceptual framework discussed in Chapter 3.

One conclusion here being that regulation tends to demand bureaucracy, which tends towards the simple and structured domain. While this suits some commercial sectors. It does not suit all. Construction, agriculture and catering have strongly unstructured characteristics (seen in Cases 5.1 and 3), whereas manufacturing in times of linear trends has a strongly structured characteristic (Cases 1, 2 and 5.2).

No additional emergent themes are identified beyond those identified already.

Summary

- Org 5.1 is another firm with a clear principles-based / values-focussed DL, and this is strongly related to the nature of the work
- Sustainability issues and SSCM are fully regulated, and as such are issues of compliance.

- The influence of bureaucratic systems such as BREEAM shows a highly structured decision logic, yet the nature of architectural design is often unstructured (for instance, intuitive or creative decision making about design issues)
- The most significant sustainability / CSR issue is workplace fatalities, as construction is dangerous for reasons that include the inherent difficulty in predicting workplace conditions.
- The link between PB issues in buildings appears to be weak, with drivers such as cost proving insufficient motivators for developing low-carbon substitutes (meaning that infrastructure-level activity may be more significant).
- The cost argument for eco-efficiency will not drive reduction in PB3 impacts because of volatility in fuel price undermining payback calculations, and risk of rebound effects.
- A DL expecting linear trends in issues such as fuel price forces a focus away from arguments for issues such as greenhouse gas reduction on other grounds.

Organisation 5.2 Construction Products Manufacturer

Description of sustainability within the organisation and how this relates to PB+SF issues

The firm has made sustainability a strategic priority for the business and so has top level buy-in and a strong internal structure of working groups seeking to drive sustainable & responsible business issues throughout the group. There are wider sector-level initiatives aimed at reducing the carbon footprint of the industry as a whole, and strong interest from customers for a wide range of sustainability indicators, including specific SSCM procurement policies.

Whilst the BREEAM code contributes to the driving of SSCM back up the supply chain from the customer end, it is a weak catalyst for addressing the carbon footprint (5.1.3.3, 5.1.3.5). As a large industrial firm, Org 5.2 has however been subject to carbon disclosure and management via the European Union Emissions Trading Scheme (EU-ETS) and the Carbon Emissions Management And Reduction Standard (CEMARS /ISO14065). The firm is described by the Operations and Supply Chain Director as "*incredibly energy hungry*" (5.2.4.1). The BES 6001 Responsible Sourcing standard and BS8903, Sustainable Procurement Standard are also used.

As part of an internal initiative to pro-actively understand their environmental footprint, the firm has been conducting life-cycle analysis (LCA) of its products, and Environmental Product Declarations (EPDs), ahead of anticipated legislation (the EU Labelling of Construction Products Directive).

The firm has also been highly proactive in closed loop recycling (5.2.3.1) and energy efficiency gains. The result of a number of years focus on the strategic and operational benefits of sustainability have started to become embedded into the organisational culture, but barriers remain. One of which is that LCA is undertaken primarily as an external auditing issue rather than as a driver for operational improvement (5.2.3.2).

Description of how SSCM initiatives are being undertaken.

Surprisingly, it was found that as the firm has a high degree of vertical integration (including owning raw material extraction sites) and of closed loop recycling (including reclaimed materials from demolitions). Hence, raw materials were predominantly part of internal operations rather than the external supply chain.

The number one source of environmental impact in the supply chain was from their electricity supply. As the firm runs industrial facilities such as arc furnaces, they have a very high demand for electricity. Whilst reducing the size of this through efficiency measures is an example of alignment between an economic gain for the firm and a sustainability gain for society (as is the case with lean manufacturing), full decarbonisation is problematic. Substituting 100% of the energy supply to a zero-carbon tariff, dubbed a green tariff from wind, solar or biomass, or a blue tariff from nuclear, encountered economic and legislative barriers (5.2.4.3).

Example SSCM Initiatives	Stage	Drivers	Barriers
1: Life Cycle Analysis and Environmental Product Declarations being developed for products across the business	Underway	Customer-demand via SSCM policies. Influence of BRE Materials Specification (via regulatory drivers on certain customers). Forthcoming legislation (EU Labelling of Construction Products Directive)	Legislative: Metallurgical and Mineralogical Processes currently exempted from Climate Change Levy so incentive for carbon-free supply is removed. Economic: customer's supplier selection decisions are primarily based on lowest price, not environmental quality, technical quality, level of service or anything else. (5.2.4.5) For water utility customers this has a legislative basis as regulator demands that consumer prices are kept low. Lack of structure and comparability of the data in relation to competitors, or for information for external audit to be useful for operational improvement (5.2.5.1, 5.2.5.2, 5.2.5.3, 5.2.5.4, 5.2.5.5) (bounded rationality)
2: Operational changes to reduce carbon footprint and resource use in manufacturing via innovation in processes, investment in new plant, energy efficient process	Established	Internal corporate strategy sustainability policy Need to reduce costs to increase competitiveness	Internal awareness of energy conservation and sustainability as an issue (5.2.5.2) (bounded rationality)

design.		Strategic benefit of innovative new product development	Cost-benefit analysis (5.2.8.1) (economic alignment) Unpredictability of the regulatory environment preventing investment decisions in carbon-reduction technologies (5.2.5.6, 5.2.5.7) (bounded rationality)
3: Closed loop materials reclamation and waste management.	Well-established	Regulatory: Landfill Tax, brownfield remediation benefit. Economic: value can now be recovered because of new technology	Economic gains are modest and largest environmental footprint is energy (

Table 27: Example SSCM Projects Org 5.2

note: length of the description of projects in Org 5.2 is partly due to the extra volume of data gathered compared to previous cases but also the large size of the organisation and the comprehensive approach taken towards sustainability.

Description of the dominant logic regarding decision making for SSCM.

With LCA a central part of the manufacturer's SSCM strategy, the approach taken appears to be structured and complicated. There is a large internal programme of data gathering and analysis. What is not clear is the extent to which the manufacturer regards it as complex. The role of competitors is significant as there is no means to compare like-for-like within LCA when a rival may make an equivalent product out of a different material.

A pipe can be made of concrete, iron or plastic for instance, or a window frame from metal, plastic or timber. Each has a range of different functional characteristics but manufacturers establish these themselves, without necessarily having an independent third party dictate

which variables matter (e.g. weight, durability and maintenance implications, carbon footprint, etc.) (5.2.5.3, 5.2.5.5). As a disclosure requirement, LCA is seen as mere bureaucracy within customer procurement processes, not a means to deliver improvement.

> "*There is a general sense of it being a tick box. Have you got an LCA? Tick. They're not yet asking what it means.*" (Manufacturer, Commercial Director) (5.2.5.3)

As far as customers with SSCM policies are concerned, LCA is a simple-structured issue (domain 1). For Org 5.2 as supplier, the act of determining the LCA is taken to be structured-complicated (domain 2, requiring expert analysis), yet it is clearly unstructured-complex (domain 3). This is firstly at the level of comparison with competitors, which will be impossible without standardisation. Secondly, for internal operations improvement (5.2.3.2). In practice, the firm also appears to be in the 0 domain of Cynefin, which is 'uncertainty'. They are exploring what is involved and seeking basic answers, providing a tick box response for supplier selection questionnaires, embarking on analytics for their supply chain (5.2.4.4), and acknowledging the presence of complexity (5.2.3.2, 5.2.5.4).

> *"We are struggling to understand the definitions, particularly when our customers will define life cycle analysis to suit their own need...I think our customers would love to be able to use life cycle analysis as a selection tool as part of their discussions. Until we actually define what the full standards of that are and the initial unit of measured definitions that go into that, it becomes a little bit difficult to do like-for-like comparisons."* (Operations and Supply Chain Director) (5.2.5.5)

Or, as a sales director describes,

> "*you have a set of criteria [when you do the LCA] but if you do something the LCA changes.*" (Manufacturer, Sales Director) (5.2.5.4)

While there is a regulatory driver on obtaining knowledge on LCA issues, there are major problems with LCA being comparable between one company and another, or one product type and its alternative, which would enable a comparison between the two in a supplier selection decision, in line with a structured decision model. The dominant logic regarding LCA as something where gathering sufficient data and then analysing it to assess the area

for best improvement might therefore be considered to be out of alignment with the external context, as a means to advance mitigation of greenhouse gases at the macro scale.

The sense-making thus divides between the buyer and supplier perspectives, and supplier and rival supplier perspectives (where there is conflict over sense-giving as to what the criteria for specification of a product should be), and conflict over the internal and external application of LCA. Conducting an LCA as an external auditing exercise is a snapshot, like an annual report, responding to an external demand. It does not (yet) act as a driver for reducing the environmental footprint (5.2.5.5).

The firm does have an internal goal for cutting carbon and this is directly linked to the economic benefit of cost-cutting, in line with the eco-efficiency discussions in Case 4 (5.2.8.1). However, beyond eco-efficiency as a means to reduce energy demand, the substitution of energy supply to carbon-free sources is prevented by a high degree of complexity in the regulatory context,

> "*it's not easy to play with it. Particularly if you are talking about energy purchasing policies and the government's incentives and renewable obligations certificates and all those things...I don't propose to understand it all, but my simple view was when we were doing our company target, that we reduce our carbon footprint 50%, I said, 'well okay, 80% of our carbon footprint comes from what we melt. That's mainly driven by electricity. So therefore, all we need to do is replace our electricity suppliers with suppliers with renewable energy and hey presto, we've then reduced our carbon footprint by 50%.' No. It's not as straightforward as that...To be able to do that sort of carbon footprint, we need to be able to claim the sustainable impact of electricity generation, however the electrical generators claim that already. So, if you are a wind turbine supplier then you have already claimed your renewable obligation benefits. So, we then can't claim it again...*" (Operations and Supply Chain Director) (5.2.5.6)

This carbon reduction of large-scale renewables has already been sold to other companies via off-set schemes (OFGEM, 2015). The legislative structures around energy generation in the UK are thus central to how firms can account for their energy consumption in carbon or carbon-free terms (5.2.3.3). In pursuing the topic further, interview data from the firm's

energy buyer (and data triangulation with the firm's energy supply company) confirms the circumstances as inherently complex and unstructured.

> "*It is so very difficult to make a long term decision. Another of the difficult features of the market over recent years has been the changeable nature of it. Different government departments fighting each other and different governments changing things, even the same government changing things. It's very difficult. Take the Feed-in Tariff, for instance [a renewables subsidy levied on all energy consumers]. Where a year ago it might have been a beneficial thing to put solar panels all over the place because you'd get a decent Feed-in Tariff for it. On a whim they could just slice it in half or remove it. We know it's a risk, and we won't take that risk. Why would we. The changeable nature of the market is very difficult to deal with at the moment. It's almost paralysing.*" (Energy Buyer)

The lack of regulatory certainty in the UK creates an unpredictable context for decision making over energy investments. The decision context is thus unstructured and either complex (predictable retrospectively) or chaotic (fully unpredictable). The reasonable assumption is that it is complex rather than chaotic as awareness of the political context makes it possible to make judgements on the way government is likely to react. Post 2010, the political context swung away from subsidising renewables as a means to address their relative competitiveness against fossil fuels on the basis of so-called 'market failure'

The unpredictability for the manufacturing sector is the result of a divide between two policy areas, one of policies influencing manufacturing - which includes the policy of cutting carbon in the sector by 50% by 2025 - and policies seeking transformation of the electricity generating sector (CCC, 2015). The context is unstructured and highly unpredictable, and so the company is unable to make long term decisions on the nature of its investment in energy.

Emergent concept: macro-economic and national regulatory context as influences on SSCM decision making

This firm saw the most in-depth study of this thesis, involving multiple interviewees across the firm and with customers and suppliers. In part, this was due to sustainable and

responsible business having become introduced across the entire firm as a strategic priority. A large number of people were involved in SSCM policy and it was possible to attend internal workshops across the group and meetings with customers concerned about SSCM and related procurement policies. The process of culture change was far from complete, due in part to inertia from staff too close to retirement to want to change their working practice or mindset. Also, significant barriers and uncertainties were found in a number of instances. These required further investigation for validation by triangulation and juxtaposition, extending beyond the theoretical model of decision theory defined by the pre-specified concepts.

Returning to the emergent concepts from previous cases, we see that international competitors are one of the most powerful external influences. The competitive advantage these competitors have, based on their lower price, is fundamentally shaped by the actions of government as a stakeholder. Government influences the firm, and the whole sector, via the differences in cost base imposed by Western standards of business. These are absent in emerging economies, particularly in heavy manufacturing such as, say, steel, where lower labour costs and lower environmental and health & safety standards, along with different currency valuations, have an enormous impact on relative competitiveness. This case is the first to demonstrate the significance of this macro-economic context and the influence that it has on SSCM and its related decision making.

The competitive pressure is also exacerbated by the UK government forcing key customers of Org 5.2, such as water utilities, to deliver a reduction in bills to consumers. This is due to political reasons as domestic water bills were argued to be too high. The impact is then that the utilities are forced to bid for work with cost as the pre-eminent criteria in supplier selection. Numerous examples of the implications of this are found (5.2.8.2, 5.1.1.1).

> *"It's a very procurement-led economic model and therefore cheapest price often wins...Where we try to get to is to absolutely maximise in terms of the technical aspects of the bid, and sustainability is included in that...and then there's the price...If you take the mantra of if you cut the carbon you cut the cost...you'll either spend less money on electricity in the first place, or less money on pouring metal in. So*

absolutely there's a strong correlation between carbon and cost, and those are the two things that are really working for us." (Commercial director)

A further instance is the difference in energy policies in different countries, and the relative difference this has on the concentrations of CO_2 associated with manufacturing. As the operations and supply chain director describes,

"*At the moment, our electricity usage in all our carbon footprint is based on UK government average, which is based on the current mix of renewable versus all the other forms of generation. If you compare that with France, which we can readily do because we've got open access to the information there - which have a lot less. Why? Because they've got a far greater proportion in nuclear generation in France than we have in the UK. So, their electricity generation from a carbon footprint point of view is a lot more favourable. So maybe in 15 years time when there's two more nuclear power stations on stream, and more wind turbines dotted around the place, it will improve a little bit. "* (Operations and Supply Chain Director)

The emergent concept of stakeholders is thus complemented by the relative carbon intensity of different countries national grids. Costs for decentralised renewable energy systems were examined but found to be inadequate in scale and prohibitive in cost (5.2.8.1). This complements the findings of previous cases (3.1.6.3, 5.1.3.6). The interesting thing about the difference between French and UK electricity provision is the contrast over the role of nuclear energy as a large scale source of carbon-free electricity (Table 6).

Emergent concept: Substitution of energy supply rather than reduction of energy demand (eco-efficiency) as central to meeting PB via SSCM decision making

This prompted further exploration of the issue, including interviews with the electricity supplier for the firm and with an alternative major electricity consumer, a rail network operator. This latter firm is the UK's largest single consumer of electricity, who signed up a ten year deal for electricity supply from a nuclear-only tariff in order to meet their mandatory carbon targets. Significantly, the construction products manufacturer (Org 5.2) is prevented from making this same tariff switch and decarbonising their electricity demand for running arc furnaces and the like, because the UK government exempted the 'metals and

mineralogical sectors' from carbon pricing, in order to help with the problems of international competitiveness, and so creating a legislative and economic barrier to them doing so (5.2.8.1, 5.2.8.2).

This may be blamed on a highly unstructured situation in UK Government policy, not least as the different elements cut across ministerial boundaries, with a dynamic interplay of regulation across energy, trade and industrial sector policies (5.2.5.7). However, there is also a need to consider the sense-making context with regard to the perception of nuclear energy as a carbon-free source of energy.

This is deserving of further investigation and as such focussed the final part of the fieldwork on a supplier in the chemicals sector, providing the provision of fuel to energy companies with nuclear power stations, Case 5.3. As a controversial aspect of the sustainability piece due to the environmental movement having grown from post-war (indeed interwar) peace movement, notably the Campaign for Nuclear Disarmament (Weart, 2012). As environmental campaigners and activists have over time come to influence the business agenda, notably through key figures developing green business consultancies, the ideological context of a particular energy technology is highly relevant.

With a singular focus on greenhouse gases with the PB framework, is there a legitimate case to be made for nuclear energy as a significant means to deliver substantive reductions in the carbon footprint of major supply chains? That is certainly the indication suggested by Organisation 5.2, even though they have not been successful in doing so. Credible academic literature into the carbon footprint of the whole nuclear sector supply chain is quite advanced, particularly when compared to other forms of low carbon energy, such as renewables. This is summarised in Allen, Pentland, and Korre (2011), which finds the whole LCA of nuclear energy comparable to wind power, and substantially lower than other energy generation technologies.

However, ideological positions that place fear of nuclear power above fear of climate change have become well established (Weart, 2012). The unstructured-complex and chaotic nature of this problem is thus highly significant, with bounded rationality and other behavioural factors among stakeholders (both regarding regulations, NGOs and the public) playing a part in the ability to make substantive cuts to carbon emissions

Summary: There is much that is impressive about Organisation 5.2's work on SSCM. It is the most comprehensive studied thus far, with LCA a significant part of supplier selection decisions. Eco-efficiency policies for operational improvement are advanced and reaping rewards, particularly around closed-loops and recycled materials as feedstocks (5.2.8.1). However, the economic benefits of this are relevant only as means to reduce costs, and these do not go far enough to reduce carbon footprint. This reveals the alignment, or balance, between economic and non-economic criteria.

There is also a high degree of uncertainty and unpredictability. This is a result of the size of the organisation, the range of activities it is involved in, and the number of external organisations influencing it, including customers, competitors and government regulators. This may be a common problem in large, international organisations, especially those characterised by a variety of functions, divisions, cultures, especially where affected by mergers or acquisitions. In Org 5.2, between the complexity and contradictions of the regulatory context, the perceptual issues around how to substantially cut carbon, and the economic penalties at hand if they attempt to do so, there are significant constraints on decision making to advance SD via SSCM. Understanding the constraints to decision making for SSCM is thus better understood via this case research, where the nature of the specifics can then inform understanding of the generality, providing insight into the role of decision theory in the implementation of SSCM.

Summary

- Org 5.2 is a large firm with a range of impact associated with heavy manufacturing, yet they have set sustainability as a strategic priority and have implemented internal processes to address it within decision making.
- The DL remains that of a major manufacturer, and some areas of the business adopt sustainability easily. In other areas employee behaviour change is being created just by small symbolic changes, such as eco-efficient lighting systems, and this influences culture and DL.
- The external economic context is a powerful influence on the business and forces sustainability innovation towards eco-efficiency or other forms of direct cost saving.

- The customer base is largely bound by standard technical specifications, and so the industry as a whole has an inertia against innovation.
- Government regulations have an impact on both the price performance and potential for decarbonisation. Notably, some potential decarbonisation options via SSCM, such as purchasing carbon-free energy from nuclear power are prevented by legal classifications within various clean-energy offset rules.
- Meanwhile energy from renewables cannot be used to declare low carbon manufacturing because of rules around off-set certification, and a cost disincentive due to regulatory intervention.
- There is no incentive or requirement for customers to prioritise sustainability, as cost is the over-riding factor in supplier selection decisions. In addition, Western suppliers with higher standards find a cost-disadvantage against lower standard rivals who produce the same technical specifications but with lower environmental or health & safety standards.

Organization 5.3 Chemical Services Supplier to the Electricity Industry

Description of sustainability within the organisation and how this relates to PB+SF issues

The chemicals firm has a very clear definition of sustainability, which refers to the longevity of the business. This is dependent on being a favoured customer, and being a good citizen in the communities that it operates in, meaning it produces no negative health, safety and environmental impacts (5.3.3.1). As the firm provides chemical processing for the nuclear energy industry, this is a controversial point for some environmental campaign groups and is a clearly contentious aspect of the definition of sustainability.

However, as shown in the OECD data (Table 6) countries that are meeting PB3: climate change in respect of having a carbon intensity in their electricity grids of less than 100gCO_2/kWh are countries such as France and Sweden with a high degree of nuclear power, or Canada and Brazil, which because of the size of the country relative to population and its terrain have high levels of hydro power.

The nuclear sector is a highly regulated, high-performance industry, and the due diligence requirements of the customers dictate high levels of sustainable and responsible management. In addition, the firm has responded to investor requirements for sustainable and responsible reporting (5.3.3.3). There is thus seen to be an internal definition (5.3.3.2), linked to organisational values (such as 'being a favoured customer and a good citizen'), and external stakeholder definitions, including government regulations (5.3.7.1), investor expectation (5.3.3.3), plus the expectations for responsible operations from members of the public (5.3.7.2) and finally, contested definitions from anti-nuclear campaign groups, which have had deep impact on some sections of the public (5.3.7.4).

The firm is resolute that it exists solely to enable the provision of high volumes of low carbon energy (5.3.3.1). Their strategic definition of sustainable and responsible business is integrated into the organisational structure and its operational key performance indicators (5.3.3.2). These have shifted from being driven by external demands for auditing, particularly by investors, to a linked set of internal KPI's that help in operational improvement (5.3.3.4). This is thus a more advanced sustainable operations management

(SOM) process than that seen in Organisation 5.2, where metrics for LCA are used for external reporting and not integrated into internal management, or also with Case 3 and ESOS reporting (3.1.3.3).

Description of how SSCM initiatives are being undertaken.

Interestingly, while the firms downstream impact on PB is significant in a positive way due to their role in providing carbon-free electricity, their potential to influence upstream is limited. Their power within the supply chain is weak compared to their large utility customers downstream who hold the commercial relationships with the upstream extractives companies. Org 5.3 is a service provider that processes materials on the request of the customer but at no point becomes the owner of those materials, purchasing them from the upstream and then selling them downstream; the customer does this.

Where the firm sees its opportunity to influence the sustainability activities in its wider supply chain is by being an active participant in debates on improving social and environmental performance throughout the wider industry (5.3.4.1). Internal operations and external communications are far more central to their policy than the nature of procurement with suppliers.

Example SSCM Initiatives	Stage	Drivers	Barriers
1: Internal operations management to establish key performance indicators for sustainable & responsible business	Well-established	Investor requirements (e.g. GRI standards) (external stakeholder)	International parts of the business having different perception and definitions of sustainability & responsibility (bounded rationality: unclear definitions)
2: Stakeholder engagement with communities	Established	Organisational values of openness and transparency (internal values)	Varying public opinion in different countries (bounded rationality of stakeholders: public)
3: Engagement with trade associations to assist in sense-giving	Established	Driven to act by weak advocacy from energy utilities (external stakeholders: customers)	Psychological, ideological and institutional bias (bounded rationality of stakeholders: public)

Table 28: Example SSCM Projects Org 5.3

Description of the dominant logic regarding decision making for SSCM.

Structured decision making is central to the business. For the most part it operates a single, relatively simply but high value process (5.3.5.4), rather than multiple product lines (as in 5.2) or multiple facilities (Case 3). It is also an engineering firm (as is Org 1.1, and to a certain extent 4.2) where the dominant culture is for simple, structured decision making. This is also fundamental to industries where high levels of quality management are important to meeting technical standards required by customers and to meet the standards of highly regulated industries. The structured demands of external sustainable and responsible business reporting shows only minor modification to existing internal reporting procedures (5.3.5.1). The main challenge has been in aligning data across different parts of the business using different legacy systems (5.3.5.3).

However, a major source of uncertainty for the business is the economic context. This in turn is influenced by political decisions, influenced in part by public opinion (5.3.5.5).

Managing public opinion is highlighted as a concern, partly because reputations are instantly damaged by a single instance anywhere in the world involving any facility involved in the nuclear industry (in contrast to aviation or petroleum where major accidents have little effect on the wider industry). Fear of radiation has created a high sensitivity in the industry, leading to a very high safety culture and desire to spread best practice globally (5.3.5.2). External influences on the firm therefore come from a variety of external sources, including the market, government and communities, and the firm's stakeholder engagement processes are clearly responding to this.

This is particularly apparent in the example of community input with regard to the opening of new industrial facilities, where planning permission is granted on the basis of having the local community being granted a formal, statutory role in the decision making process. While the firm exhibits many rules-based processes, there was some indication of ethical principles applying within the wider context. This argument is not central to the organisational culture however (5.3.3.4, 5.3.3.5). Rather, it is an appreciation of the ethical context that enables the firm to gain a licence to operate from local communities on the basis of demonstrating that they are a safe and socially responsible business with the interest of communities and the natural environment at heart.

This organisation is taken to be the last in the thesis as a point of saturation is believed to have been reached. There is no additional emergent concept coming forward from the data, besides comparisons to previous cases. The case returns to the stable and structured culture seen in Case 1.1. The organisation also represents a high upstream point in the supply chain of Case 5. Finally, it is a firm that has a substantive positive PB impact. Finally, the role of perception in the firm's operations is central, with contested understanding as to whether the firm's operations are 'sustainable', yet clear factual evidence of the scale of impact in relation to PB.

Summary

- Org 5.3 has a DL associated with being an engineering-led firm in a highly regulated, high performance industry
- The firm has substantive impacts on PB+SF (PB3) via provision of high volumes of carbon-free electricity.
- The fundamental business of the firm means it has a strong alignment between economic performance and addressing PB3.
- However, it is affected by macro-economic factors, which include regulatory interventions in other countries affecting supply and demand and related inventory levels.
- Public opinion on the nuclear industry and its contested status as a sustainable business influences regulations in some countries.
- The public image of the nuclear sector creates a high sensitivity to risks anywhere in the supply chain, so as such the firm has a high degree of visibility and actively contributes to promoting best practice, transparency and public engagement.

Conclusion to the Findings chapter

As a summary to this chapter, the process of gathering primary data from semi-structured interviews across different sectors has resulted in a large volume of rich data. Presenting this in the style of narrative vignettes, formatted according to the pre-specified concepts, and discussing emergent concepts, has aimed at capturing the detail of the contexts. New issues relating to the themes of dominant logic and bridges from firms, through their supply chains to macro scale PB+SF impacts have been allowed to emerge. The next chapter on cross-case analysis refines the data further, establishing parameters for pattern matching and subsequent analytical generalisation.

Chapter 5: Cross-case analysis

The purpose of this chapter is to consider the common themes across the cases and describe the commonalities and contrasts. The purpose of this process is to consider the findings from the primary data in light of the research questions originally posed. The structure of this chapter is therefore subdivided into the following themes. The first two relate to the original research questions,

RQ1: How do firm's SSCM policies relate to PB+SF in practice?

Then to the second, concerning barriers to effective action,

RQ2: How does DT help explain barriers to meeting PB+SF via SSCM?

The following sections therefore concern:

- The scale of impact of the individual firm and what this means for both the meeting of PB+SF challenges and organisational decision making in relation to SSCM (Kleindorfer's bridge).
- The constraints on decision making that companies face in relation to acting on SD (defined as PB+SF) in their SSCM (the principle, or paradox, of divided responsibility - leading to a model of strategic alignment for sustainability)

How firm's SSCM policies relate to PB+SF in practice.

The first area of cross-case analysis concerns the link between the micro-scale of firm SSCM policy and the macro-scale of PB+SF impacts. Cases were selected according to PB+SF relevance, as shown in Table 7. However, the research has explored the degree to which the chosen firms have influence over the PB+SF issues that are present in their supply chains. As such, this relationship between the descriptive, context-specific characteristics of a firm and its place in a supply chain explain the degree of connection between the micro and the macro, which can be referred to as Kleindorfer's bridge.

The length of the bridge between micro and macro, can be thought of as how far the firm is aware of the upstream and downstream impacts. The width of the bridge could refer to the degree of control or influence it has over each tier. Some firms provide only a short part of the bridge as their visible horizon is limited to one or two tiers, such as Org 1.1, which, upstream, has an essentially dyadic relationship only. The consumer OEM customer at the other end of the chain, who receives the most direct influence from the Dodd-Frank conflict minerals regulations could be regarded as having both a long and wide bridge back up the chain. It has lengthy visibility and strong power. In relation to this case, similar characteristics can be seen with other large, electronics brands.

It may follow therefore, that large firms are more significant than small firms for delivering change in SSCM that can meet the ultimate goals of addressing PB+SF impacts. The cases covered in this thesis are therefore exploratory, seeking to establish relevant criteria with the goal of elaborating theory around SSCM and DT.

Other cases have a longer visible horizon, but represent a very small part of the market share in that supply chain, such as Org 3.1. Here the bridge is longer, but very thin. Awareness of the PB+SF impacts of the whole supply chain are very good, but ability to influence it is low. Both of these represent examples of limited influence as a result of their scale.

Org 4.1 has a comprehensive SSCM programme, but weaker links to PB+SF. Attention on carbon reduction arguably proves effective at reducing PB3, but this proves to be due to downsizing of the business, driven by technological change. Pursuing the policy of carbon reduction from the logistics supplier, further up to the providers of alternative, low carbon vehicles and alternative fuels, major barriers are encountered. These include technical barriers, where the automotive sector is unable to provide such vehicles, and financial ones, where the potential to change the nature of fuelling infrastructure to lower carbon alternatives is impossible. Meanwhile, the focal firm (Org 4.1) maintains a strong financial dependence on fossil fuel industries, and so all its involvement in carbon reduction are orders of magnitude lower than those of carbon expansion in relation to the firms it is helping to finance. This highlights a lack of freedom in the firm's decision making, where its ability to take a leadership role is limited by its obligations to return profits to shareholders.

Case 5, the largest of the cases, benefits from a clear regulatory driver at the far downstream end, encouraging energy efficient design and other environmental features in new build construction. Moving back up the chain, the manufacturers of construction products face certain regulatory and competitive barriers that similarly illustrate the barriers to advancing SD by firms that are required to act in ways that meet their obligations to investors to retain profitability. While the manufacturer has a potential to decarbonise its supply chain or act on other sustainability criteria, it receives no competitive advantage from doing so, and so is prevented. Moving to the final stage of the electricity supply, Case 5.3 shows a substantial impact, but again is hampered by legal and perceptual barriers. Table 29 shows the level of impact of the different case organisations.

Link to PB+SF / scale of impact	Examples in cases
Strong impacts	Org 5.3 for GHG reduction, with Org 4.1 arguably responsible for GHG addition. The Extractives industry (via Org 1.2) also has large firm-level impacts.
Moderate impacts	Org 5.1 (assuming mandatory eco-design brings GHG reduction).
Potentially scalable impact	Org 3 and Org 4.2 are both involved in R&D for sector transformation around GHG reduction. Org 5.2, as a large manufacturer could provide scalable GHG reduction if the legal and economic context changed.
Weak impacts	Org 1.1 and Org 3 because of low power to influence the upstream supply chain, and size of market share. Org 2.1 because regulations have forced the problem (phosphate pollution) to be addressed elsewhere, weakening the company's contribution to helping meet the problem, beyond symbolic value. Org 4.2 because of technical and financial barriers, and possible rebound effect.

Table 29: Scale of impact from micro org to macro PB+SF - length of the bridge

The case research has thus revealed both the relative scale of impacts and the barriers to firm's acting to address PB+SF. One of the significant issues to emerge is about the role of scale. The above case studies have illustrated the issues at play in SSCM when viewed from a firm-level, micro-scale perspective and contrasted with macro-scale PB+SF issues. The research has sought to determine how effective firms are at reducing negative PB+SF impacts via their own operations or supply chains. What has been found is that a firm-level focus in SSCM is disconnected from the macro scale of PB+SF and hence, SSCM research should be concerned with working top-down by addressing the sectors and firms that are most relevant to meeting PB+SF issues, rather than consider the firm-level perspective.

At the micro-scale, firm-level perspective there are multiple stakeholders and a primacy of economic responsibility over social responsibility. Regulators are particularly important influences in bridging the gap between the firm-level and the macro, environmental level. Whilst firm-level justifications of SSCM policy frequently point to initiatives that are clearly

eco-efficiency measures, there should be scepticism as to whether these contribute to any meaningful reduction in consumption. Besides low levels of reduction, rebound effects can mean that efficiency enables additional consumption. Preventing wasted energy enables an expansion of firm activity with the money saved, which also uses energy (Polimeni, 2012).

Taking a view at the supply chain level, whilst it is clear that supplier selection decisions do include environmental and social criteria, in these cases they do not appear to weight these more highly than price performance. As such, sustainability issues may at best become a hygiene factor but are not and will never be a differentiator.

As Case 5.2 found, procurement questionnaires may award a point for having an environmental product declaration (EPD) certificate, but won't interrogate what this certificate says the environmental impact actually is, and compare it to any competitors as the basis of a decision. Hence, either sustainable procurement policy must prioritise non-market factors (such as environmental and social performance) above market-factors (such as price) or firms must achieve alignment between cost and social and environmental performance. Such alignment is where there is a strong business case for sustainability. Areas of non-alignment or non-synergy illustrated by some of the incumbent organisations in the case research indicate the challenges of sunk costs and network effects of industries that produce negative PB+SF impacts.

A major theme emerging from the cases is therefore that there is not a strong attention on PB+SF issues in SSCM, and where there is, there is a common, symbolic mention of carbon and climate, or primates and palm oil, but seldom a substantive account of the scale of the companies' potential contribution against the actual scale of the issues. It is notable however, that SSCM initiatives can be put in place relatively quickly, so for instance, a supplier development initiative in Case 3.1 of direct relevance to SF criteria is a recent addition. This was begun after the primary data collection was complete. Hence, the cases described are snapshots or general constructs, that can quickly change. The goal is to understand the variables at play and how theory development can help in identifying relevant levers to increase impact.

One conclusion, relating to potential future research, is that small firms may have a low relevance for their contribution to meeting PB challenges. Instead, it is the large, multi-nationals, dominant in particular sectors, and with influence on their supply chains, in cross-sector associations and government regulators, who are most able to drive progress in addressing PB+SF. On the other hand, small firms can also have a disruptive impact in terms of innovation, or can be targeted by campaigners, despite their low influence, causing an NGO criticism to become a customer specification, no matter if the customer is small. SMEs can also have an impact if their actions on an aggregate scale are relevant. Such actions may therefore help to encourage transformation.

Having shown that a bridge is needed between firm-scale SSCM scholarship and practice and macro-scale economic and ecological scholarship & practice, the role of organisations in relation to their sectors and cross-sector associations may be all important. Furthermore, regulators appear central to systemic change, and here, partnership between business and government, particularly around low carbon innovation or land-use management, appears vital. What this means for SSCM and firm-level recommendations, is that some firms simply have little role to play in successfully reducing PB in their operations and supply chains. Firms are experiencing normative institutional pressure to make statements affirming their commitment to sustainable and responsible practices, but these are predominantly symbolic.

Only a few firms have truly substantive impacts, and if these firms do not change their practices, then any number of firms seeking to reduce their own (tiny) impacts, will have no successful effect on addressing PB+SF challenges. An initial expression of these relationships is shown in Figure 18 and Figure 19. These show the relationship between external parties, economic performance and social & environmental performance. Further elaboration of this in relation to the second research question is continued in the next section. Figure 18 shows how the dominant logic of a firm and its external context leads to and PB+SF outcomes in a typical business that prioritises economic performance over social and environmental performance. Priority influences are customers and competitors. Figure 19 then shows an

organisation that is enabled by its external context to achieve alignment between economic and social and environmental outcomes and so can make a contribution to PB+SF outcomes.

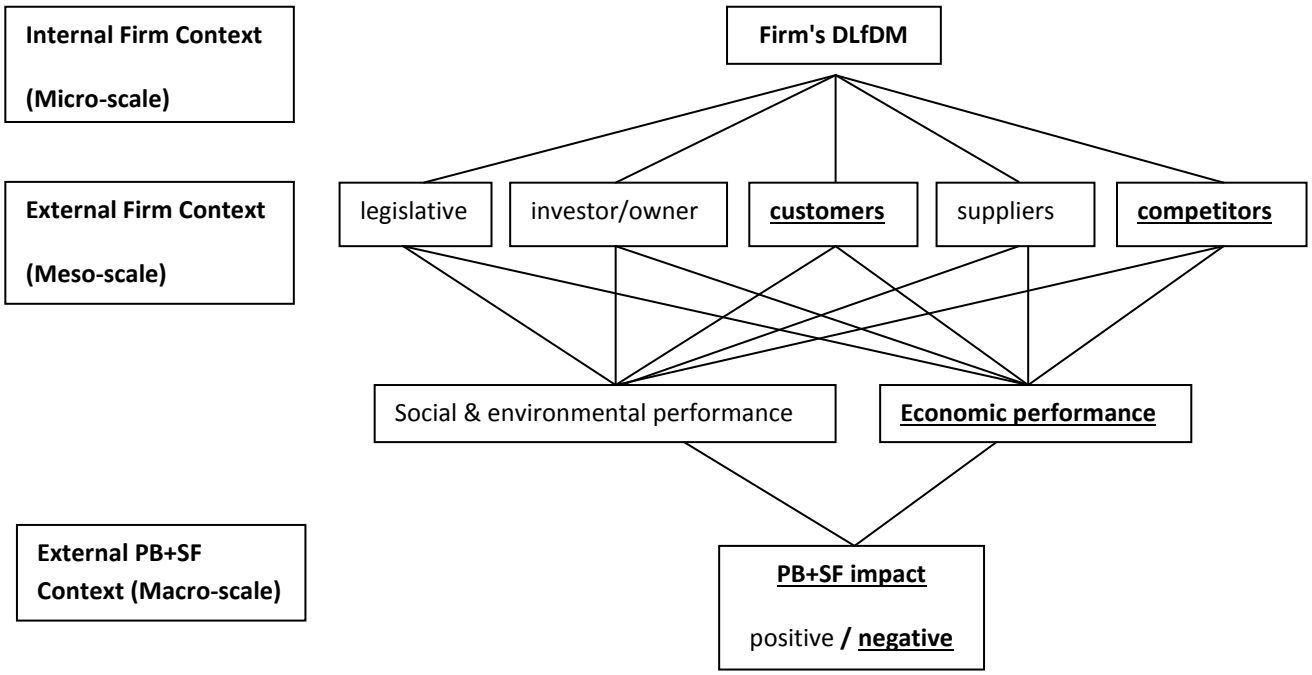

Figure 18: Internal firm dominant logic for decision making (DLfDM) typical business prioritising economic performance.

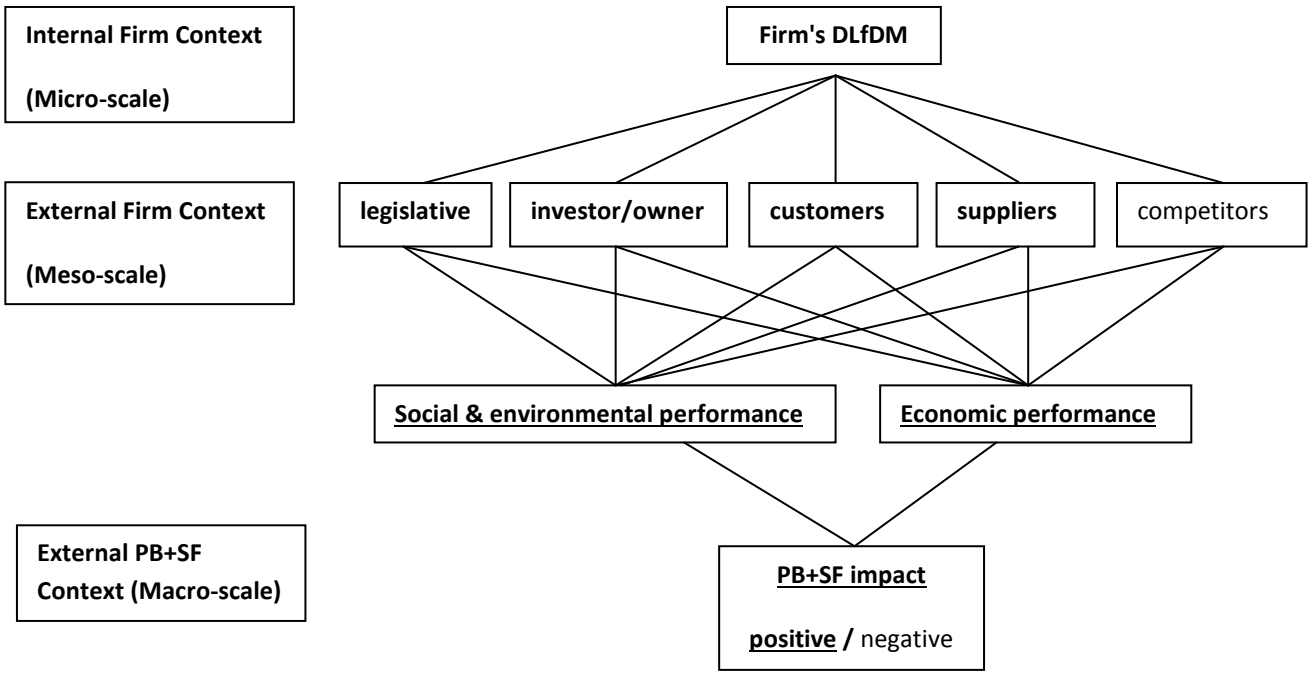

Figure 19: Internal firm DLfDM with positive PB+SF outcomes (example of a business that has alignment between economic and social & environmental performance)

RQ1: 'How do firm's SSCM policies relate to PB+SF in practice?' is therefore answered as follows:

Despite all firms interviewed in this research having an SSCM policy, only one (Org 5.3) had a clear understanding of the positive scale of impact that the firm's operations had in relation to a critical PB+SF issue (PB3). Another, Org 4.1, understood the negative scale of their commercial activities on PB+SF (PB3) but was not empowered to act on it due to misalignment between positive economic performance and negative PB3 performance (reducing negative PB3 performance would result in negative economic performance and so is not tolerated within the dominant logic). Similarly, Org 3.1 understood the PB+SF issues, but was disempowered to act on the basis not of the scale of their impacts (which were relatively minor) but because their relatively weak position in the supply chain prevented attempts at reform of the supply chain. Org 1.1, 2.1 and 5.1 did not provide clear explanation of the scale of the impact in their supply chains relative to PB+SF, which were regarded as materially insubstantial on a macro-scale due to the size of their operations. Org 5.2 could be regarded as capable of making a moderate contribution, but in fact was prevented from doing so due to regulatory and commercial barriers. A summary of the impacts, drivers and barriers is shown in Table 30, consolidating data from the findings chapter.

It therefore follows that answering RQ2 is essential to understanding these barriers to SSCM in relation to PB+SF, and this is examined in detail in the next section.

Case	**SRB Impact addressed via SSCM**	**Current Impact (PB+SF)**	**Drivers (Int. or Ext Stakeholders)**	**Barriers (Int. or Ext.)**
1.1	Electronics co. Social impact (SF) (environmental issues not central to SSCM policy)	WEAK Due to position in supply chain	Customer contractual requirement (due to regulation)	Low knowledge and influence. **(bounded rationality from lack of data / knowledge)**
1.2	Extractives Trade Association Social impact (case is not focussed on env. impacts)	MEDIUM i) due to influence on wider sector	i) Investment community, ii) Public reputation, iii) Regulation.	Cost analysis of sites and role of price volatility **(bounded rationality from complexity)**
2	FMCG Manufacturer Environmental impact: phosphate/ nitrate (PB2)	WEAK Due to minor position in market and larger impact of other sources (agriculture, water utilities)	i) Consumers (with pro-eco/ethical values) ii) internal company core values	i) Lack of knowledge and engagement with env. stakeholders (e.g. water utilities) **(bounded rationality: lack of knowledge &/or strategic alignment)**
3	Restaurant Chain Environmental impact: i) Habitat loss due to cash crops. ii) GHG from ops and SC (PB1, PB2, PB3)	WEAK Due to position in market / supply chain	Internal - company core values.	i) Regulations ii) Internal persuasion **(bounded rationality in knowledge of staff)**
4.1	Bank Environmental impact (PB3) GHG in ops and SC. GHG in client investments Habitat loss from client investments (PB1)	STRONG i) investment decisions are very powerful.	i) consumer values (poor reputation). ii) regulations (banking sector reform) iii) regulations (CRC)	i) Economic imperative means carbon lock-in **(bounded rationality: decision making bias - the fallacy of sunk investment) (Kaufmann et al., 2009)**
4.2	logistics supplier Environmental Impact: GHG from transport emissions	WEAK i) reduction from efficiency may include rebound effect	i) - dyad/triad collaboration for CO_2 cuts from cost cutting need due to tech change(rise of digital banking) ii) Vehicle emission standards from UK and EU regulations	i) financial barriers to low carbon transport (CNG infrastructure, Hydrogen, etc.) ii) technological barriers (EVs, hybrid trucks not yet on the market) iii) economic argument for eco-efficiency impacted by expectation of upward trend in energy prices **(bounded rationality - unpredictability)**
5.1	Contractor (materials buyer 1) Social impact: (SF)	MEDIUM i) firm is an exemplar for the sector, helping to	i) GHG reduction via Client requirement, driven by legislation	i) BREEAM is a 'tick box', but high quality design and construction is v. context

	Health & Safety from building construction.	drive high standards. note: design is the responsibility of the architect (PB3 from energy-efficiency)	(Climate Change Act, via Govt. budget for capital works requirement for BREEAM eco) ii) H&S via Corporate Manslaughter Act	specific and subject to qualitative design & build decisions. ii) 'hearts and minds' vital to achieve on-site safety. **(bounded rationality - assumption suitability of bureaucratisation)**
5.2	<u>Construction Products Manufacturer</u> Environmental impact: GHG in manufacturing processes (from electricity supply)	MEDIUM Firm is a large electricity consumer.	Reducing costs assists in competitiveness (energy reduction via eco-efficiency)	Full decarbonisation by switching to alternative carbon-free supplies are prevented by legislative barriers. **(bounded rationality: knowledge & unpredictability)**
5.3	<u>Chemicals Company</u> Environmental impact: GHG from electricity.	LARGE i) firm enables large scale carbon reduction.	Regulations and investor requirements.	Public understanding (sense-making). Wider economic conditions.

Table 30: Determination of the PB+SF impacts plus internal and external drivers and barriers.

A DT perspective on barriers to SSCM and how to overcome them.

This section addresses the organisational context that permits or constrains effective decision making in relation to SD and SSCM. While the previous section was primarily descriptive, with an introduction to some of the themes emerging from the data informing the creation of causal models, this section provides the detail of those models.

The second aspect of the research was stated as,

RQ2:' How does DT help explain barriers to meeting PB+SF via SSCM?'

The primary research therefore investigated the nature of the dominant logic used for decision making as an aspect of organisational culture. The Cynefin framework was adopted as a starting theoretical position, along with VFDA. The distinction between rules-based and principles-based decision making was then added. As discussed above, a significant emergent phenomenon was the nature of alignment between economic performance and social and environmental performance.

The first clear outcome is that the Cynefin domains describe dominant logics around decision making that are closely related to the nature of the business (Table 31). A clear divide is seen between organisations in sectors that saw unpredictable complexity as fundamental to their business, namely in extractives, catering and construction, and others defined by a structured 'engineering culture', in electronics, manufacturing, logistics and electricity generation. The FMCG firm, with a mature SSCM policy (more than 15 years), was defined as having an 'environmentalist culture' that was principles-based and also used values as a means to address a lack of resource for structured analytics. The financial services firm (Org 4.1) was also notable in attempting to change its dominant logic from a rules-based to principles-based culture.

Engineering-led firms all adopt structured, rules-based logics for decision making, but some had successfully incorporated SSCM into their standard operating procedures and KPIs (e.g. Org 4.1, and Org 5.3), successfully integrating relevant issues into performance management, quality control and improvement programmes. Org 1.1 was at the beginning of this process, defining SSCM criteria into supplier contracts according to a simple-

bureaucratic approach, but not yet establishing SSCM into the day-to-day working practices of the organisation.

Some firms have a principles-based, VFDA culture that is suited to the unstructured nature of their context, notably Org 3.1 and Org 5.1, though this had little to do with sustainability. However, Org 2.1 had an ecological VFDA culture due to values alignment with consumers over green & ethical issues being central to their core strategy. A similar need to align with consumer values is seen in the case of Org 4.1, where a rules-based dominant logic resulted in a collapse in consumer service and public reputation failures. The Cynefin domain and VFDA offer an insight into this transformation.

While the structured decision cultures are seen as effective, there is also evidence of problems when encountering a rapidly changed context. In relation to SSCM policies, clear examples are seen in relation to the assumption of a constantly rising energy price. This was used in a number of companies to justify expenditure on eco-efficiency measures on the basis of a given payback period. However, unpredicted change in the external context, as the price of oil crashed during 2014 and 2015, undermined the assumptions of these financial models. The dominant logic of a stable, predictable context of rising fossil fuel energy prices is rendered deeply problematic in the face of an unpredicted crash, undermining a core economic justification for SSCM.

A further example is seen in Org 5.1, where the use of bureaucratic eco-construction rules are criticised as potentially problematic compared with principles for good design. These are based on the insights of architects and contractors rather than prescriptive rules, derided as inappropriate 'tick-box' standards. Both architects working to balance multiple demands to achieve quality designs, and contractors working with constantly changing conditions during construction projects, appreciate the inherently unstructured nature of their work. Both are resistant to the attempt to impose structured standards for some social and environmental performance measures, including issues such as percentage of anticipated energy demand to come from renewable energy, percentage of recycled material to be used, number of local unemployed people to be given apprenticeships, and so forth.

A further finding in relation to VFDA is that values are explicit in Org 2, Org 3 and Org 5.1 and play an emerging role in Org 4.2, relating to social issues but not environmental issues.

In Org 2, values play a powerful role in maintaining an environmentalist dominant logic. However, there is no indication that the environmental outcomes of the business are substantial on a macro-scale. Indeed, the claimed benefits of the product are now met through regulatory standards, undermining the firm's claims. Although there is a strong symbolic element to the environmental values that supports the serial innovation strategy of the firm, the firm is not making a direct substantive difference to the environmental outcome in question. This returns to the topic of bounded rationality, as values can overcome rules, but because values act as a form of heuristic, they can be wrong, or at least sub-optimal, according to the DT principle of satisficing (good enough, but not necessarily best) (Simon, 1947).

In Org 3, values also play a powerful role, but not in support of an environmentalist logic. As the catering industry has high variability in the local context by location and by time, much decision making is decentralised to branch managers, but central coherence is maintained by a strong organisational culture that reinforces individual responsibility. One notable aspect of this culture is the tolerance that it has in decision making to ambiguity or uncertainty. Decisions can be taken because they are intuitively the right thing to do, rather than because there is a strong analytical argument of a specific financial return over a specific time-frame. As such, the firm has a strong ethical culture, though not (yet) a strong environmental culture. The nature of the ownership may also play a role in tolerating this ambiguity, as the firm is not under pressure from investors to show returns. Such pressure is seen in other cases.

In Org 5.1, values are again central to a culture that decentralises decision making authority in order to empower workers and sub-contractors to think on their feet. In Org 4.1, values are central to the way in which the organisation is seeking to change its decision making culture, although this is only a partial process that is far from fully established. Finally, in terms of the macro-scale of the impacts, the managers and directors interviewed rarely seemed to grasp the nature of the challenge of sustainability (Rockström et al., 2009), its scale, or their role in relation to it. Only Org 3, Org 5.3, and certain members of Org 5.2, stood out for their level of appreciation of the nature of the sustainability challenge.

Predominantly there is a firm-level focus and so managers frame their responses accordingly. When firm-level economic performance takes precedence over societal level environmental or social performance, due to external pressures such as from investors, this is an instance of conflicting responsibility. Hence, only options that lead to a clear alignment between economic performance and social/environmental performance leads to action. Therefore, one notable finding is the role of regulation as an effective driver (across all cases, with some much more than others).

However, whilst some regulations were seen to prompt organisations to disclose data or pay levies, they did not necessarily drive down negative environmental or social impacts. For example, in a number of cases (Orgs 3.1, 5.2) the UK Government Energy Savings Opportunity Scheme (ESOS) was regarded as a carbon tax, not as a motivator to reduce impact. Calculating the size of the levy was conducted as a central office accountancy function, not integrated into operational levels where performance could be made more efficienct in order to reduce waste. The cost of creating a data architecture sufficient to monitor energy performance with sufficient granularity was seen as more expensive than the cost of the carbon tax.

Outcomes are therefore ambiguous, pointing to the level of complexity that is inherent in political decision making processes by which regulations are forged, implemented and adapted. One stand out finding from Org 5.2, was that the regulatory context around clean energy had become so unpredictable that organisational decision making had become effectively paralysed.

Where business investment decisions required investor confidence on the basis of a degree of certainty, a turbulent, unpredictable environment could result in no decisions being made. By contrast, a values-based view, such as seen in Org 3.1, could tolerate ambiguity and not rely on an assumption or requirement for predictability, as the dominant logic was different, and shaped by different assumptions.

Notably, key aspects of organisational culture appear to be influenced by both the sector and the influence of external stakeholders such as government legislators, investors or customers. The interplay between the nature of a firm, and its external context is thus central to a description of an organisation, forming the first part of a general analytical

model for DT and SSCM. Contingency theory, and institutional theory offer additional perspectives on firm context, but central to the findings here are the influence of bounded rationality.

Large organisations with dedicated resource may be able to advance work on sustainability via significant data analytics, and can even address uncertainty via costly processes such as scenario planning and expert forecast analysis. Others, more resource constrained, or operating in sectors that are naturally dependent on decentralised decision making have dominant logics based on values. This is a different undertaking from that relying on standard operating procedures or data driven calculations as the basis of decision making. The dominant logic of each case plotted against Cynefin domains is shown in Table 33 and Figure 20, and the appropriateness of the DL to the external context, the level of fit, is described in Table 32 and Table 34. Characteristics of SSCM initiatives in relation to the dominant logic is then shown in Table 35 and Table 36. The next section seeks to elaborate on the role of decision making culture in advancing SSCM issues at the micro and macro level.

Case	Concept	Application
1.1 Electronics design firm	Cynefin domain 1&2	Dominant Logic - Rules-based engineering culture.
"*don't forget we are an engineering firm so people are very linear in their thinking...and don't necessarily get off their islands."*		
2.1 FMCG Manufacturer	Cynefin domain 3	Dominant logic - Principles-based values culture.
"*As a values-based business, we recruit on the basis of 'will people be able to fit in and add to our culture and work, and adopt and support our values...the idea is that everyone in the team is fostering, and working to drive, those values.*"		
3.1 Restaurant Chain	Cynefin domain 3	Dominant logic - principles-based values culture.
"The culture takes a bit of getting used to...It's a big company where it's got a very small company feel..." *""No one is saying to me, 'where's your compliance monitoring'. No one is saying, 'we need to go through loads more boring processes, that move us extremely slowly and just gets us a figure at the end of a year's work - and then we don't know what to do with that figure.* "		
4.1 Finance firm	Cynefin domain 3	Dominant logic - seeking to transition from rules-based to principles-based DL at particular parts of the business.
"*we have all sorts of delegated levels of authority...it all went very control focussed...we are reaching a situation where this very risk-averse position is unsustainable. So we need to rebalance and...I think, that's led to a more principles and values-based approach.. It's not a compliance-based, you must follow this set of rules. It's about equipping people with the principles that they need and the values to make that decision independently, without having to rely on a system of rules...the more rules you put in place, the less independent thinking there is within an organisation.*"		
5.1 Construction Contractor	Cynefin domain 3	Dominant logic - principles-based values culture.
" *[Construction] projects are a series of problems that are to be solved. If it was easy to build them, you wouldn't need a principal contractor, because you just tell the subbies to turn up and send them a little list and when they should turn up. They are complex and they are one-off and that's difficult....We've got a really good PM [project manager] who's done jobs like this before, and will do jobs like this again, but on every one of his jobs he's got a massive learning curve... That can't be under-estimated."*		
5.2. Heavy Manufacturer	Cynefin domain 2	Dominant Logic - Rules-based engineering culture.
"*It's high spec, specialist [engineering] where I have a team of engineers working for me who do the calculations. They rock up and, say I want an architectural facade on this, and he and his team would tell you exactly what you needed - calculate it all out. There are various models of wind resistance and all that stuff*"		
5.3 Chemical	Cynefin domain	Dominant Logic -

Services	1	Rules-based engineering culture.
"Governance around it basically is quite structured, so we have our sustainability agenda that is governed by our board committee. We then have [member of the board] oversee the KPIs around it... site champions which work with the group champions to deliver the KPIs...Our external impacts are at the absolute minimum of what they could be ...[and, ultimately] what we do is very simple and very standard."		

Table 31: Summary table of dominant logic

Case	Characterisation of External Environment	Dominant logic for decision making	Level of fit between DL and external env.
1. Electronics	Stable market	Cynefin Domain 2	Strong
2. FMCG Manuf.	Low variability but no capacity for analysis and values alignment essential.	Cynefin Domain 3	Strong
3. Restaurant	Constant variability	Cynefin Domain 3	Strong
4. Finance firm	Repairing reputation	Introducing Cynefin Domain 3 alongside Domain 2	Was weak, trying to improve
5. Contractor	Constant variability	Cynefin Domain 3	Strong
6. Heavy Manufacturer	Legal and commodity volatility	Cynefin Domain 2	Some difficulties
7. Chemical Service	Stable market but with significant risk of socio-political impacts	Cynefin Domain 1, some attempts to address Domain 3	Strong, but potential difficulties

Table 32: Levels of fit between dominant logic and external environment

How VFDA may apply to SSCM and PB+SF

While the section above details the role of organisational values as part of the dominant logic, an important part of VFDA (values-focussed decision analysis) is as a different approach to AFDA (alternatives focussed decision analysis). While the latter is about structured decisions between a given number of options, VFDA enables all alternative options to be rejected on the basis of whether they are compatible with the values of the decision maker. These are also referred to as the principles or the objectives of a decision maker.

While there is evidence of VFDA being used instead of AFDA, such as in Orgs 1.2, 2.1, 3.1 and 5.1, there is a question about how well this relates to PB+SF. Might this be considered an objective in an organisation, and hence that all decisions relating to particular choices could be rejected. For instance, a choice between two types of fossil fuel vehicle, one more polluting that the other, could be rejected completely if the principles said, no fossil fuels should be burnt at all, in line with a principle objective of attention to PB3, greenhouse gases and climate change.

This notion is relevant in the context of Org 4.1. There, a rules-based decision making was highlighted in contrast to a principles-one with the example of possible complaints of potentially unethical decisions that were nonetheless legal. This potentially highlights a diversity of opinion or perspective, or divergent dominant logics between commercial organisations and social & environmental campaigners. The latter are prepared to argue a moral case ahead of legal change, precisely to lobby for that legal change. The former say they can make money if it is legal to do so.

However, it is also argued, that the set of objectives are not aligned, as Org 4.1 may feel duty bound to maintain profitability and ensure employment (economic sustainability) to its employees and myriad customers. These issues around the role of values in terms of ethics do not appear to be as clear cut from the research as those around Cynefin.

How the Cynefin framework explains barriers to effective SSCM to meet PB+SF

SSCM initiatives relating to PB+SF may involve a descriptive, empirical measure, which for some firms is known and others is hypothetically knowable. Using the Cynefin framework, the complexity or simplicity of the context is relevant to the extent to which the scale of impact may be unknowable or only retrospectively knowable (Figure 4 and Table 10). The fifth domain of the Cynefin framework is uncertainty. Org 1.1 appears to be in this domain, without basic data on its impact, and so adopting a reactive, compliance-based stance. At the opposite scale, Org 5.3 has a known substantive impact, clearly measurable via their significant provision of carbon-free nuclear fuel.

In between, Orgs such as 5.2 are faced with life cycle analysis that is thought of by some in the organisation as a knowable, complicated undertaking that will result in clear data to

inform operational improvements to reduce impacts, or provide certification that will assist supplier selection decisions by customers. However, evidence collected also points to LCA in certain product categories as an unstructured, complex problem; there is insufficient means for standard classifications or comparisons that can be made across multiple product types. The system is thus fluid and dynamic, subject to change and competing definitions. It therefore does not represent a structured decision problem. Whilst recommendation from this might readily be to seek to impose structure, via seeking to influence the nature of the regulatory context, evidence of this was not forthcoming. Instead, we might conclude that LCA is a fool's errand until it becomes standardised and formalised under some form of regulatory standard, moving from the unstructured domain of plural and contested definitions, to a structured domain.

Instead, the short-term position in terms of supplier selection decisions by customers, was that firms are awarded for having an LCA or EPD in place, but not necessarily on the basis of any comparison between one supplier and another as to what that certification says. The environmental (and social) footprint of construction products is therefore not fully considered. Instead, the tick box presence in a qualification questionnaire is a clear example of a structured-simple decision space in the Cynefin framework.

What is *known* is whether an LCA or EPD is present, and that is awarded a simple point on that basis alone. At best, this may represent a catalytic trigger towards sector transformation towards increased sustainability in the supply chain. However, the static nature of an LCA or EPD certification, means that once a product had its data recorded and formally certified there is a potential disincentive to improve the underlying operational processes to reduce performance further. That would require the LCA to then be redone, reflecting the improved performance. The structured nature of the bureaucracy around LCA, including via established certification schemes such as the BREEAM eco-design standard, may run counter to principles of continuous improvement in operations management.

The Cynefin framework, as an element of organisational DL, therefore provides insight into the nature of SSCM that bridges into the macro-scale of PB+SF impacts. Here, whilst the shape or form of such a bridge may start to be pictured, in practice the boundaries to a rational approach and structured decision making are clear.

Other cases demonstrate different aspects of this link between the nature of the SC link with PB+SF, both as an externally measurable phenomenon and as the awareness of this link as an aspect of firm-level managerial attention and action.

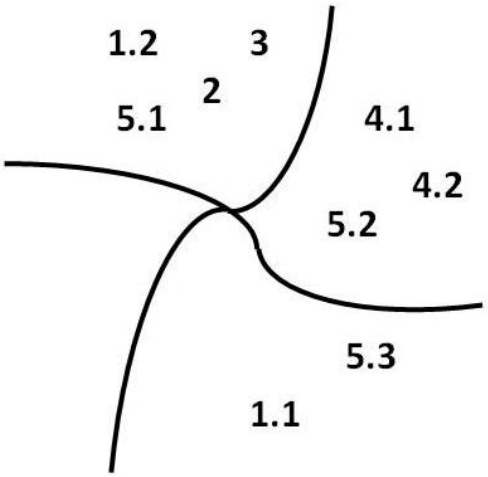

Figure 20: Case org dominant logic and Cynefin domain

Case	Cynefin domain description	Domain number
Org 1.1	structured-simple practices	Domain 1
Orgs 1.2	unstructured-complex context (but expert structured analysis likely important for decision support in large corporations.)	Domain 3 with some domain 2 - different domains at different levels.
Org 2	unstructured-complex (re: values, plus no resource for analysis)	Domain 3
Org 3	unstructured-complex (re: values, plus no resource for analysis)	Domain 3
Org 4.1	structured-complicated (considerable OR/analytics resource available, but new principles-based decision making culture seeks to decentralise some aspects, moving aspects of decision making into domain 3, some of which may relate to SSCM. Many aspects of SSCM operation are also bureaucratic-based compliance reporting (domain 1).	Domain 2 - but moving into Domain 3 at some levels.
Org 4.2	structured-complicated (considerable OR/analytics resource available, particularly around route optimisation.	Domain 2
Org 5.1	unstructured-complex (re: values inherent in the culture), bureaucratic compliance issues (plus BREEAM) also present.	Domain 3
Org 5.2	structured-complicated (considerable OR/analytics resource available, particularly around manufacturing operations and supply chains. LCA attempts some structured analysis, but bounded rationality present (complexity, uncertainty)	Domain 2
Org 5.3	structured-simple (internally, the business essentially conducts a single, simple process on a large scale and its supply chain is short and simple. However, external price volatility is complex. Stakeholder perceptions also entail complexity, but this is more loosely related to SSCM.)	Domain 1

Table 33: Summary of Cynefin domains

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	Dominant Logic			
	Domain 1: structured simple	Domain 2: structured complicated	Domain 3: unstructured complex	Domain 4: unstructured chaotic
		Rules-based	Principles-based	
External context:				
Stable and predictable		1.1	2.1	
Unpredictable (characterised by regular or single instances of volatility, uncertainty, ambiguity, complexity)		4.1, 4.2, 5.2, 5.3	1.2, 3.1, 5.1	

Table 34: Nature of fit between dominant logic and the external context

	Dominant Logic			
	Domain 1: structured simple	**Domain 2: structured complicated**	**Domain 3: unstructured complex**	**Domain 4: unstructured chaotic**
		Rules-based	**Principles-based**	
SSCM activity				
Stable and predictable	1.1, 5.3 (5.1)	5.2 (4.1a)		
Unpredictable (characterised by regular or single instances of volatility, uncertainty, ambiguity, complexity)		(4.1b)	3.1, (2.1)	

Table 35: Characteristics of SSCM initiatives against DL

Table 36: Cross case analysis of SSCM, with DL and PB+SF

Case	Dominant Logic	SSCM stance	Maturity of SSCM	Main drivers for SSCM	Main barriers to SSCM	PB+SF Impact in supply chain
1.1 Electronics	Rules based	Reactive, compliance	0-5 years	Int. Alignment with potential investors. Plus Ext. legal, via customer contract	Int. Employee engagement	Uncertain / minimal
1.2 Extractives	Principles based	Pro-active, conviction	>15 years	Ext. Investors, customers	Ext. Commodity price volatility	Uncertain / moderate
2.1 FMCG manuf.	Principles based	Pro-active, conviction	>15 years	Int. values of founder	Ext. regs show limit of firm-focussed SSCM	Uncertain / low-impact products, no significant macro-scale impact
3.1 Restaurant	Principles based	Pro-active, conviction	0-5 years	Int. Values of top mgt team.	Int. Employee engagement, Ext regs (e.g. re Tier 2 innovation)	Uncertain / potentially moderate
4.1 Bank	Changing from rules-only to add principles	Reactive compliance to regulation, pro-active conviction to change DL.	>15 years	Ext. Govt regs, plus consumer reputation.	Business case.	Minimal in own ops / substantial in investments
4.2 Logistics	Rules based		5-10 years	Int. Values of Top Mgt and cost-saving	Technology availability	Uncertain / potentially moderate
5.1 Contractor	Principles based	Reactive, compliance	>10 years	Ext. Regulations.	Technology availability (besides site safety)	Moderate social impact , minor PB impact
5.2 Construction Products Manufacturer	Rules based	Pro-active, conviction	0-5 years	Int. Strategic decision of Top Mgt Team. Plus, anticipation of regulation.	Cost disadvantage with competitors, influenced by regulations. Firm strategy ahead of mkt.	Uncertain, ghg footprint large but major projects create substantial local benefits.
5.3 Chemicals	Rules based	Pro-active, conviction	0-5 years	Int. Decision to meet potential investor expectations.	Cost disadvantage due to macro-economic factors (cut in demand 2011-2015)	Substantial positive PB impact. Very large GHG abatement.

External constraints on decision making

Seen from the theoretical perspective of DT, external organisations are relevant in that they constrain decision making. Org 1.1 is constrained by contractual relationships, for instance, though the impact is minor. The example of Org 4.1 in relation to fossil fuel investments is one of what economists call 'strategic hell', where managers are unable to act in ways that can produce advantage because the external environment (Begg & Ward, 2007). In economics, it is the condition of perfect competition, where the firm is unable to generate competitive advantage, that forces it into a reactive strategic position, making it harder to then create the value necessary, i.e. the freedom to act, to then best secure its future. In the decision making application, strategic hell for SD represents the inability to be free to act as a result of the external pressure. This is very similar. The competitive pressure and legal pressure is such that the firm cannot choose to disinvest on moral grounds. Any CEO that attempted to do so would likely be swiftly replaced on the basis of threatening the return on investment.

Only CEOs with very good relationships with shareholders might be able to persuade them of the long-term value proposition around ditching short term performance for long term strategy. Notably, those companies who are pushing for long-term goals on the basis of sustainability have been those with very healthy balance books and good relationships with investors, such as Nike and Puma, InterfaceFLOR and Apple.

	Dominant Logic	
	Rules-based	Principles-based
Ownership type - publically listed	1.1, 4.2, 5.2, 5.3 (4.1)	(1.2)
Privately-owned		2.1, 3.1, 5.1

Table 37: Link between ownership and constraints on decision making.

Taking this DT perspective on external influences is in contrast to that adopted by stakeholder theory, institutional theory or other organisational theories discussed by Sarkis et al. (2011) in a review of theories that could potentially be applied to SSCM. Table 38 summarises the position of each of the case organisations.

Case Org	Freedom to decide?	Main driver
Org 1.1	No. Coercive regulatory requirement drives SSCM	External regulation
Org 1.2	Yes. Can choose to cancel projects if cost profile changes	Strategic advantage
Org 2.1	Yes, but actions surpassed by coercive legal change elsewhere	Regulation
Org 3.1	Yes, but firm has weak power in the supply chain	Internal values
Org 4.1	Some. Acts in some areas but overall is highly cost sensitive	Eco-efficiency
Org 4.2	Some. Acts in some areas but overall is highly cost sensitive	Eco-efficiency
Org 5.1	No. Coercive regulatory requirement drives SSCM	Regulation
Org 5.2	Yes, but it is ahead of the market and ahead of regulation	Strategic advantage
Org 5.3	Yes, but they don't need to change what they are doing	Public acceptance

Table 38: Drivers and freedom for decisions

An emerging theme here was that political context is all important - SSCM as a way to address PB+SF would benefit from a link to political science and legal studies. It is an important part of the link between innovation as a driver of firm-level competitive advantage, and large-scale market transformation to address net impacts on environment and society. This is a critical meso-level of analysis (a level between micro and macro). There are different types of regulation that are relevant here - coercive versus catalytic and classic divides between compliance versus conviction - and the flaws of either extreme (compliance only = gaming, conviction only = incompleteness / minority action.

As noted in Chapter 2, there is no such thing as 80% sustainable. However, top down coercion does not necessarily work well either. As shown by the example of fertilizer control in China - a balance is sought between government demands and farmer behaviour, often to meet local demands (Huang et al., 2015) .

Chapter 6: Conclusions and implications

The nature of the problem discussed here is that sustainable development is important, but practitioners struggle to define what it is or should be. Hence, problems are encountered as to how to make it operational via their internal and external SSCM policies. While numerous companies now claim to be active in this space, the research has found that there is a high degree of symbolic action, and a very mixed picture of visibility regarding substantive action.

To some extent this is because of the organisational horizon that executives experience with regard to what is in their remit (or purview), and the difference between this and the existence of problems somewhere within their ultimate supply chains. The recent publication of Carter et al. (2015) on supply chain theory needing to consider the visible horizon, and Carter et al. (2015) on the need for more multi-level research, echoes the approach taken in this thesis. While both of these papers seek to advance SCM theory, the application to SSCM is particularly evident. As shown in the previous chapter, this thesis has attempted to investigate the links between the micro-firm level, through the meso-level of the supply chain, to the macro-level of social and environmental impacts, as defined by the PB+SF framework.

This has meant examining the visible horizon of different focal firms (Table 19). However, an additional concept has been added as regards the ability of a focal firm to influence the supply chain in terms of sustainability (Table 38). While some managers are forthright in their limiting their purview to the dyadic relationship, defined by a contract with their tier 1 customer or tier 1 supplier only, external parties (stakeholders) such as consumers, campaigners or regulators may regard transparency of far upstream or downstream issues as within a focal firm's ethical responsibility. Importantly, the actual scale of any given firm's PB+SF impact is not necessarily relevant. The exposure of the firm to symbolic action rather than substantive responsibility can be based on the nature of their customer perception.

For instance, Org 1.1 has no influence over its upstream supply chain, yet campaigners successfully lobbied regulators to introduce coercive regulations. Meanwhile, consumer facing firms (OEMs) were subjected to campaigns highlighting their responsibility for negative impacts. The result was that some consumer facing OEMs began to engage in

activities to increase their visible horizon into the ultimate upstream parts of the supply chain where social and environmental problems were associated with raw material extraction. Had the campaign focus and legislative driver been targeted at worker conditions in assembly plants, or the impact of e-waste on developing countries, then these areas may have been the new priorities for the firm's SSCM actions instead (work does of course continue on these issues as well).

Whilst seemingly opposite in its characteristics, Org 2.1 displays a similar form. Whilst it is proactive in SSCM policy, coercive regulations elsewhere in the supply chain have influenced their business, addressing a PB+SF issue that they had little influence over. The positive symbolic relationship with customers is also affected by this legal change.

Org 3.1 by contrast has no brand value attached to its SSCM efforts. It has a good visibility of its supply chain, but it has the benefit of a supply chain that is actually very simple. Org 1.1 has bounded rationality regarding their supply chain due to limited visibility beyond Tier 1. Org 5.1 and 5.2 have bounded rationality from the broad and eclectic nature of their supply networks. Org 3.1 instead, has only a small number of strategic supplies, from a supply chain that is really only two tiers deep upstream and one tier downstream. As such, it is easy for its SSCM team to calculate the relative environmental impact of different stages and engage with the supply chain on innovation to reduce this. Its main barrier is not knowledge but influence, being only a minority customer of very large suppliers.

The last two cases centre on large corporates with well-established SSCM programmes, Org 4.1 and Org 5.2. Here, the influence over the supply chain is stronger, but the influence over PB+SF remains relatively weak. The reasons for this are primarily to do with the alignment between economic performance and social & environmental performance, and the high degree of cost sensitivity of both businesses. The nature of decision making here is arguably one that is highly constrained. It was highly telling during discussions with the sustainability director at Org 4.1 that firms seen as leaders in the field of strategic eco-innovation were those with very healthy balance sheets and deep pockets.

Cost sensitivity limited the range of SSCM options capable of delivering progress on PB+SF to those with immediate, unambiguous cost benefits. Seeking to map the impacts across the supply chain, as with the major LCA initiative at Org 5.2, is a complex process. Redesigning

the logistics network between Org 4.1 and Org 4.2, massively reduced fuel consumption and therefore environmental impact, but was a necessity of changing socio-technical factors in the market-place and therefore would have been undertaken irrespective of the fact that fossil fuels are now seen as undesirable.

The extension of purview - greater supply chain knowledge, or 'reading the road ahead' - are thus driven by these external factors. SSCM policy can therefore be thought of as not always something a company necessarily has a great deal of ability to control. Of central significance in this appears to be the relative power between different external parties seen across different cases. Some see regulations as the dominant driver, where laws are well designed and implemented.

Ensuring a low resistance from industry to new regulations may require effective, although potentially lengthy, stakeholder engagement. For example, in the European Automotive industry where rules on energy efficient engines were developed over a 15 year period, successfully transforming the operating practice of much of the sector. Notably, in 2015, it was discovered that certain car manufacturers had decided to cheat the regulations by manipulating the performance of the vehicles under test conditions. The resulting scandal and economic impact serves as an example of the commercial risks of failing to comply with well-intentioned environmental legislation, and the resulting public health impacts show the seriousness of such commercial opportunism (Burki, 2015). A contrasting example is also seen with the USA's regulations on conflict minerals. These are of a different nature, with little stakeholder engagement and arguably weak success in reducing the intended negative social (SF) impact in Central Africa (Narine, 2012; Reinecke & Ansari, 2014).

For others, it is investors who have been the most significant drivers for change. New organisational decision making processes have been enabled by the need to report on specific metrics in relation to the sale of part of a business, the potential to attract new sources of investment, or to improve the operating performance of a business. This is seen across multiple cases (e.g. Orgs 1.1, 1.2, 5.3) and illustrates that investors share similar qualities to customers, in that they provide the revenue to businesses, and to regulators in that they can demand compliance. This helps to elaborate a new theoretical space between DT and SCM / SSCM as well as strategic management. In summary,

- the external influences on decision making have a significant effect on the actual ability of managers to make progress on reducing PB+SF impacts.
- This is formalised by the concept of alignment between economic and non-economic outcomes, i.e. social and environmental ones, here defined as PB+SF.

These dominant influences represent strong forms of imposing an interpretation on what SD must be and therefore what SSCM should include (Angus-Leppan et al., 2010; Touboulic et al., 2014). However, this imposition may or may not be an effective way to meeting the goals of the business or the meeting of social or environmental goals (here, defined as most importantly, the PB+SF goals, but other SD goals are not invalid, just less urgent from a macro-perspective). A wider discourse evident from this research is the role of coercive rules-based decision making environments, versus the more voluntary, principles-based decision making environments, or 'dominant logics'.

A significant contribution to the literature is therefore that coercive regulations are ineffective if they are resisted, and the nature of this resistance is likely from misalignment between economic performance at the micro-scale level of the firm and non-economic performance (social and environment) at the macro level of society or the planet.

Where there is alignment between the two, this can be a source of competitive advantage. This is illustrated by a simple model, showing economic performance on the Y axis and non-economic (social and environmental) performance on the X axis (Figure 21).

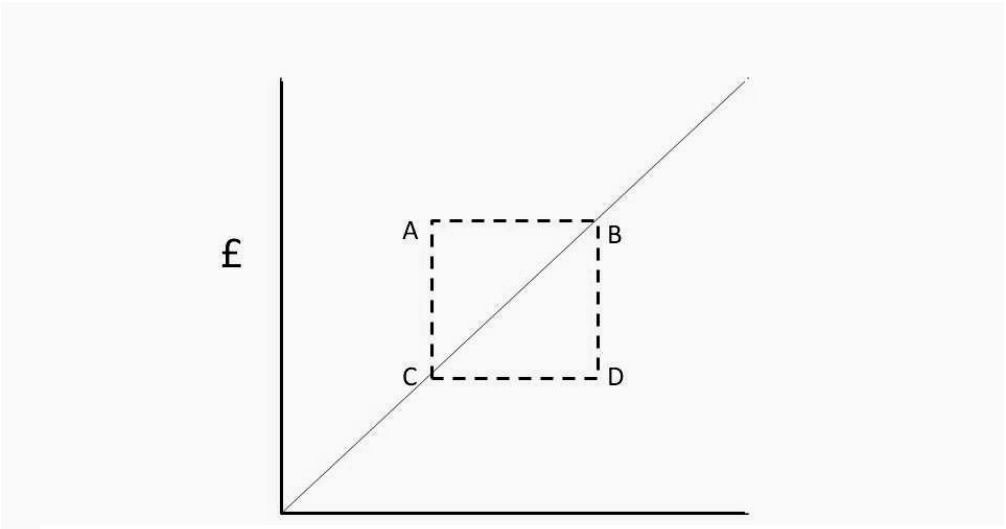

Figure 21: Economic and non-economic alignment diagram

Firms achieving alignment between the two are those with a clear 'business case for sustainability'. Increasing profits are aligned with increasing social and environmental performance. A number of the firms in this thesis have SSCM projects that are on this 'line of fit' but the size of the impacts associated are small in all but Org 5.3, where they are substantial. One discourse within the wider literature is that innovation will meet the need for alignment (Porter & Van Der Linde, 1995). However, within the perspective of PB, outlined by Steffen et al. (2007); Steffen, Richardson, et al. (2015), can innovation be trusted to meet the scale of the problem, given the speed and potential risk of failure entailed by research & development, plus new product development and market deployment? The carrot of commercial opportunity operating in a purely economically motivated context, and the stick of coercive regulations forcing the meeting of non-economic outcomes in the public, remains a central issue.

Interestingly, the research has found that the nature of dominant logic within organisations affects the levels of concern for economic and non-economic outcomes. Org 2.1, 3.1, 5.2 and 5.3 are all explicit in their commitment to achieving the non-economic outcomes, with

Org 2.1 and 3.1 willing to tolerate an increase in costs to do so, and Org 5.2 doing so reluctantly, given a strategy intending to develop competitive advantage from a focus on sustainability.

Decision theory offers salient models as to why this is so. As principles-based decision making decentralises responsibility to a given level, it is suited to a complex environment. Rule-based decision making imposes a structure, and hence is suited to simple contexts, where standard operating procedures, bureaucracy and basic legal standards apply. Complicated environments may be seen as those where expert lawyers are needed to interpret exactly what the relevant rules are or what they allow.

What follows is that while principles-based decision making may be the most effective for responding to a complex context, there is no way to rely on a whole population being motivated by principles. These require conviction, while regulation requires compliance. The moves to introduce principles-based regulation (Black et al., 2007), highlight the political desire for catalytic legislation that incentivises good behaviour through reward structures, in contrast to coercive regulation that can penalise non-compliance, and lead to resistance or gaming, and stifle company freedom to innovate.

This is epitomised by the divide between the informants in the pilot study. One maintaining that clear and strong rules are vital for the corporate reporting needed to meet social and environmental targets within the timescales demanded (a normative approach). The other, that sustainability or ethical issues and global supply chains are inherently complex, plural and contested (a descriptive approach). No regulation will ever be responsive enough, and the evidence of effective regulation around environmental issues may be regarded as inconclusive.

The interplay between effective regulation and actual economic opportunity is itself a matter of determining the nature of the decision context, and while this is an area of academic study within law and politics, it is of fundamental concern to the business and management discipline, particularly in relation to the effectiveness of SSCM.

It is thus highly relevant to management scholarship how an organisation manages its dominant logic in relation to SD issues. This is keenly demonstrated by the theory

elaborated here. The divide between the normative and the descriptive branches of decision theory, and the influence of bounded rationality, as described by Herbert Simon, in works such as Simon (1947) and Simon (1959), is central. Prahalad and Bettis (1986) in introducing the concept of dominant logic (DL), highlight that the attempt to change the dominant logic is a major challenge for organisations. Precisely this phenomenon is encountered in Org 4.1. To recapture a reputation for public service, underlying its social licence to operate, a change programme centred on changing the basis of decision making from rules-based to principles-based is encountered.

The link between DL and SSCM is addressed throughout the cases and elaborating the concepts with reference to Cynefin and VFDA has helped provide additional theoretical explanation to the phenomena encountered in each case. Returning to the four facets or requirements for SSCM in Carter and Easton (2011) and the five challenges for SSCM in Abbasi and Nilsson (2012), the thesis findings provide considerable elaboration on the nature of 'organisational culture & mindset' as both a requirement and a challenge for SSCM implementation.

The additional aspects of these two typologies, illustrated in Table 9, provide further opportunity for elaboration. Strategy and cost are clearly a common element in parts of the discussion above. Transparency, risk, operationalisation, uncertainty and complexity are all put into a deeper theoretical context by reference to the evidence and discussion presented in this thesis.

In the case of Wu and Pagell (2011), where guiding principles are found to be a means to address complexity in eco-exemplar firms, the theoretical context from French and Geldermann (2005), Keeney (1996) and Snowden and Boone (2007), plus the evidence gathered here, help explain why this is so. Further correlations with existing SSCM research, such as Tachizawa, Gimenez, and Sierra (2015) on the stances firms take towards SSCM, are reflected in the research, providing additional potential for conceptual synthesis and development of DT as a means to examine SSCM.

Primary data and analysis provided by this thesis contributes to answering the challenge posed by Sarkis et al. (2011) that greater interdisciplinary application can advance future research in SSCM,

"*1) It is unclear how external and internal factors interactively promote GSCM practices. 2) How to identify core companies along supply chains and how can governments exert pressure on such companies?*" (ibid. page 5)

It is hoped that the above discussion goes some way to answering this, and providing deeper theoretical explanation.

Towards a model of substantive SSCM: helping firms see their position more clearly

The next section addresses the development of a model of SSCM aimed at assisting firms in understanding the extent to which their SSCM policies are likely to have a substantive impact on what matters, namely the PB+SF criteria. As described by French et al. (2009), the bridge between universal issues and the context of a given decision maker is to bring the rational, normative ideal and the bounded and biased, descriptive reality together. This process of combination is what they call 'prescriptive decision analysis', and it is something that can readily be demonstrated when DT is applied to SSCM in relation to PB+SF.

The descriptive stage addresses a given organisations context, its internal and external influences that shape its decision making - both its internal dominant logic and pressure from customers, regulators, suppliers, NGO pressure groups, etc. - that affect its decision making on a day-to-day basis. The structure of its supply chains and the relative power it has to influence their activities or force (reliable) disclosure of impacts, the competitive pressure it faces, the psychological or legal pressures, are all evident from the examples explored in this thesis.

The normative model of what firms should do is that their definitions of sustainable development should first and foremost include the planetary boundaries and social foundations frameworks. These are identified by credible authorities as being essential and urgent requirements for sustainability. All other definitions of sustainability applied by firms in their operational or SSCM policies may be important at local levels (such as, reducing toxic air pollution, or using excessive levels of fresh water, or assisting local community charity work) but they do not necessarily have any relevance at the global, macro-scale, as defined by PB+SF. It is important to ask if these actions are necessary conditions to meeting PB+SF, or not. Largely, such actions should not be cancelled, but they illustrate a need to

consider local community support and social licence to operate, rather than substantial contribution to macro-scale goals. This is important precisely because the macro-scale goals are not being met. Attention on the wrong things is creating a dangerous illusion of progress towards these urgent and vital goals.

A prescriptive decision analysis for SSCM based on PB+SF can be illustrated with the cases here, using the data summarised in Table 36. Looking at the supply chain context of a firm, seeing this context in relation to PB+SF, and then comparing the two helps establish whether its SSCM actions are able to have a substantive impact on meeting PB+SF outcomes.

These two factors can be illustrated in a classic 2x2 grid shape, reminiscent of a stakeholder analysis grid shown on Table 39. This table shows the relationship between a firm's ability to decide and the scale of its potential impact, providing a clear consolidation of the themes presented in this thesis. The clarity of these two variables, derived from the primary data collection, provide a simple decision model to help a top management team, or middle management supply chain manager, in assessing the value of their firm SSCM policies and the importance of what it seeks to address.

- Do their operations or supply chain have a substantial impact.
- To what extent can they do anything about it.

It can be argued that what a firm should do is related to what it can do as responsibility implies agency. If a firm is constrained to act, such as by the pressure for economic maximisation, is it able to act? Under what circumstances might it be considered that there is a misalignment between the economic responsibility of the firm's managers and the social responsibility not to produce harmful impacts on innocent people or the natural environment?

The attempt to summarise the concepts from this thesis in this way seeks to answer Kleindorfer's challenge as to how to bridge the scales between the micro and the macro, firm and societal / global impact. The macro is represented here by the PB+SF to provide some definition and clarity from which specific routes through the meso scale of the supply chain come down to the micro scale of specific firms (shown in Figure 8).

	DRIVERS	BARRIERS
SUBSTANTIAL PB+SF IMPACTS IN THE SUPPLY CHAIN	**Important firms:** **(to be encouraged and assisted)** empowered to influence SC and has substantial PB+SF impact. PB1: Big buyers for agri commodities (e.g. Cargill, Li & Fung, Unilever?) PB2: water utilities / chemical companies PB3: Org 5.3 and customers (large-scale carbon-free electricity)	**Important but problematic firms:** (to be assisted) Substantial PB+SF impacts but disempowered to act. Need help to overcome barriers to action, such as no economic alignment (Org 4.1), no technical capability for viable alternative (Org 4.2), regulatory and competitive barriers (Org 5.2)
INSUBSTANTIAL PB+SF IMPACTS IN THE SUPPLY CHAIN	**Less important** Org 5.1 sustainability enshrined in legislation (UK building regulations, etc.) but impacts are small.	**Less important** Org 1.1, weak supply chain power. Org 2.1 legislation now addresses PB2 elsewhere in supply chain Org 3.1, weak supply chain power
	EMPOWERED TO INFLUENCE THE SUSTAINABILITY OF THE SUPPLY CHAIN: FREE TO DECIDE TO ACT HAS POWER TO ACT ----STRONG POWER OVER SC ----ENABLED BY LEGISLATION ----CLEAR BUSINESS CASE	**DISEMPOWERED TO INFLUENCE THE SUSTAINABILITY OF THE SUPPLY CHAIN:** BY BOUNDED RATIONALITY -----LACK OF KNOWLEDGE -----AMBIGUITY/UNCERTAINTY -----COMPLEXITY BY ECONOMIC DISADVANTAGE -----NO CLEAR BUSINESS CASE BY WEAK POWER OVER SC BY PREVENTATIVE LEGISLATION

Table 39: Model of substantive SSCM with drivers and barriers

Understanding the detail of their problems in comprehending and acting on SSCM policy via in-depth qualitative case studies has led to the formulation of the concepts displayed above. The first step in seeking to a bridge between the micro and the macro is to examine firm-

level understanding of both sides of the divide. Many firms may not realise that they have virtually no substantial impact on anything that matters. They may be swept up in the notion that everyone has to play their part and that it has become a social norm. Firms increasingly display earnest commitment to the intentions of sustainability, particularly consumer-facing firms concerned for the commercial impact of their public reputations (Eltantawy et al., 2009). But making symbolic statements to look good to their customers or investors, or having regulations impose costs without driving changes in performance, are not sufficient to meet the challenges of sustainability.

Table 39 above, shows firms that have little contribution to make, even if they seem to attempt to do so or are affected by regulations intended to change their behaviour. The more important category is that of companies that do have a substantive impact on PB+SF but can't do anything about it. Particularly, this includes those who feel prevented from action because to do so would undermine their economic survival. As discussed above, these firms may be stuck in a state of what in economics is called 'strategic hell'. They are unable to act because the implications prevent them. As action is inherent in the definition of a decision, they are prevented from decision making regarding sustainability because of misalignment between economic outcomes and sustainability outcomes. Decision theory thus has a significant contribution to play in helping to understand the nature of the business contribution to sustainability in terms of the drivers and barriers to action. This provides a clear answer to RQ2, and immediately presents a new understanding of the challenge.

For instance, do we need regulation to step in more forcibly? Politicians may be worried about job losses, so need to consider the economic and social implications of introducing measures that threaten the survival of industries in their countries, whilst those in other countries don't face similar measures. This question is far from theoretical, and is found to be central to performance in relation to SSCM throughout the case research.

Conclusions and contribution from the research

A contribution has been made in this thesis by assembling for the first time in the SSCM literature data on PB+SF and the role of the major sectors contributing to these. The sectors explored in the case research were considered deserving of particular attention: carbon-free electricity generation, phosphate-free detergent, and agricultural policies for encouraging biodiversity.

The role of the decision cultures within firms has also been shown to have an important impact on the nature of action in light of uncertainty in the decision context around SD and SSCM. Firms with a principles-based dominant logic appear more likely to tolerate ambiguity in their possible SSCM initiatives (Org 3.1). The example of Org 4.1 in seeking to change its dominant logic is also highly relevant.

Prahalad and Bettis (1986) introduced the term dominant logic as a schema by which organisational decision making practices are shaped by the senior management team, and included the question of how the cognitive schema of a dominant logic can be changed. In the wider SSCM literature, the role of leadership shaping organisational culture to assist SSCM is found by Gattiker and Carter (2010) to be highly effective driver but one that is often under-utilised. The way that interpretation is imposed, called 'sense-giving' (Angus-Leppan et al., 2010), is a key aspect of this. So how well leaders understand the issues of sustainability and can express this in their stories, relates strongly to how well an organisation can respond to the presence of bounded rationality in SSCM (including complexity and uncertainty). One company used the metaphor of a boat at sea in a storm, needing to keep on a heading to a safe harbour, to describe their situation in recent years. They accept uncertainty and unpredictability, but use values and guiding principles as a way to keep on a particular course.

However, a second key theoretical conclusion is that in the face of plural and contested definitions of sustainability and responsibility, applying PB+SF serves as a simplification tool. It is a normative way to impose a simple structure in order to prioritise what matters in the face of an emergency. The plural and contested definitions found in SSCM, as detailed at length in the existing literature (Hassini et al., 2012; Preuss & Walker, 2011) serve to pull the

issue into the complex domain, making it unstructured and subject to multiple interpretations (the various theorisations of which are shown in Table 10). The resulting confusion is a barrier to action and a key instance of bounded rationality due to lack of clear definition.

Taking PB+SF as a definition of what matters in relation to SD and thereby SSCM means pulling the issue back into a being a more easily defined, structured problem. The analysis undertaken to illustrate the relevant sectors shown in Figure 8 represents the issue being brought into the structured-complicated domain. Defining the significance that particular firms in the case research hold in relation to PB+SF in the 2x2 model in Table 39 represents a move towards the structured-simple domain. The scale of the impacts and hence the significance that the firm alone has towards substantial contributions, both positive or negative, to PB+SF is thus 'known'.

This leads to what is called the principle of substantive sustainability.

The central issue is the relative effectiveness of SSCM initiatives, assuming that the normative priorities should be those of PB+SF as SD cannot be achieved without them. Considering the data provided by the case studies here, the success of the company SSCM initiatives studied (in light of the enormity of the challenges posed by the PB+SF) is very poor. Managers and directors interviewed rarely seemed to grasp the nature of the challenges and their scale. Only Org 3.1, Org 5.3, and certain members of Org 5.2, stood out for their level of appreciation of the nature of the sustainability challenge and the role they could really play.

Predominantly, there is a firm-level focus and so managers frame their responses accordingly. When firm-level economic performance takes precedence over societal level environmental or social performance, due to external pressures such as from stock-market investors, this is an instance of conflict.

This is called the principle of divided responsibility.

What follows from this is that only options for firm-level SD actions (including SSCM) that lead to a clear alignment between economic performance and social/environmental performance leads to action. The bulk of SSCM research concerned with establishing that

social and environmental considerations do result in improved economic performance, and the related theoretical perspectives from strategic management, such as the resource based view, are all based on the primacy of firm-level performance. As noted by Whiteman et al. (2012) and Pagell and Shevchenko (2014), this requirement for economic alignment is insufficient for meeting the challenges of worsening environmental impacts.

Therefore, the following propositions are drawn:

1. To make a substantive and meaningful contribution to achieving SD, SSCM researchers should focus on what matters more, and less on what matters less or does not matter at all. This is a sense-making and perceptual issue and hence there needs to be greater communication on the nature of PB+SF as an SD priority.

2. SSCM researchers need to consider what steps are required to achieve alignment that will meet PB+SF needs. These may include priorities for research, development and deployment and government industrial strategies to best enable this. This entails a level of inter-organisational analysis and strategic management at the sector scale.

3. SSCM research should explore the role and impact of regulation as an effective driver, in partnership with scholars in law and political science. In particular, the role of catalytic regulations, such as the Landfill Tax or *de facto* carbon taxes that impose financial penalties that prompt changes in behaviour but do not mandate specific targets to be met. Coercive regulations, by contrast, can ban practices outright, or require reductions to specific levels under threat of fine.

The outcomes of all of the above options can be ambiguous, pointing to the level of complexity that is inherent in political decision making processes by which regulations are forged, implemented and adapted. The conflict minerals rules in Case 1 for instance, are catalytic, but not necessarily effective at meeting the goal of the policy. Org 1.1's perception of the issue was at an early stage and focussed on compliance to a customer requirement rather than how they might increase their level of substantive contribution (if at all).

In conclusion, understanding the descriptive characteristics of an organisation includes addressing issues of bounded rationality about context in terms of their supply chains and the relative PB+SF impacts therein. Secondly, understanding the descriptive characteristics

that shape their decision making ability due to their organisational culture and exposure to external influences. This is the internal Dominant Logic (DL), but also the external influences, whether defined in terms of stakeholders, drivers & barriers, or institutional pressures (e.g. social norms, competitive pressures, coercive regulations).

This can be summarised in two parts

- Description of the SC in relation to PB+SF
- Description of the DL and external pressures.

Once the description of the firm context is considered in this way, it is clear that some firms matter more than others (as shown in Table 39), and hence some procurement decisions are more important than others. Electricity generating companies, auto manufacturers and manufacturers of energy efficient gas boilers or immersion heaters are the most relevant companies for advancing progress on meeting PB3: climate change. Achieving this via carbon-free substitution of these technologies is more important than for other firms to reduce their on-site energy consumption via efficiency measures.

The extent to which regulation can help tame complexity is perhaps the next stage to be considered in research designed to determine how best to help meet PB+SF targets. This is part of what is needed to answer the call of Whiteman et al. (2012), that corporate sustainability activities taken in isolation or only to benefit the individual firm, are unlikely to effectively meet environmental or social challenges.

However, taking the PB perspective, as they recommend, this thesis has examined how the three most urgent issues (and SF impacts), correspond to specific sectors. This cross-sector analysis has not been found in previous SSCM literature.

Urgent PB issues may be isolated to specific industries responsible for these specific impacts. Secondly, the research found the extent to which country-specific legislation (or lack of) can affect these impacts, both negative in terms of causing them and positive in terms of seeking to reduce them.

Company activities in relation to PB+SF as a requirement of sustainable development therefore do not take place in a vacuum. They have a geographical and regulatory context.

However, firm's enacting SSCM policies appear to be ill-informed about their place in relation to these impacts and the policy goals seeking to deliver them. In some cases, such as Org 3.1 and 5.2, even when there is a strong strategic commitment to delivering macro-scale sustainability, the attitude is that government regulations, such as carbon taxes, are a bureaucratic barrier that have a negative economic impact without properly helping to deliver macro-scale PB targets. Regulatory change creating uncertainty, and lack of context on the nature of the source and scale of impacts, is actually creating barriers to effective action.

In conclusion, the application of the PB+SF framework as a novel contribution to SSCM literature leads to the following summary in answer to the research questions (RQ1 and RQ2)

- Sustainability is not a property of organisations but a property of the world as a whole (the planetary ecosystem, or global society).

- Successfully addressing PB+SF criteria is an essential condition for achieving sustainability/sustainable development.

- Organisational level SSCM actions may be a necessary condition for achieving sustainability, but they are not a sufficient condition for sustainability.

- Establishing the sufficient conditions for sustainability means understanding which organisations have a relevant to role play.

- Failing to address which organisations are essential for addressing PB+SF means potentially paying attention to organisations that are irrelevant and failing to pay attention to organisations that are essential.

- The roles that organisations play can be both positive in helping to achieve sustainability, and negative in that their actions prevent the achieving of sustainability.

- DT can help develop theory in SSCM as it shows how drivers and barriers to implementing SSCM come down to the influences on managerial decision making.

- An important aspect of this is the dominant logic in a firm's culture that shapes decision making. Some firms can tolerate or even expect uncertainty, ambiguity or complexity, and this affects their ability to act.

- However, where this uses values as a heuristic, instead of rule-based, quantitative analysis, there is a risk that the results are suboptimal in terms of their environmental or social impact, as the use of values may shortcut the need for known facts.

- Firms that are publicly listed and face pressure from shareholder investors risk being disempowered due to their decision making being constrained by the responsibility to maximise economic performance, conflicting with the social responsibility of not contributing to negative PB+SF impacts.

- The contribution that firms make to PB+SF impacts varies considerably, with some firms having substantial impacts and others having insubstantial impacts. Understanding the scale of the impacts is essential for making meaningful progress on addressing the problem.

Recommendations for practitioners on the basis of the research

There are many common claims on corporate sustainable and responsible actions, not least relating to packaging or charitable giving or energy consumption. But the relationship between common claims that may have value as symbolic statements supporting reputation among the public, and substantive actions, where specific measurable results are achieved, is all important.

While many firms are starting to talk the talk on sustainability, who is really walking the walk? This research has shown that there are many barriers to how these substantive results can be delivered, not just lip service, also known as green wash. These issues are well known to some managers working in this space. This research has helped to articulate why these barriers exist, and what to potentially do about them.

There are two implications from this. One is that for many firms they actually have less importance than they realise. They may be perturbed that they are being called on to do more, but that they think they are doing more than they should. One aspect of the popular debate around sustainability is the notion that all firms should become sustainable firms and that a supply chain will be a sustainable supply chain if it eliminates all its bad impacts. This view may be an inefficient one.

This research has shown that some firms have far more substantive impacts than others and this is due to the assumption that there should be a small set of priorities for sustainable development, and these should be the focus of attention first. These are the PB+SF factors.

Once these are adopted, then it is clear that there are specific sectors that are important, as shown in Figure 8. What has been missing from research on SSCM to date is a clarity on the role of particular sectors in particular impacts. This thesis includes an initial, brief contribution to this goal.

Under the broad umbrella of issues around sustainable and responsible business, it is important to understand which industries are truly important, and which are essentially unimportant. There is little connection between the level of claim made about impacts by businesses and the related impact or outcome. Indeed, the relationship may be inversely proportional, with very vocal firms actually having a relatively insignificant impact, while the major firms causing the greatest problems are quiet on the issues.

This distinction also relates to the concept of strategic alignment between economic performance and environmental & social performance. The degree to which a firm acts on PB+SF is related to their economic advantage in doing so. On the one hand, this means that SSCM has been correlated by research as linked to economic advantage (Golicic & Smith,

2013). However, this should be self-evident from the perspective of alignment, as non-aligned activities should either be curtailed or never even attempted.

By contrast, where there is an antagonistic relationship between a substantive sustainability or responsibility goal and a firm's strategic advantage, then the firm will pursue a range of options from ignoring sustainability, to greenwash, to contesting the very notion of sustainability with all its might (Bowen, 2014).

As such, firms that are vocal but irrelevant give false hope, while firms with huge impacts, whose decision making is constrained because to act would undermine their own economic performance, act to divert attention and prevent regulation that will put them out of business. Research around Org 4.2 found a clear example of this where the government was lobbied to drop a carbon based tax on fuel on the grounds that it would have a negative impact on business and social users of transport (such as ambulances). The claims of 'fossil fuel is a browntech sunset industry', or the divestment movement or (short lived) regulations such as the Australian carbon tax, point to the politically contentious and deeply challenging nature of this issue (Kiron et al., 2013).

The end result is knowing the nature of one's firm and the related supply chain from the perspective of PB+SF in the first instance. If the link is small, don't claim to be saving the planet. And vice versa, if there is a clear link, explain it, and people may flock to your business. As is seen in the case of nuclear, however, merely having a fact-based argument is not enough. Issue framing and various other forms of psychological influences can have a far greater influence, and so behavioural decision making is an essential part of understanding the potential of SSCM to meet the challenges of sustainable development.

Future research directions.

This thesis has explored the PB+SF leaving clear areas for future investigation. Firstly, the SF factors, then the PBs of nitrogen and habitat loss are under examined. All of these are more closely linked to sectors such as agriculture, textiles and to a lesser degree extractives. These represent future areas for research. Building on the conclusions of the research, it is

the nature of the decision making processes, the interplay between economic and non-economic performance and degree of alignment between the two in organisational strategies and relationships between firms, sectors and regulators, are all important areas to develop.

At the scale of industries relevant to the UK economy specifically there are many that were not explored. These include pharmaceuticals, the public sector and automotive. The last of these is particularly relevant in light of the clear PB contribution from fossil-based transport and its likely persistence for some time to come. Working on industries that are of key importance suggests automotive and aerospace engines and fuels, electricity generation, agriculture and agro-chemicals are key areas.

Business and management academics may make a contribution to sustainable development goals by understanding and improving the performance of organisations in these sectors and this includes barriers over financing, profitability, structure of the value chain and supply base and the role of disruptive innovation.

Of course, other factors at a smaller scale are vital as well, such as land-use practices or small scale farmers, and so forth, which may be valid from a base-of-the-pyramid perspective and when viewed at an aggregate level. However, the research has found that powerful MNCs are better able to influence change in the supply chain than smaller and weaker parties.

However, one conclusion of the research is that it is the level of awareness in organisations about their supply chains and the level of (PB+SF) impact in them that is important. A metaphor for this might be that of learning to drive. At first, the learner driver must direct their attention to the controls of the car - the pedals, steering, brakes and indicators. For a firm these represent the internal operations. Then, attention must move to the immediate environment around the vehicle - the car immediately in front, and by looking in the mirrors those behind, and looking left and right as the vehicle is manoeuvred. This represents the dyadic relationship in supply chain management. Finally, the learner driver must anticipate the road ahead, moving attention beyond the vehicle immediately ahead or the nearby road conditions. For a firm, this is akin moving attention to the extended supply chain, and becoming mindful of the potential risks on the road ahead.

The research has explored a number of companies who are at a relatively early stage of SSCM implementation, and may thus be said to be in a learning phase. Some firms are pre-occupied with the internal focus or the immediate threat of competitors. Others, such as Org 3.1, are able to think about the road ahead and the potential future hazards. These are the qualities that link organisational attention and subsequent decision making to effective SSCM policies.

Future research could thus explore the current set of cases in more detail. More research into the electronics supply chain, particularly monitoring the progress of large companies to improve standards at the opposite end of the chain. How Orgs 2.1 and 3.1 work on supplier transformation issues and how these become scalable across to other firms, including competitors. Examples of similar phenomenon have been seen in FMCG packaging for instance, where corporations such as Coca-cola and Pepsi have diversified into the packaging sector on the basis of their innovations in bio-plastics, for instance.

Addressing theory is another area, and here there is a clear opportunity to build on the work of Carter et al. (2015) and elaborate the nature of SCM and SSCM in relation to the theory of decision making and what it tells us about the nature of knowledge and reason, and the boundaries of reason.

Future research on the implications of the methodologies explored here and the link between decision theory and the philosophy of science on the nature of what can be known under conditions of complexity are important. Qualitative research makes an important contribution here, as by definition, quantitative research is to many extents constrained to structured contexts. This point is discussed at length in, for instance, Christopher and Holweg (2011) and Bell and Thorpe (2013).

Returning to the literature review in Chapter 2, it should be restated that the majority of work conducted on DT in SSCM uses models in the structured-complicated domain of Cynefin, which are fundamentally a rule-based dominant logic. This thesis has attempted to elaborate on the role of the wider context across the Cynefin framework to suggest that such research is limited in its conception of the reality of business, especially with regard to SSCM.

In addition, there were a small number of papers concerned with behavioural decision theory in relation to SSCM and these provide a seed from which a new field of research into SSCM can develop. The additional finding of the literature review, that a modest number of papers concerning ethical decision theory were relevant to SSCM, suggests an interdisciplinary approach. Significantly, both the behavioural and the ethical branches open up the discussion to values, mindset and culture as significant determinants of organisational effectiveness with regard to SSCM and SD.

Again, the field of research concerning dominant logic within SSCM or the Cynefin framework within SSCM, and this presents an opportunity to expand this topic further. Notably, management has a natural tendency to want to simplify and quantify, and various cases showed potential barriers with this regard (particularly the life cycle analysis plans in Org 5.2). Overcoming these barriers would be a useful next step, and building understanding of which areas of a supply chain are most significant to achieving the greatest positive impact in the shortest possible time.

Pathways to impact

The principle of substantive sustainability could be powerful for optimising effort and countering greenwash in an age of increasing transparency. Rather than attempt to over-state their actions regarding sustainability, companies could admit their insignificance. Better visibility and awareness of the challenge of 'Kleindorfer's Bridge' would help. Notably, green campaigners are equally guilty of this, as demonstrated by MacKay (2010), where an over-emphasis is seen on solutions that are insufficient in scale compared to the size of the problem.

There is a risk that this principle could be used to prevent any action on sustainability or responsible actions by companies, but the basis of the principle of substantive sustainability is of establishing basic facts of what matters. As mentioned above, a clear example of this is seen in the case of Org 5.2. Essentially, the idea of being able to assess the actual environmental impact of the supply chains of a wide range of products, and have these impacts collected into a single decision model, fails when considered from the perspective

of DT. As the case research showed, at present, this attempt is marked by unstructured complexity in terms of the availability of data, the comparability of one product with another where both fulfil a function but in different ways and according to different performance criteria and how these are measured. Ultimately, the fact that - for that sector - customers are under cost pressure that means that price is always weighted more heavily than environmental or social performance in supplier selection decisions. Unless there is alignment between economic performance and non-economic performance then this is a challenge for the delivery of SD. This empirical, behavioural, descriptive approach is an important addition to normative, rational decision models.

Furthermore, the scale of intervention can be all important and this is something potentially missed in SSCM research taking a firm-focussed view. Taking the perspective of Orgs 5.2 and 5.3, if the national electricity supply becomes effectively carbon-free (as it is in France) then the supply chain of goods manufactured using that electricity is also increasingly carbon free. This means that the principle of substantive sustainability prompts one to consider the right part of the supply chain in order to obtain optimal benefit at the largest scale, fastest and with the least cost across the whole system. So far, the wider context and where the most important interventions should take place, demands greater attention in SSCM research, reaching out from the micro-level of the firm, towards the macro-level, and so seeking to build Kleindorfer's Bridge.

Appendices

Appendix A: published papers related to the research

Alexander & Walker (2013) Sustainable supply chain management and decision making: A literature review of decision analysis, stakeholders and systems theory. *International Purchasing and Supply Education and Research Association (IPSERA)* conference, Nantes, France, 24-27 March 2013.

Alexander & Walker (2013) Sustainable supply chain management: achieving optimal performance and outcomes. 20th *European Operations Management Association* (*EurOMA) Conference* 2013, Dublin, Ireland, 7-12 June 2013.

Walker, Touboulic and Alexander (2013) An overview of sustainable public procurement research. *Balancing Social, Environmental and Economic Considerations in Procurement, Supplement to the Annual Statistical Report on United Nations Procurement*. United Nations, pp. 8-14.

Alexander, Touboulic & Walker (2014) Making sense of SSCM: How companies express sustainable supply chain management issues in their public reports, Euroma Sustainability Forum, Groningen

Alexander & Walker (2014) Values and attributes as key decision making factors for delivering collective improvement in sustainable supply chain practices. 21st *European Operations Management Association* (*EurOMA) Conference* 2014, Palermo, Italy, 21-25 June 2014.

Alexander, Walker and Naim (2014) Alexander, A., Walker, H. and Naim, M. (2014) Decision Theory in Sustainable Supply Chain Management: A Literature Review, *Supply Chain Management: An International Journal*. vol. 19, issue 5/6, page 504-522.

Walker, Touboulic and Alexander (2015) Sustainable supply chain management beyond buyers and suppliers: A literature review of impacts, *Academy of Management* 2015 conference, August 2015, Vancouver, Canada.

Alexander & Walker (2015) Symbolic or substantive claims: an analysis of planetary boundary impacts from tracing supply chains of UK based companies, Euroma Sustainability Forum, Lancaster, April 11-12, 2016.

Appendix B: Selection of Primary Data

Pilot Study Org A: Expert on sustainability reporting

Quotation
A.3.1 "*A...disturbing study...from KPMG...looked at the 10 largest global companies and the 10 largest industry sectors and they found from these 100 companies that ultimately 2.5 percent of their total pre-tax profits were being invested into social and environmental issues. That actually -- when you put that into dollar amounts, that's 12.5 billion U.S. dollars are being invested into sustainability areas. However, 80 percent reported that they have none or limited quantified metrics to assess the impact of that investment which is just insanely wrong from the fiducially responsibility. And 68 percent actually didn't have any due diligence up front before they actually made the investment.* *So as an accountant I just sort of sit here and think why am I working in this space, because you're mad. You're insane. But what it does present is a huge opportunity for integrated performance management...put yourself in the shoes of business...This is what crap we've had to deal with over the last 30 years. All of these alphabet soup or acronym idiots have developed what they consider to be the way forward. And some of this stuff is great, don't get me wrong, but it's coming at you like, 'here, have another one, have another one'.*"
A.6.1 "*So we had a lot of organizations from the investment community saying we need this, we need that, we want this, we want that and then we have the GRI [Global Reporting Initiative] and the IRC [Integrated Reporting Council] getting involved saying well, the demand is there so here's the supply. And then we had SASB [Sustainability Accounting Standards Board] saying well, hold on, the Americans aren't as far as you lot so we we're going to do our bit differently....then we had in 2013, which many consider to be the year of reporting, it was the year of insanity as far as I'm concerned...SASB produced the first standards...that prescribed lots of material and what you disclose. You had the GRI saying the supply chain and the value chain is all important...and you have to think about all stakeholders not just the investor and here's G4 [latest GRI reporting standard]...And then we got the Integrated Reporting Council issue the Integrated Reporting Framework at the end of December 2012, which was supposedly the evolution of corporate reporting, but anybody that practiced corporate reporting saw this as probably a backwards step because it was principle based and it didn't give you any rules as to how to go about doing it...It was lovely, but from an accountant's perspective it was a nightmare...I may sound as if I'm being facetious or being cynical, but I'm also putting myself in the position of business. And business reporting is very much rules based. It's based on legislation in terms of external disclosure, it's based on accounting rules - that have been developed over 150 years - that are clear and provide guidance and there's seven years' training goes into an accountant.*"

A.6.2 "*Today within corporate reporting, main stream financial economic disclosure, you see that at the base of the pyramid you have measures and data which are inputs and outputs... You've got debits and credit, you've got invoices and you have cash out-flowing. You've got other metrics involved in that as well such as the number of people that joined and the number of people that leave, et cetera. You've got internal decision making tools which are based on double entry keeping or double entry bookkeeping for making sure it's controlled. You've got your control systems on top of that, you've got management accounting techniques whether it's costing, whether it's budgeting, whether it's analysis, et cetera which doesn't depend on double entry bookkeeping. You have systems, you've got SAP, you've got other systems, blah blah blah. You have got controls, you have got data, you've got competent people. That then gets wound up quarterly, half yearly or annually through generally accepting accounting practices into pre-defined and prescribed financial statements. So you must produce a profit and loss statement, you must produce a balance sheet, you must produce a cash flow statement and a statement of revenue, and then all of the notes for the accounts. Now, that isn't necessarily a great read, but at least it's a read and it's comparable and it's referenced and you know what went into doing it, and you know if you got an auditor's certificate at the end of it that it's free from material misstatement, i.e. that none of those numbers are overstated by more than five percent. That's all grounded and documented in legislation or professional standards...*"
A.6.3 "*Everybody's in a rush to get an integrated report out which is icing a cake that doesn't exist. So you create this beautiful, delicious idea of something and then you cut into it and well, there's nothing there. And that's what we have today with integrative reports and the sustainability reports is that once you scratch the surface, there may not be anything in it that's actually day-to-day management."*
A.6.4 *"SASB takes the American approach which says, 'This is what you have to do. Do it.' So it's very much a rules based approach, which I advocate, but at the same time there needs to be transparency as to how they got there. And the GRI is all things to all people and stakeholders are at the centre and that gets into the dilemma as to whether or not an organization has a legal obligation to report to them or not, versus a moral obligation. And if it's only a moral obligation, would 'communication' be a better name to attach to it as opposed to reporting. Because reporting has an implicit understanding that you have a duty, and I'm not sure, under current governance regulations, that's understood...and you've got the US Commissioner saying, 'who the hell do SASB think they are, and piss off from our space because you have no authority'. So there's a complete difference."*
A.6.5 *"What we've found in summary is that materiality, context and measurable KPIs are not being used. There's lots of case studies that tell about how many children they went and rocked to sleep, but they don't actually tell you about the important stuff...It's important to understand who the intended reports are written for."*
A.6.6 *"Non-financial reporting is a very diverse world with multiple formats and titles...Speed of publication is by far the biggest issue. You cannot tell when they are going to be published. So information from 2013 took up to maybe 12 months to report it. That's not reporting, that's just a waste of time...In my*

experience...for many sustainability reports, it's an annual, once-a-year exercise that's consultant driven and consultant led and usually authored by someone that doesn't even work in the organisation."

Pilot Study Org B: SSCM Expert

Quotation
B.3.1 "*We call it responsible sourcing...ethical trade...refers to the social, but we also cover the environment and anti-corruption...our four pillars; labour standards, health & safety, environment, and business practices - which is corruption...Then you've got split down legs: trade unions, freedom of expression, child labour, then health & safety stuff..."*
B.3.2 "*One of our challenges now, we are addressing organisationally, is that actually now we have got UK retail, Australian retail, South African retail, South American retail, and you've got our consumer goods, chemicals, pharmaceuticals, packaging, construction. That is a challenge for us organisationally because the way people approach sustainability in all those different categories is completely different. So with one, the person you might want to go in and talk to is the CSR chap. The other the person you might want to talk to is the procurement chap. The other person you might want to talk to is the risk chap. One might be talking about the consumer pressures, another about the legislation pressures... in a nutshell, it is incredibly diverse and increasingly diverse, and that will only continue.*"
B.3.3 "*One of our longest serving and well known working groups is an auditor group... its' purpose to drive coherence in social and ethical compliance... the market is a lot muddier than it was ten years ago... new companies have come into this space and there's a million different options out there; within the consultancies, private sector trade initiatives, industry groups, government this, that and the other.* "
B.3.4 "the US market has been quite challenging, because you go in saying, 'you share all the same suppliers, why don't we all just collaborate' and they say, 'no, we're all different. We are different - completely different.' Collaboration in itself was a concept that is still debated, whereas somewhere like Australia, 'of course, we collaborate'. But the US is different. That isn't something ingrained within the business culture, so that is just an easy example of that debate, but also you've got the maturity of understanding of sustainability, so the Australian market, the procurement people have often worked in the UK or have done some CSR in the past. So it's less about, 'why do you do CSR' as 'how do you do it properly'. Then you get other markets like South America where that isn't the case, so our approach is 'why do you do CSR'. That is a new learning curve for them. So, yes, there is huge variation about it."
B.3.5 "*The multinationals, say a Mars or a Pepsi. They're everywhere. And I think a policy level will still get driven vaguely from where they are based, either UK or US... everyone basically has - the same supply chain. Everybody knows that. No matter where they are, they all have the same suppliers roughly speaking when they are in similar sectors... Then you get the micro split of companies supplying into Europe that we see affecting us as well...*
B.3.6 "*interestingly enough now the American market is moving quicker. The people that are doing things*

in America are doing it quicker than in Europe... The Patagonia's, Wal-mart to a certain extent. People like DKNY... Some smaller, some of the tech stuff, Nike, Adidas, people like that. They're doing amazing stuff, but there's a huge polarisation. The guys that are advanced in the States are moving quicker than in Europe, but I think"
B.4.1 "Packaging is a really interesting cross-over sector because they supply everyone and there's not that many big packaging companies out there. You've got the big five, Tetra-pak, Amcore...and they supply branded juice cartons for Nestle, Danone, to everyone...Ingredients companies too...or Cargill. You get these big B-to-B companies who just supply everybody. Suddenly you see this huge grid. Everyone probably has Cargill somewhere in their supply chain if they are serving food: catering, airlines, construction site food, cafes, Pret, whatever, probably they will have them somewhere...Li & Fung are an interesting one [textiles]....they source into the Patagonia's and Nike, Addidas and everybody...
B.4.2 "the challenge in textiles is that it won't ever become day-to-day until people have agreed what the standard is...if you look at food quality in Europe, it is pass or fail. Plenty have tried that on ethical trade or sustainability, and easier on environment because you can just do levels of relatively speaking good and bad, pass or fail. Social is a whole other thing. You take the tiny example, one strand of a massive cluster, like child labour and if you say that factory is child labour, is that a pass/fail? To many and to some it would say fail, but that then shuts down that factory, the kid becomes unemployed, maybe 150 people lose their jobs... ? Levis got famously stung on this a while ago. 96 I think it was, when they shut a big factory down, burnt all the jeans and made 2000 people unemployed at the time, so it had a worse effect, and that's just one example, not even the trade union complexities, minimum wage stuff, that's the challenge of making the hygiene thing. Even look at the Accord and the Alliance, post-Bangladesh, which take two different perspectives on it. You've got the American one doesn't want to make it litigious and doesn't want it to have proximity to trade unions, and the European one does. So you're not going to get a standard like you do within product compliance, where people go, 'how much lead is in that product?', percentage of X, nice and simple. Is that going to hit on social? It happens on environment, it can happen to a degree on anti-corruption as it's a bit more granular, social we are still a long way away from that. There are no agreements. You alluded to wage levels, working hours, there are some baselines, but the baseline on child labour is that we agree it is bad, there's no disagreement on the concept of that, but how do you define a child? Is it sixteen? Is it fourteen? And what do you do when you find it? Do some companies make it policy to send the kid into education. You've then got American issues where if you keep the factory open with the child working in it, then that's illegal and opens us up to litigation. It's really difficult, and I think we are still a long way away. And that's no more apparent than in textiles. While it is a little bit better than others, it's still a long way and then breaking into our other conversation about consumers, consumers will just say 'child labour is bad.' So there is a huge gap between the complexities of the topic area and the consumers understanding, which means that it is a challenge and you've got retailers jumping like loonies at the moment, post-Bangladesh, but many of the retailers who are part of the Alliance, weren't even part of Rana Plaza, and they are spending millions on supporting projects. The consumer's awareness of that just thinks, 'big bad corporation, ugly, horrible people, nasty big business' whereas it is much more complicated

than that. Even the horsemeat debate was brought up as an ethical issue, as ethical trade, but it was corruption. It was a crime. You can't fault a retailer if there was fraud, but a public's perception of it - We were getting calls left right and centre from the media, but this was criminal activity. It wasn't that they didn't have traceability.. that is the big challenge with consumer understanding. There is a big chasm. A gap. And every company will have child labour somewhere in their supply chain. That is a fairly acknowledged fact, but if you said that to a consumer, what would they think of that? Do they understand that sometimes they don't know where the stuff comes from? I think that's a big, fuzzy debate that's going on, particularly in textiles.."
B.5.1 *" I do think there is so much variation, and opinion. Working hours is another one. There's hugely complex pieces about living wage, local law, international law, etc. I think there is a challenge that everyone needs to be aware of, there's been more discussions on imposing Western perspectives on standards. But I also feel that you can't go completely to the other perspective. If you just ran the standards as what the local supplier wanted the standards to be, they might not be up to scratch, so there's a part Western culture, but generally, do they have the right perspective on what the standards should be?"*
B.6.1 "*[the initial driver for this topic]... It's consumers. It's the consumer piece. My personal perspective is the rising awareness, the double page spread in the weekend magazine of the child labour scandals. That is what kicked this whole piece into play. That personal perspective has been refined then with new factors, with investors, with government regulation etc. but it started with the consumer piece.*"
B.7.1 "*I think five years ago or longer, media and NGOs were part and parcel, now, with new legislation and the investor piece has changed the dynamic, so the more investors that request the information, it has changed the dynamic that NGO's will never dig this up, we are B-to-B, whereas now it is our investors asking that, and that has changed the dynamic enormously.*"
B.8.1 " *the other challenge that we see, is that when you've got someone completely new coming to the table, who've never done sustainability before, suddenly the CEO or chairman wakes up in the morning and wants to do it for whatever reason, working on this clean slate, a clean page, they can take all the cutting edge stuff - and it's very exciting and they can move very quickly. But you get in and try and change one of the goliath's CSR programmes that's been around for 20 years or whatever, in Europe, and they've got to change direction, it's much harder than in a typical business model. So with the Chileans who have never done any of this before, they can just adopt all the new stuff - and so that's another reflection of the different market place for it. It might be more established in Europe, but actually when you look at, for example, a lot of the new work going on around auditing, post-Bangladesh, a lot of the cutting edge stuff is going on outside of Europe. Because trying to change people's direction in these huge CSR teams. So lots of dynamics.* "
B.9.1 *"I think the ethical consumer is vastly misunderstood by measuring it just on the amount of Fair Trade sold per piece. I think it is much more complicated than that."*

Org 1.1 Electronics Firm

Quotation
1.1.1.1 "*I am working in the [electronics product] industry. That is not a clean technology by any means...In the process we use a lot of chemicals...you are using harmful product to the planet. The difference is how well do you control that process, by your recycling and your waste. How much water. How efficient are you in terms of consumption, of energy and water, and so on.*" (Financial Director)
1.1.2.1 "*We are an engineering company, we are more focussed on quality and assurance, and that's how we deal with our suppliers.*" (Financial Director)
1.1.3.1 "*It's actually quite wide as it touches on anything to do with employees, anything to do with environment, investment in local communities, in terms of relationship with universities, training and development. Everything that we have in our sustainability report, and the other area we would focus on will be risk - this is not in there but will be the extension of that - for contingency plans, or resilience or business continuity planning*" (Financial Director)
1.1.4.1 *" when we look at the pressure that's put upon us by our own customers in terms of applying...CSR in particular and the contract we end up signing, I am not sure we do an equal job with our suppliers so we can stand up and say, we signed that contract with our clients - all the requirements they put on us in terms of governance, in terms of ethics, and so on, [which] goes beyond just the commercial aspect of the contract...there's a lot of criteria that we are expecting you to follow, because this is what you, in signing over, are complying to. This. You are engaging a company that is working in ethical manners, that don't employ children and so on and so forth... "* (Financial Director)
1.1.4.2 *"if we are going to sign, we better make sure we are compliant. To be compliant, I need to impose the same on my suppliers. They are using us as a proxy... we request our suppliers to sign off that they are not sourcing anything from conflict mineral countries. But we can't test it. No way. I can't.*" (Financial Director)
1.1.4.3 "*It's not my job to do that. It's my job to make sure my first level applies that to his next level and so on and so forth. So [Fabricator company #1], I need to sign with me that you are compliant with these, and for them to sign, they should be assured that the same is applied to the food chain.*" (Financial Director)
1.1.4.4 "*I need to sign with [Consumer OEM] that I don't do it, and I have a requirement from my auditors on my annual report as a public company to our stakeholders on our position to sign up to the UN charter.*" (Financial Director)
1.1.4.5 "*We wouldn't have any say on the components that were used to give us the product. We have no input there... At the back end we have a little more say. For example, we are moving away from gold to copper... In terms of front end I would say we have zero influence to be absolutely clean. We have zero influence as to the material they are going to be using and the process they are going to be using to achieve the guaranteed library of design.*" (Financial Director)

1.1.4.6 "*I would plan to go, in Q3, to [smaller country], on my regular visit to our headquarter in Asia. I usually meet customer and supplier. Definitely will talk to [Assembly Company] and [Fabricator Company] and I will speak primarily about ESG...We will see a little bit of engagement to see if we can do the right thing, and the suppliers come back and say, by the way, we have all that, you just didn't ask for it. We have to do our research.*" (Financial Director)
1.1.4.7 "*In the process we use a lot of chemicals. When you bathe the silicon to make the layers you are using harmful product to the planet. The difference is how well you control that process, by your recycling and your waste, how much water, how efficient are you in terms of consumption of energy and water and so on...I'm not going to look at how much water they consume, how much energy they use and go with the one that's most efficient - that's not going to happen...Quality, performance and service should be driving that anyway. If they are very good in quality, service and availability, they are most likely to be efficient in maintaining the equipment, therefore they should have less wastage.*" (Financial Director)
1.1.8.1 " *One issue that I've got is when I look at my organisation, it's not in the DNA to do CSR. Of the group or the individual*." (Financial Director)
1.1.8.2 " *I think there is still an education piece in some areas needed...people understand the words sustainability and corporate responsibility now. They understand what we are doing, they understand why we are doing it...they get the employee volunteering stuff, they get the fund-raising. They get the work that I'm doing on education and university relations and school relations and things like that. They get the fact that we need to be cleaner technology. They get some stuff around carbon goals. There is a lot that has been done, but don't forget we are an engineering firm so people are very linear in their thinking. Whether they are a design engineer or one of the quality guys...people are incredibly linear and don't necessarily get off their islands..they're not used to doing that.*" (CSR Manager)
1.1.9.1 "*So if there is an issue...and it goes into the press...they have blood on their chips...They should make sure none of that happens... So you have a social responsibility...you should say, 'actually I've got a problem with that'. I think this is part of the drive we have, because we know our image could be significantly impacted by any of those events*" (Financial Director)
1.1.9.2 " *You can be seen as being a wonderful citizen in giving lots of money for charity by giving one donation per year of $1million a year, and that's the end of it. You give it to Red Cross and you wash your hands. You say that's fine, 'I feel good. I've given $1 million in one shot, and I've ticked all my boxes for what I want to do in one year in 5 minutes. But that's not good enough for me. It's not about how much you spend its about what you actually do with it, and how much you drive at that.*" (Financial Director)
1.1.9.3 "*We have a reputation to defend and to defend our reputation we have applied to our suppliers, our eco-system, the same ethical values that we have inside the company. But how much we can drive I don't know.*" (Financial Director)
1.1.9.4 "*What about the Electronics Industry Citizenship Council, EICC, or groups like that?" (researcher) "I don't know about them*." (Financial Director)

Org 1.2 Extractives Industry Trade Association: Informant: Sustainability Director

Quotation
1.2.3.1 "*...it is often a struggle because there are varying degrees of capability or understanding, or at least interest, shall we say, in the whole topic as it stands*."
1.2.3.2 "*As far as sustainability and supply chains, to be fair, there are people within the organisation, even here, who are [aren't] prepared to even think about it or talk about it in a general way as they can't see how you can talk about sustainability in a single sentence. To us...even though we haven't articulated it in a single sentence or a single paragraph...sustainability in our context means the ability to continue to responsibly produce and responsibly market minerals and metals.*"
1.2.3.3 "*I don't think the whole...operative context of responsibility has been defined officially, but it is a dynamic thing at the end of the day, because no one thought of the issue of conflict minerals five years ago...The motivator within our sector that is relating to conflict minerals is the industry's behaviour in respect of human rights in the countries in which they operate. And that has been a topic of interest and activity etc. for longer than five or six years, so, yes, there's some well-worn themes on what are the issues - 'how do we define responsible behaviour' - but it's never been enshrined in a common standard.*"
1.2.3.4 "*Something that is material to one company working in the Congo is totally immaterial to another company working in the US, for instance. So it's not easy to define a common set of - a common piece for-responsible behaviour.*"
1.2.4.1 "*[major multinational] have re-oriented themselves with respect to looking at their value chain and corporation understanding impacts in the value chain in order to look at issues of sustainability.*"
1.2.4.2 "*They started off...looking at this from a very general perspective as a result to a large extent of NGO pressure on them. But...latterly they are very focussed on the issue of conflict minerals. That...is something that has obviously been of tremendous importance, because of regulatory involvement in that area. I've not actually asked them this, but whether they would say it's been a bit of an unwelcome distraction or not, I don't know. Clearly they take it seriously and they have to be diligent in that course, but their initial activity was very life cycle based, across the life cycle and multi-issue, where as now they are driven to be focussed on the issue of conflict minerals and human rights.*"
1.2.4.3 "*They pushed the electronics industry directly but they also used the consumers to write in and send mail to the likes of Apple and Microsoft and all the big brands saying, 'I'm concerned about purchasing your gadgets and am cross about what's going on in the Congo, etc.'*"
1.2.5.1 "*Unpredictability relates to price volatility. It relates obviously to supply and demand, economic conditions with respect to the actual cost of mining, extraction and production of metals and minerals. It relates to the risk factors of mining in different countries as it were, or certain countries, if you like. So there is a degree of dynamism there. There's a degree of unpredictability. I wouldn't necessarily say that should affect their responsibilities, but the perception or the realisation of whether that responsibility is being enacted, undertaken, it can be influenced by those unpredictable, uncontrollable circumstances."*
1.2.6.1 " *Volatile circumstances can often be read across to being - what's the word - adjusting or*

reinterpreting your values...For instance, a company would be in a situation where it would be seeking to open a mine, it would be engaged in conversations with local communities about the impacts and the costs and benefits of that mine, and seeking their support as it were, their tacit agreement in terms of working towards establishing a mine. And then you might reach the situation where the price and the cost of production is such that the mine is no longer viable and the company will pull out, for obvious economic reasons. Yes, we're all looking to contribute to sustainable development, and sustainability, but at the end of the day in order for a company to be sustainable it's got to be profitable. So it would pull out, but then the instant reaction would be 'you are neglecting your responsibility. You talked about doing this, doing that.' And this is where the line between the two gets blurred very easily. In terms of societal perception, that pulling out doesn't mean the company has changed its values or principles in any way. It just means that it is making decisions on its primary motivation, which is profitability for shareholders and long-term stability, if you like."
1.2.7.1: "*There are many players, but the three main categories of players that are influencing observation and action in respect of sustainability and supply chains are what we call the investor community - big banks, big sovereign wealth funds...Then there are the customers themselves. The classic model is the brand customer, the brand manager looking at this in terms of their brand risk and therefore seeking to ensure there is more of a climate of sustainable or responsible sourcing within supply chains. And then the third element is then the strong green NGOs who are pushing this*."

Org 2.1 FMCG. Informant: Director

Quotation
2.1.1.1 "*...we can create a positive change for the world through business, and if we can persuade more people to buy a cleaning product with good ingredients...'we'll make sure, the ingredients we use are good ingredients, they're not going to kill the fishes basically, and they're not going to cause any health problems."*
2.1.2.1 " *how do we work with partners that is not just based on can you supply that ingredient for the lowest cost, but how can we partner together to make an improvement - whether that's biodiesel fleets or...LED lights*"
2.1.3.1 "*[we] wanted to get rid of phosphates in laundry products. So that was all about what is the impact of these phosphates on the planet in terms of when that laundry powder goes eventually down the drain and also on skin etc. So it's ultimately starting to find a different solution to a common everyday task of cleaning. So, built on the values of 'I want to improve the world, I want to provide better solutions'.* "
2.1.4.1 "*There's a whole load of incentives...[for] suppliers to encourage them to be more sustainable...not just based on 'can you supply that ingredient for the lowest cost' but, 'how can we partner together to make an improvement' "*
2.1.4.2 "*We see our position as a thought leader...our commitment is to be the pioneer...to try to raise*

awareness of that issue...that's exactly where the brand wants to be."
2.1.4.3 *"we give out grants for some of the suppliers we work with for LED lights, all kinds of things to improve across the piece, both up and down the chain*."
2.1.5.1 "*we don't have the same resource as [other FMCG firms] have, so are going to have to be fast and nimble and use the resources we have to maximum effect.*"
2.1.6.1 "*As a values-based business, we recruit on the basis of 'will people be able to fit in and add to our culture and work, and adopt and support our values...we spend a lot of time making sure we get the right people in the team...As a team, we have a quarterly review session that checks-in on how are the values living in the office...we deliberately don't have a leader on each of the values as the idea is that everyone in the team is fostering, and working to drive, those values...The way the values come out day-to-day is that...you'll hear people use them...When we've got a problem or an opportunity, rather than say...get the sales team together and say, 'there's a retail opportunity', actually, 'who's around who can help input'. Whether that's the team PA, the supply chain manager, the marketeers, the finance person, or the [retailer] account manager..."*
2.1.9.1 Researcher: " *Is there actually an evidence base you can draw on. I know WWF did toxic things in the home. Is there a detailed set of impacts that are known, relating to the incumbent cleaning products?*" Interviewee: "*I'd say, yes. It's very difficult to be very direct and scientific about those"*
2.1.9.3 " *we were the only cleaning brand in the aisle that had [particular environmental feature], that is expensive. So that cost us more money to produce that [element]. We could easily look at it and if we were being only commercial, actually we shouldn't do that because it means we have to sell our product for [xx] more, and obviously the consumer has to pay for that somehow, but we think it's the right thing to do. Five, six, seven years ago that was our innovation, no one else was doing it. Now...[rivals] are starting to do that, which is great. That's what we want. What shall we do next..."*
2.1.9.4 "*we're working on a project at the moment trying to [produce new pro-environmental process] instead, so we've actually just, in the factories, started to work on those types of things* "

Org 3.1 Restaurant chain

Quotation
3.1.3.1 "*We launched [CSR programme] in 2009. It was done more as a people thing than an environment thing. When I took the job in 2012, 18 months ago, they said, 'we are far more likely to do something progressive with our people, than with the environment'. So they weren't even really thinking environment then, but I'm much more of an environment thinker. It's where my passion is. I actually think climate change is a people issue - it's what I keep telling them. The biggest people issue facing us is climate change...*" (CSR Manager)
3.1.3.2 *"I was recruiting for a [CSR] assistant, and as part of that recruitment we got to a final three for our*

assessment day, and on the assessment day I said, 'what's your understanding of climate change and why is it a problem?' One of them told me the polar bears were in trouble, and two of the told me, 'oh, I dunno, it's tricky isn't it, it's not that clear cut.' And I was like, shit, if the three people in this business who've got to this point, don't even say 'this is a serious issue' - I was hoping they'd say, 'yes, climate change is happening and it's our food supply chain that is in trouble'. That was the answer I was looking for. Nowhere near it. Absolutely nowhere near it. *I then had a conversation with one of the regional managing directors, who was like, 'whatever'. And I was like, 'No. It is not 'whatever''. Then it was the week after - these regional directors meetings. So I drew the graph - you've seen An Inconvenient Truth - you know the graph between temperature and CO_2 and then it comes off the scale. I showed them this, and how the 10 hottest years on record have come in the last 16 years. That's because we've just done that, and we are fluctuating in and out, some come below, some come above. And I said, 'categorically, this is real and pressing.'...We also have some serious challenges and threats.'... Weetabix had made a commitment to use 100% UK wheat. In 2010, we ran out of wheat and they stopped making Weetabix Minis. I sat and looked at them and reflected and said, 'Let's just look at that, Weetabix stopped making Weetabix because they ran out of wheat. ...'Guys, get your head around this. This is really, really important.'* (CSR Manager)
3.1.3.3 " *We get clobbered with everything. CRC [Govt carbon reduction commitment scheme], ESOS [Energy Savings Opportunity Scheme], which is coming in this year. Luckily we are not part of the Climate Change Agreement [UK Govt carbon tax scheme]...We have to report on our annual consumption of gas and electricity, then we have to pay an amount per ton of CO_2 emitted. .. we have to audit a representative sample of the restaurants and produce reports and that's it really. But we have to pay someone to do it. We have to pay to register on the Government's website... The CRC when it first started had so much potential and I know that quite a few energy managers were really looking forward to the chance of bringing energy management back up the agenda, but then there are some excellent lobbyists out there, and they lobbied for it to be diluted and then it just became more work really."* (CSR Manager)
3.1.4.1 *"[our Tier 1 supplying] farmers are going to have to pay more for the feed because China is buying more soy...rather than banging our heads against the soya industry, when demand for soy goes up so rapidly, particularly in China- global yields of soy are going up as well, but there's going to come a point when that stops. Then there's going to be climate impacts like droughts, pestilence... Then the provision of soy is going to go down, but demand is going to go up, so the price of our chicken is going to go through the roof. The availability of our chicken is going to go through the floor. We know that's coming. Whether it's five, ten or twenty years, that's coming."* (CSR Manager)
3.1.5.1 "*I think the future looks bad...[but our suppliers are]...farmers, so it's a problem for them, but they are probably being quite realistic about it - people saying, just like they are saying about climate change, 'yeah temperatures go up and down. It's cyclical. China are buying loads at the moment. Who's to say what will happen next year.'*" (CSR Manager)
3.1.5.2 "*No one is saying to me, 'where's your compliance monitoring'. No one is saying, 'we need to go*

through loads more boring processes, that move us extremely slowly and just gets us a figure at the end of a year's work - and then we don't know what to do with that figure.' " (CSR Manager)
3.1.5.3 *"We sit in a certain place which is much more about doing some of the exciting stuff but I couldn't really care about compliance. That's a personal view. I just get bored by it very quickly."* (CSR Manager)
3.1.5.4 "*you should be able to build your business resilience, you should be able to reduce your impact, and you should be able to do it at a competitive price. So that's something we are exploring because all the ingredients should be there. So the ambition is there, and this is partly why I work the way I work; if I get an idea that's got legs, they'll go for it. But if I start giving them formal structures, and say 'this is where we are at on these formal structures, we almost slow our own progress. [The unused edible food to charities project] was a fabulous idea - it wasn't mine, I just helped it happen - and every time I came across something, the business accepted it. So suddenly, two years down the line we are already in 80% of the restaurants, because it was a good idea, and the business said yes. Secondly, that moves us into the sweet spot because it's also environmental and social.*" (CSR Manager)
3.1.6.1 "*...it was really important for me to go into [regional director] meetings and hit them with the quite emotional reality, climate change is something you need to buy into. And that's all I wanted to achieve there. I just wanted to plant that seed because I can provide as much evidence as I can put together - if you buy into the premise that climate change is real, and therefore all this evidence - but if they go, 'love all your evidence, but actually I don't buy into your basic premise.' then I'm out."* (CSR Manager)
3.1.6.2 *"I remember one of the regional managing directors, who at the time I thought was just a hard-nosed operator. He introduced himself and he said, "I just want to be able to sleep easy in my bed at night..."* (CSR Manager)
3.1.6.3 *"I don't do things just for the sake of doing them. For example, I have fought back on the installation of photovoltaic solar panels, because I believe there are other things that we could do and should do that have more benefits. Not necessarily financial, but they're not just ticking 'Oh look aren't we wonderful' boxes, which is where the marketing comes in. I know other companies that have leapt on that because it's an immediate sign that we are doing stuff about the environment because we have got PV on the roof. A lot of the stuff that we do is hidden but it's the right thing and all our guys are bought in to it... We work very closely with our property team, and we have a sustainable place forum where no idea is too daft and between us we decide which will be the next project. We've done LED lighting. We're trialling an extract control system. And they came in saying, 'Oh, we are going to put PV on the roof', and I said, 'why waste your money'."* (Energy manager)
3.1.6.4 "*for example, we could say to ourselves, how are we going to cut our energy use in the next year, in the next 2 years, 3 years. What's the equipment available today, and then you can start doing some metrics. Clearly, not a bad way to do it. Or another way you could do it is to say, the government has set a carbon reduction target of an 80% by 2050, the world will look very different. Let's assume we have got to*

get there. There's no choice. What do we need to do today to start that journey. So we've got for example, our grills are one of the biggest energy using piece of kit. No one is going to innovate the grill except us. We can go out to the market and find that there are no other grills available. Or we could look to 2050 and say one of the things that's going to have to change is the grills. So lets start by commissioning some consultants and some grill makers to see what a more efficient grill might look like. Radically more efficient. So it's that kind of thing." (CSR Manager)

3.1.7.4 " *they were trying to catch us out and actually it didn't even work for them. I have said back to them, to [NGO] that I am really disappointed with the way they handled this. I can't believe they sent us an email and then never chased us and then put a press release out which effectively judged our ability to respond to an email, not our ability to source soy for feed. So it was just a really stupid thing for them to do. So I am delighted that they didn't get the coverage they wanted... I spoke to a couple of NGOs yesterday about this whole arena, and they spent so long talking about the issues, and when I said, so what do we actually do about this, they were less clear. I think NGOs quite often live in this space where they understand the issue fairly well, but they come at it from much more of a helicopter view of the world and the way it should be - possibly the way it could be - so they don't look at it from the perspective of an individual business and what they can do about it. So, yes it's true the rainforest's are coming down. Yes, it's true the world is eating too much soy, demand is going up faster than production, and with more extreme weather events and climate change, that is a risk. How the businesses actually find a way that disrupts that in a way that gives them positive competitive advantage, I don't know. But if the answer was easy I think more businesses would be doing it. I think the angle that [NGO] had taken was 'we need to do something about this, but we don't have any easy answers', so they write to the press, to try and raise awareness, in many respects because they just don't know what else to do... I do perceive it as a waste of time. And I'd much rather spend my time trying to get this innovative, progressive project off the ground.... I don't think there was any reputational damage. There was an internal response and we are still talking internally that we need to get information together so the next time this happens we are ready. And actually that is all that was ever going to happen as a result of this anyway. So even if they'd have got their perfect result all it would have been that we would be better at getting information together. It wouldn't have changed what we do.*"

3.1.8.1 *"It's different from any other company that I've worked for, and I've worked for some quite large corporate businesses. The culture takes a bit of getting used to, to be perfectly honest. I can't really describe it. It's a big company where it's got a very small company feel... there's the mindset for a start. You don't have to go in and battle different people for different reasons. You don't have to go and battle with the FD because he's got a different outlook, about money, or the Ops Director... They're a very entrepreneurial company in that they will try things and it's ok to fail. But you don't know until you try. "* (Energy manager)

Org 4.1 Bank

Quotation
4.1.3.1 "*we take quite a broad definition of sustainability I would say and try to...ensure that all of those areas [of the organisation] are considering sustainability factors as part of running their business... That can be everything from signing-off a new lending policy for oil and gas, through to pay decisions around our cleaning staff and do we pay them the Living Wage, through to signing off a donation to an international disaster appeal*." (Sustainability Programme Manager)
4.1.3.2 *"In terms of health, safety and environment, this is very compliance based. This is what you have to do...within that we have operational targets and looking at things like reducing our energy impact, travel, paper, waste, water..."* (Environment and Health & Safety Manager)
4.1.4.1 "*...when you look at scope 3 going into our client base... we still do a lot of oil and gas lending, to the criticism of some areas of the public and NGOs...but we are also [a large] lender to renewables.*" (Sustainability Programme Manager)
4.1.5.1 "*In terms of how we gather that data..and report it externally is quite a complex picture in its itself...It's a big challenge... I don't think its hugely well defined...say you are looking at it from government perspective you want to look at the whole end-to-end supply chain, ideally you would want to be able to aggregate the whole chain and get the total. I don't think you will be able to do that because I think there will be double counting... So for [BANK] to do scope 3 we are going to try and include the relevant portions of our supply chain. There's also discussions around how far can we deal with, reach into, the client base. Obviously there's some things you have to do from a regulatory perspective, but there's also the question of where do we draw the boundary of what is the right thing to do. In terms of how far we go, and how we do. I guess to set the scale, a sense of scale is for every - I can't remember the exact numbers, but for every unit of own consumption in terms of usage of energy or carbon rather, its ten times within supply chain and then 100 times within the client base. "* (Environment and Health & Safety Manager)
4.1.5.2 "*Whose job is it to go first? Do we turn off the money in order to force more rapid development in a direction which is widely agreed? Do we wait for government to do it? Stop issuing shale gas licences and put up the duty on petrol. Stop mucking about. Or do we wait for the companies?*" (Sustainability Programme Manager)
4.1.5.3 *"[bank] is a large and complicated place so the understanding, even internally, and the consistency of what we do is not as powerful as it might be."* (Sustainability Programme Manager)
4.1.5.4 "*there's very strong similarities [with other large corporations]...fiefdoms or citadels...functional, cross-cutting teams...Who is in charge is often a good question.*" (Sustainability Programme Manager)
4.1.6.1 "*You've got all the contractual SLAs, and you've also got the supplier assessment measures, that you measure annually. We're now building in - much to the point of culture - there's no point in bringing in suppliers based on cost, regardless of everything else and then trying to change them, because that's just painful. So a bit like you would recruit in the right people in the first instance, we are now building in to our...standard language...what's important to us and what our values are and why they're important to us*

and why we would expect our suppliers to help us in this way." (Supply Chain Director)
4.1.6.2 "*there are some parts of the business where it's all about cost. Fact. Because without that their business is not going to survive, so it needs to be about cost.*" (Supply Chain Director)
4.1.6.3 " *we have all sorts of delegated levels of authority within the bank. We have more risk process checkers, checkers, checking checkers than you would believe. Post 2008, when clearly banks were running amok - the media language not mine, for the record - clearly there was an element of there not being enough control, and we are now uber-control centric in terms of risk, really risk averse internally...There was probably a period of time in the early noughties where we were too relaxed in terms of risk...Then you hit 2007 and crisis, and everything then shifts a different way. Regulation increases or changes...You saw banks recruiting in lots of risk management and it all went very control focussed. I think what we reached last year was a very poignant time where we said, actually we've had a good recovery in the industry...and we are reaching a situation where this very risk-averse position is unsustainable. So we need to rebalance and it's that rebalancing, I think, that's led to a more principles and values-based approach.*" (Supply Chain Director)
4.1.6.4 *"We have what we call a yes-checklist...if you can go through and say 'yes', 'yes', 'yes', then you are doing the right thing... 'would you be proud of this as it hits the headlines'. If it hits the paper in 3 years time would you be proud to say, 'yes, I was involved in that or not'. If the answer is no then you are probably not doing the right thing. Would you talk about it to your family and friends...There's five or six, principles-based. It's not a compliance-based, you must follow this set of rules. It's about equipping people with the principles that they need and the values to make that decision independently, without having to rely on a system of rules...the more rules you put in place, the less independent thinking there is within an organisation."* (Supply Chain Director)
4.1.7.1 "*My team tries to be the interface between the decision makers and the rest of the business, so we do the governance and policy stuff, we do a lot of external engagement, speaking with NGOs and Socially Responsible Investors and other consumer groups and other stakeholders who have an opinion about what we should or shouldn't be doing, and we try to make sure their voices are reflected back into the business and heard. Then the bit we also work on are group charitable programmes like payroll giving and grant giving and volunteering.*" (Sustainability Programme Manager)
4.1.7.2 "*we do things that have a community facing front to them, if you like, and they don't have a commercial basis for being done. So there's no ROI [return on investment] that's obviously there in a short enough horizon that anyone could usefully measure it, but they are things that our stakeholders tell us are important...There are also things that are relevant to our core business so the stuff we work on is mainly around financial education and capability, support for enterprise, around employability and diversity and things like that and finally around our environmental footprint. So all of those things - as a bank and as a large UK company - our stakeholder groups say we should be doing something about, and we have a degree of expertise and capability to influence and therefore it drives business value as well as good or*

responsible for us to do." (Sustainability Programme Manager)
4.1.8.1 "*[there is a] difference between the expectation on companies and the reality of where we are and where we are on that [low carbon] transition...This is climate change. We have to deal with it and we have to accelerate what we are doing. But then at the same time you see another three shale gas licences have been provided this week by the UK Government...We will always be a reflection, because we are just where the money goes. We will always be a reflection of what's going on out there.*" (Sustainability Programme Manager)
4.1.9.1 "*At what point do we pull the moral judgement? ...[campaigners] protesting at our AGM because we as an organisation fund some [extractive industry projects]...But the reality is that local government allows that to go on and actually encourages the minerals to be taken from the land there, much to the disgust of the local communities. So actually there's no laws or regulations being broken...It doesn't make it right, but where do you draw the line of the moral decision on your clients. Similar scenario when recently [company] not paying enough British tax, corporation tax, we had a member of staff saying...'we should stop using [company]. Ok, we could make a judgement we should stop... [but] where do you draw the line? And if you don't use them as a supplier, should we say we won't bank you either? You've got to think through the ramifications because some of these are big clients who are important to us. So we typically try to not take the moral judgement because it's harder to define what's right and what's wrong. There's an element if it inherently feels wrong you wouldn't do it, but if all things stack up and it's reasonably accepted practice, it would probably happen.*" (Supply Chain Director)

Org 4.2 Logistics Company

Quotation
4.2.3.1 "*Euro 6 became law in October...and we discovered that while air quality emission is reduced...we were finding that we were burning more diesel to get to that air quality level, so the net effect was that CO_2 emissions were going up. So you'd got this imbalance between the vehicle manufacturers and the fact that they'd been driven by Brussels to reduce the air quality levels for the vehicles they're producing, but now we're finding that certainly in our operation that the CO_2 levels of diesel consumption is going up. So there's a bit of an imbalance yet, but that's air quality versus CO_2... in Brussels..you've got two camps. You've got the air quality camp and you've got the CO_2 camp.*" (Head of Environment)
4.2.4.1 *"Because of the product we are moving, the requirements of [the customer]...it became a very inefficient operation...How do we work together to drive efficiency into that solution?...The initial driver wasn't around environmental benefits...it was because of throughput - you were getting less throughput for the money you were spending, so that was becoming increasingly more expensive."* (Account Manager)
4.2.4.3 *"The routes became more efficient because they weren't trundling a load of dead weight...We could make collections more efficient, deliver them in more locally and get that work pushed through."* (Account

Manager)
4.2.4.4 "*we began to look at electric vehicles way back in 2006... One of the challenges we have...[was after-sales service] and from an operational point of view, we did experience some problems with the battery technology. It has improved with the switch to lithium-ion batteries but we've reduced the number...We have a supplier who we work with, a sub-contractor...and they use all electric vehicles to deliver freight around a patch in central London...[at present] we think the technology has a fairly limited use because we've got something like 2,700 pick-up delivery rounds and we reckon that the electric vehicle technology would only fit about 10% of that.*" (Head of Environment)
4.2.4.5 *" we've been running with aerodynamics for 25 years and we introduced them on our fleet and it was nothing to do with CO_2 , it was the fact that we reduced our diesel consumption... So they were introduced from a cost perspective, a cost saving perspective. Now the side effect of that now is, of course, we reduce CO_2 levels because of it... we're using electric vehicles, we're starting to pilot gas vehicles...[but] to convert to gas at those [fuelling station] locations is a significant capital investment by the business.. in the UK is that the gas infrastructure is not quite there yet. Now a number of carriers, perhaps about a dozen, 15 carriers have got their own gas refuelling stations but from a central government point of view, that is very few gas refuelling stations out there."* (Head of Environment)
4.2.4.6 "*if we decide to go to a manufacturers and say [I] want 200 tractor units that are dual fuel, I would like them in six month's time, we'd struggle to get them. We wouldn't get them. We're going back to the idea that we recognise gas is low emission, we recognise gas is cheaper to run, so there is a business case for us to operate those types of vehicles but we haven't got the infrastructure in the UK with it that would support it unless we go out and install our own gas stations and there's a huge capital investment to do that.*"
4.2.5.1 *"Our fuel costs are second behind payroll...we run a huge fleet of vehicles...we've got to think outside the box because fuel costs will continue to rise... and it's not just the fuel costs of the fleet, you know, we spend a lot of money on utility costs - gas, electric heating oil; it's a huge spend for the business. So we are starting to plan together as a group how our strategy should be shaped in the next one, two, three, four, five years. That can then be built into the budgetary cycle so if we decide that we want to get a couple of gas stations within the business, there's considerable investment in that, but on top of that, we need to be clear that the fleet manufacturers can provide us with Euro 6 vehicles, which are dual fuel. At the moment, the technology's not out there."* (Head of Environment)
4.2.5.2 "*let's really think, let's stretch our thinking on this because energy costs ain't gonna be dropping.*" (Head of Environment)
4.2.7.1 "*If you think about the UK market, it is only a fraction of the European market, and the main manufacturers...[are focussed on] where the greatest demand is...It's like the chicken and the egg. We are saying to the manufacturers, 'We are keen to use green technology', but the availability of that is relatively limited.. From a green perspective, we are saying to the manufacturers that we're happy to pilot whatever technology...but it's about them producing the technology in general production so people like us can go*

out and buy it." (Head of Environment)
4.2.7.2 "*There's been a hell of a lot of talk about corporate responsibility over the last five, six, seven years...For us one of the main drivers for us doing things in a sustainable way is firstly to protect our license to operate. Secondly, is it's been shown to our customers and to our suppliers that as an organisation, we do things in a sustainable way. I suppose there's a variety of pillars for that and one is the environmental piece. The other piece is really whether or not it makes good business sense to do that, and clearly we do think it does, or we wouldn't be doing it. And, of course, we're getting pressure from our investors and from our customers to say to us we do need to be doing things to reduce our impact on the environment.* *If you go back to [earlier time], I remember one occasion when [CEO] had been to see the investors for his usual grilling and one of the questions that was asked wasn't about how much money are you going to make next year, it's how are you going to reduce your environmental impact? That was asked by one of the big investors. That was a while ago, mind you, but that's what got [former CEO], I think, started on a route to sustainability, looking at the [investment community sustainability accreditation], looking at what we do as organisations to reduce our carbon footprint, and that legacy to a degree continues. Albeit, we have to mindful that, at the end of the day, we are a business, and we are in business to make money and we need to get that return for our shareholders, for our investors. But clearly there are some connections with suppliers, with customers. They are keen to make sure that we continue to do what we're doing in a sustainable way - because it does have impact on their performance as well.*" (Head of Environment)

Org 4.3 Logistics Trade Association

Quotation
4.3.3.1 "*When you look at Euro standards and carbon, they don't really match, and this is one of the challenges that we have in the UK government and also at the European Commission level. It would be better to tackle both*" (Policy Manager)
4.3.5.1 "*It's quite messy and complicated..there's still quite a lot of barriers for the take-off of alternative fuels...transport seems to be of concern to most counties and to the European Commission because they think it's just going to grow and grow and grow and it's not going to get better, that the emissions would just keep rising...I don't think it's going to be one solution, it's going to be a whole range of solutions. You've also got to bear in mind that whilst there are big, large operators, there's also lots of companies with one, two, three trucks, and that's predominantly what makes up most of the [sector]...whilst you can target the larger operators...our smaller operators...have got less opportunity to be investing in the decarbonisation measures.*" (Policy Manager)

Org 5.1 Construction Contractor, plus architect and client

Quotation
5.1.1.1 "*The efficiency of the capital outlay compared to the savings you get, you are far more likely to invest in making a building more airtight and insulated, which gives you much greater payback...Do you make decisions on the carbon footprint? No. I've not experienced that... If it truly includes embedded costs, transportation as well as production, the raw material and everything, that would be an interesting thing to look at... if we had the impact models, cost wouldn't be the factor. How do you make those decisions in terms of, 'Yes, I'm willing to pay a million pounds more because this has got a lesser carbon footprint.'...Energy usage in a building is something that we can easily relate to.* " (Client, Estates Director)
5.1.1.2 Client: "*[government funding body] introduced a policy where all [government] funded projects would have to achieve BREEAM Excellent, [we] had already set a policy that all new builds would be BREEAM Excellent and a refurb would be Very Good.* Researcher: *And was that just down to the operational efficiency?* Client: *Yes.* Researcher: *And was that a cost decision or a carbon decision?* Client: *Both. Carbon costs money.* Researcher: *If you were going to start from scratch doing one of those models today, what would the difference in fuel price now have on those models?* Client: *The amount that we use, I don't think the fuel price has a huge impact because we buy years ahead, don't we. So the need to be efficient is obviously linked with how much energy costs, but the fact that you can still show benefits, so if you introduced an initiative that would give you seven years payback with a fuel bill of X, and now the fuel prices have come down, it grows to ten or fifteen payback, you could still show payback. So the criteria we used in [other organisation] was anything with more than fifteen years payback you would put it into the amber instead of the green. But anything 20 plus would be red. So long-term payback, you wouldn't consider it. So initiatives like biomass boilers would go beyond the 20 year lifespan.* Researcher: *Because they are too expensive?* Client: *And operation costs are unknown, and difficulties in getting the fuel source and all this sort of stuff. And the efficiency of the capital outlay compared to the savings you get, you are far more likely to invest in making a building more airtight and insulated, which gives you much greater payback than a...* Researcher: *bit of kit in the basement.* Client: *Yes. Solar PV is probably one of those things that was still ten, fifteen years payback. So that's one*."
5.1.2.1 "*There used to be a day when principal contractors had a lot of labour and buy a lot of materials themselves. Now we tend to try and pass down the risk of the package to the sub-contractor ... We'll take certain bulk items if there's an advantage for us, in terms of concrete or bricks. But, they'll procure their own materials. The thing about materials is the key risk is the wastage...so...if the guy who's paying for the*

materials is taking care of them, then he'll take care of them a bit better. And that's been proven many times before." (Contractor, Regional Director)
5.1.3.1 "*As a BREEAM assessor I work on an architectural side as well, so I work on specification with the BREEAM element in mind.*" (Architect & BREEAM Assessor)
5.1.3.2 "*We have other elements in terms of sustainable design, which are requirements under different pieces of legislation...[for example, in this specific building] we have to prove 10% recycled content in the project*" (Architect & BREEAM Assessor)
5.1.3.3 "*It is not carbon footprinting, it's about the certification. It's not an exacting figure, it's about using the BRE calculator tool. What you do is you assign each level of certification...based on the BRE criteria, the industry standards, the [BRE] Green Guide ratings. It's not a number to each individual material. On the wall build-up, you can grade them A, B, C, D or E, and then we choose a wall build-up that can be an A+, and an A+ would give you more credits, and an E will give you no credits...They are blunt tools...*" (Architect & BREEAM Assessor)
5.1.3.4 "*Transport is completely out of most people's, or any designers, control. It is quite heavily weighted in the BREEAM criteria. There's quite a lot of things that we can't really do anything about. So, it's neither here or there really, it just is what it is.*" (Architect & BREEAM Assessor)
5.1.3.5 "*Under BREEAM if a product holds a BES certificate it gains much higher credits than it does if it just has ISO14001. There's a grading of one to eight and depending on how green your certification is for your product depends on how you score on that.*" (Architect & BREEAM Assessor)
5.1.3.6 "*Quite frankly, the only thing that is driving in investment in environmental is building regs and fuel prices. And fuel prices are still low. In some cases, some of the stuff is quite misguided actually... In terms of our mental energy used on EPCs [Energy Performance Certificates] and all that good stuff, we respond to the legislation, but by and large we do not find that our customers are interested in it very much yet. As actually, the cost of energy into buildings is not very big. It's very small compared to the operational expenditure. Where you get excited people are supermarkets, who see their costs go 'woosh, oh no I don't like that'... Fridges were driven by compliance with regs, and destroying the ozone and all that investment, and petrol stations, and all preventing leakage and recovery of vapour. So that was reg driven.* *In terms of environment there is a story they want to tell. But [major supermarket]'s probably pushed it further than anyone else. They've got PVs on the top of just about every one of their stores. They've got biomass on there. Does biomass work? Maybe 10% of them actually work, or, you know, can you get any biomass, and stuff to put in them? When you start to dig into these industries - but they are early industries, they will come. It's just trying to get them worked out and working. It's early adoption stuff. Some customers will drive for them, but like biomass and PV are just window dressing. It's not a massive amount of impact it's happening... I was talking to a British Gas guy the other day who is drilling two very big holes in [location] and creating geo-thermal energy. I said, 'That's good. How much does one of those cost?' He said, '35 million.' La la la la. Ok, I won't have one then.* " (Contractor, Regional Director)
5.1.3.7 "*Health and safety drives it. Construction kills a lot of people every year - an awful lot of people. And*

that's just not good enough. We are going to build things. We don't want to kill people doing it. So that's the driver" (Contractor, Regional Director)
5.1.5.1 *"There are a lot of other aspects that aren't necessarily BREEAM Based. BREEAM is quite structured but ultimately there are opportunities for [more sustainable]design that aren't necessarily BREEAM based..."* (Architect & BREEAM Assessor)
5.1.5.2 "*I don't mind doing the number crunching. I quite like it. It's a learning process. What you perceive as being green isn't necessarily what BREEAM tells you is green. People's perceptions of green are very different from the reality. So it is a learning process, but whether it is a realistic process or just learning how to do BREEAM, I don't know.*" (Architect & BREEAM Assessor)
5.1.5.3 "*BREEAM is only a tool and there's various tools out there for various different things. It's just a tick box. Things like BREEAM actually are quite misguided as well. Building regs tend to be more solid and drive performance to be what we want to get from places. BREEAM is a little bit more airy fairy to be honest.*" (Contractor, Regional Director)
5.1.5.4 " *[Construction] projects are a series of problems that are to be solved. If it was easy to build them, you wouldn't need a principal contractor, because you just tell the subbies to turn up and send them a little list and when they should turn up. They are complex and they are one-off and that's difficult....We've got a really good PM [project manager] who's done jobs like this before, and will do jobs like this again, but on every one of his jobs he's got a massive learning curve... That can't be under-estimated. The learning curve is dramatic in each project...*" (Contractor, Regional Director)
5.1.5.5 "*We want people who get on with work and want to do the job and then everything will go fine. But when you get too comfortable then you lose your competitive edge, so you've always got to refresh... We are very resistant to project managers having their own favourites... as those favourites start really well, but then start to reinforce bad behaviour. And as soon as they say, 'that's the way we always do it', I want to scream and run away. As that's the last thing I ever want to hear from anybody. 'That's the way we always do it'...If you work with guys used to standards, they get irritated by the amount of change*" (Contractor, Regional Director)
5.1.5.6 "*In the construction industry at the minute, the most important thing is people...the competition for people is just terrifying at the minute; because there has been no standardised way of repeating these things or building them in a factory or repeat anything; because each project is different, the people thing is so important. So, yes, the whole industry keeps looking for ways out, has always looked for standards, and the new great white hope is BIM [Building Information Management - digital management and design system for construction] and what that could do for us. How intelligent that could make it and how much better. It's possible. It's about the best bet I've seen for a while...but it's never going to take away from that person driving a site and dealing with people.*" (Contractor, Regional Director)
5.1.5.7 "*The guys that manage these sort of projects, they're just fantastic to watch - to see them do their job. They can juggle hundreds of things at the same time, and they've almost built this a hundred times in their head. They've got to get that deep into it, so when a sub-contractor comes in and asks them the silly*

question, they can answer them straight away and push them back out the door." (Contractor, Sustainability Manager)
5.1.6.1 "*The architect's have the BREEAM assessor and the architect working in the same office, which I think is a seriously good thing to have when you are talking about design and specification of products*" (Client, Project Manager)
5.1.6.2 " *I've been in the maelstrom of the Balanced Scorecard and steering wheel at [large company]. That's not strategy, that's implementation. Understand that it's a blunt instrument. It works - it did work - but you can see it isn't working now... We don't have an equivalent. A driver regulating, or something actually physically driving it... We have a set of KPIs we use, but to be honest, they are in and out a little bit. The balanced scorecard is a pretty impressive thing, but it is a pretty impressive thing when you are doing the same thing...when it is aligned. It's more difficult when you are dealing with a series of unique projects...*" (Contractor, Regional Director)
5.1.6.3 *" [large company] were a pretty mature company with a good product when they did that, and everybody was fairly well aligned to deliver it... it worked sensationally, but the issue was that it created massive executive power, because of the success. And this will come back to them, it is always a danger in a company... You must not let executive power get too high. The bottom line in a company is strategy. And execs don't do strategy... me and my boss will not do the group strategy, that's done by non-execs...Non-execs should do that, and have the main say on that, not the execs... [large company] last year wrote off just under a billion pounds...They're probably going to do the same this year. That's the over-run of that machine that was working. They should have seen this earlier. They should have said, 'Hold on a minute, lets slow this down'. They couldn't control them. They couldn't stop them...It worked before, but it's not working any more. So they couldn't turn off that executive power off, and that was the issue.*" (Contractor, Regional Director)
5.1.6.4 "*communication and regular communication is the key thing...if you can get out of 300 people, two thirds of them even heading in the right direction, the company flies. Absolutely flies. And the difference is hearts and minds. The steering wheel is not hearts and minds... It's about the hearts and minds because I always think if people want to do it, my God, it's powerful. It's really, really powerful. You cannot make anybody work any harder by giving them more money, or giving them an incentive, they just will not work any harder. Guarantee it. The way you make them work harder is to take away the things that are pissing them off or stopping them. One of those may be 'I'm not getting paid enough', or may be 'why am I doing all this paper work', or may be 'I'm too far away from home'. Take those things away, set the guy up in a job he's happy doing and wants to do, and seriously, they will cane it. I suppose, the balanced scorecard just tries to roll over that a little bit, and tries to make people do things they don't want to do.* " (Contractor, Regional Director)
5.1.8.1 "*the culture of an organisation is set by the leader...and our leader [name] is a hard working guy who likes to enjoy himself and have some fun and get around and do things, and doesn't like to be tied up*

in process. And that's the culture of our organisation." (Contractor, Regional Director)

Org 5.2 Construction Products Manufacturer

Quotation
5.2.3.1 "*It's proper sustainability in that it's pretty embedded in the business rather than the green-washing...It's quite a grounded and sensible approach. For instance, with landfill, we've got a huge landfill site...with the advent of the Landfill Tax we got our skates on...and...some of the processes and control methods are so good that we are actually extracting stuff from our existing landfill so that stuff that was previously waste and consigned to the ground has been taken out...We now take thousands of tons of tyre wire from end of life tyres. The runner goes off and is used for either roads or children's playgrounds, that sort of stuff. We are able to take the wire and recycle that because it's just steel.*" (Commercial Director)
5.2.3.2 "*We don't use it [life cycle analysis] as a tool for improvement at the moment. We use it in terms of [external auditing]. We are struggling to understand the definitions, particularly when our customers will define life cycle analysis to suit their own need and then use that as a comparison... Our competitors...they've got a life cycle that is based on slightly different starting points, slightly different definitions to make their system advantageous over ours. So, it's difficult to compare like with like. I think our customers would love to be able to use life cycle analysis as a selection tool as part of their discussions. Until we actually define what the full standards of that are and the initial unit of measured definitions that go into that, it becomes a little bit difficult to do like for like comparisons. I guess there's a need for standardization. Ultimately, I can see that coming.*" (Operations and Supply Chain Director)
5.2.3.3 "*At the moment, our electricity usage in all our carbon footprint is based on UK government average, which is based on the current mix of renewable versus all the other forms of generation. If you compare that with France, which we can readily do because we've got open access to the information there - which have a lot less. Why? Because they've got a far greater proportion in nuclear generation in France than we have in the UK. So, their electricity generation from a carbon footprint point of view is a lot more favourable. So maybe in 15 years time when there's two more nuclear power stations on stream, and more wind turbines dotted around the place, it will improve a little bit. "* (Operations and Supply Chain Director)
5.2.3.4 " *People like me sit on the sidelines and look at what's happening in Germany [well-known renewables-based energy policy] and France [predominantly nuclear energy mix], and think how is that ever going to fit into a COP21 deal? How on Earth are we going to deal with that? They're not decarbonising - Germany might have a lot of wind blowing or a lot of sunshine for some of the day - but the rest of the time they're fuelling their energy through the dirtiest coal possible, and still building those plants.*" (Energy Buyer)
5.2.4.1 "*The elephant in the room is that we are incredibly energy hungry, even on a recycling basis, and that's probably not sustainable.*" (Commercial Director)
5.2.4.3 "*We said to ourselves, "Well, we've got a target of reducing our carbon footprint by 50% by 2025 on*

our UK manufacturing operations. And if we do that then hey ho, that will reduce our impact, our life cycle analysis impact...why we're driving to it is because it makes economic sense generally...But my simple view was when we were doing our company target, that we reduce our carbon footprint 50%, so I said, 'well okay, 80% of our carbon footprint comes from what we melt. That's mainly driven by electricity. So therefore, all we need to do is replace our electricity suppliers with suppliers with renewable energy and hey presto, we've then reduced our carbon footprint by 50%.' No. It's not as straightforward as that." (Operations and Supply Chain Director)
5.2.4.4 "*We spend just under one billion pounds a year, so we've got quite an opportunity to influence the supply chain... our definitions are around environmental and social... In each of the categories there's basically a risk assessment done to say, "here's waste to landfill." Behind this is some definitions that say which of these are we bothered about, are we 'your use of CO_2' for example, or are we talking about CO_2 emissions right down the supply chain to the raw material?... We do a risk assessment in a category that says actually this particular thing we are buying is a high risk in terms of labour standards, for example. So when we are procuring that, we need to make sure that we've mitigated that risk through the qualification, the tender, then post-contract management.*" (Commercial Director)
5.2.4.5 "*The real sticking point is that when it really comes to it, there isn't necessarily due value within a tender process associated to sustainability or technical support or other things. So the price dominates. So you can be high in these technical and highly value adding, and highly sustainable and still lose out or not get a fair value for that because there is a lot of emphasis on price.*" (Commercial Director)
5.2.5.1 "*We're often seen as a tick box, 'have you got information from your supply chain on what their LCA performance is?', 'yes, we have'. Tick. The challenge, we often ask of them, and this is to some big organisations... 'How do you use the information? How do you put it to use?' and as yet we've not had a response to say, 'we use it to evaluate a preferred supplier list'. They are just not coming forward about that information. I don't know if that's true of other industries, certainly within the water, civil engineering and construction industry, we're finding perhaps it's a lack of understanding or an unwillingness to share with us what they are going to do with it. But there is no clear indication as to how they use information that we submit to them..It's a CSR requirement as part of their framework award process but there is no set measurement or KPI behind it. It's just a tick. Have you got it, yes. It's a pass or fail pretty much with that.*" (Process Manager)
5.2.5.2 "*We need to increase our understanding as an organisation. If we're going to have this sort of debate with our customers, so those people are knowledgeable...at the moment the knowledge is held with too few people within our organisation...So as more people become more knowledgeable about what's involved in an LCA, and also the benefits of it to our market positioning.*" (Process Manager)
5.2.5.3 "*There is a general sense of it being a tick box. Have you got an LCA? Tick. They're not yet asking what it means and there was a recent debate about how comparable these things are. It is possible we will get non-comparable LCAs in the market because each business can define their functional units in such a*

way that it's just irrelevant." (Commercial Director)
5.2.5.4 "you have a set of criteria [when you do the LCA] but if you do something the LCA changes." (Sales Director)
5.2.5.5 " We don't use it as a tool for improvement at the moment. We use it in terms of the latter [external reporting]. We are struggling to understand the definitions, particularly when our customers will define life cycle analysis to suit their own need and then use that as a comparison between for example when they're comparing the choices of their having that in their supply. An example, when we quote our [product] and we have a life cycle developed for our [product]. Our [product is] made of [metal], our competitors are in plastic and they've got a life cycle that is based on slightly different starting points, slightly different definitions to make their system advantageous over ours. So, it's difficult to compare like with like. I think our customers would love to be able to use life cycle analysis as a selection tool as part of their discussions. Until we actually define what the full standards of that are and the initial unit of measured definitions that go into that, it becomes a little bit difficult to do like-for-like comparisons. I guess there's a need for standardization. Ultimately I can see that coming. *We don't use that as a driver for our economic and sustainable target. We said to ourselves, "Well, we've got a target of reducing our carbon footprint by 50% by 2025 on our UK manufacturing operations, and if we do that then hey ho, that will reduce our impact, our life cycle analysis impact. But it's the reduction that we're driving towards and the consequence is including - why we're driving to it, is because it makes economic sense generally."* (Operations and Supply Chain Director)
5.2.5.6 "it's not easy to play with it. Particularly if you are talking about energy purchasing policies and the government's incentives and renewable obligations certificates and all those things. It's quite -- I don't propose to understand it all. But my simple view was when we were doing our company target, that we reduce our carbon footprint 50%, so I said, 'well okay, 80% of our carbon footprint comes from what we melt. That's mainly driven by electricity. So therefore, all we need to do is replace our electricity suppliers with suppliers with renewable energy and hey presto, we've then reduced our carbon footprint by 50%.' No. It's not as straightforward as that... to be able to do that sort of carbon footprint, we need to be able to claim the sustainable impact of electricity generation, however the electrical generators claim that already. So, if you are a wind turbine supplier, then you have already claimed your renewable obligation benefits. So, we then can't claim it again" (Operations and Supply Chain Director)
5.2.5.7 Researcher: "*how do you think this level of complexity actually affects your ability to make decisions about some of this stuff?*" Energy buyer: "*Oh, tremendously. It is so very difficult to make a long term decision. One of the difficult features of the market over recent years has been the changeable nature of it. Different government departments fighting each other and different governments changing things, even the same government changing things. It's very difficult. Take the feed-in tariff for instance, where a year ago it might have been a beneficial thing to put solar panels all over the place because you'd get a decent feed-in tariff for it. On a whim they could just slice it in half or remove it. We know it's a risk, and we won't take that risk. Why*

would we. The changeable nature of the market is very difficult to deal with at the moment. It's almost paralysing... You ask any energy buyers across the country and they'll say the biggest problem is legislation changes. We don't know where we are. How can we make a decision on legislation that could change tomorrow on a moment's notice. We look at other European countries, like Spain, where they've changed their regulation retrospectively. UK said we'd never do that, but no doubt Spain said that too." (Energy Buyer)

5.2.8.1 *"It's a very procurement-led economic model and therefore cheapest price often wins...Where we try to get to is to absolutely maximise in terms of the technical aspects of the bid, and sustainability is included in that...and then there's the price...If you take the mantra of if you cut the carbon you cut the cost...If you take carbon out, you either spend less money on electricity in the first place, or you spend less money on pouring metal in. So absolutely there is a very strong correlation between carbon and cost, and those are two things that are really working for us... there is a connection between pound notes and carbon at this stage in our development, so if we can take out carbon, it will take out pound notes. The tension comes if we are trying to hit, let's say, our arbitrary 50% target, and we end up making non-economic decisions to do that, that's where the real tension is. So if we were to go and spend millions of quid to construct a wind farm just to supply the electricity we need and therefore it changes the P&L, fundamentally it puts our prices up. That becomes an interesting debate, but at the minute we are at the beginning of the curve, so there's enough carbon reduction that gives us pound note benefit."* (Commercial Director)

5.2.8.2 " *I'm not cynical, I still believe in the environment and that's because I do a lot of this myself and, you know, to make sure that I do the best I can, but I do get cynical because we pass all the laws here and all we seem to be doing is putting our industries in the UK out of business because what we've got to conform to makes our product more and more expensive. It's not helping in any way having products coming in from abroad cheaper and getting sold in market. So eventually all that's going to happen is businesses closing down here. It's a bit of a shame really, but we're seeing a lot of that and it's just the way we are here... I guess in the company we're doing everything we can in design, so we design the most economical design, but at the end of the day, we pay wages, we have health and safety to look at. We have lots of rules and regulations and we don't get subsidized in any shape or form, like in other countries... in India and China is they just sell products here which is to standard. Nobody looks at their environmental performance, or their processes, or the wages. I mean, the water company couldn't say to a supplier in India, you've got to pay them minimum wage which we have here. Or they can't say to them, 'well you must wear this helmet, gloves, you know. You've got to give them holidays, you've got to have breaks, you've got to improve you plants. You must design your plants so there's no dangers to anybody'. They can't do that, can they? All they're doing is buying a product based on is it to standard? Yes, it is. Has it got third party accreditation, yes it has? So it's a basic test, but when it comes to standards, the environment isn't an influence. So maybe the standards should take in, as part of the standards, an environmental policy or what we would expect to see as human beings in our standards. Maybe that's the way to do it? I don't*

know, but certainly if it were, it wouldn't happen overnight, but all they do is create a standard based on product performance. They don't base a standard on the environment and health & safety or anything like that. It's based around the product and can it meet this strength, does it meet these dimensions. And you know, you could make a little box in your garage and make it to standard, so long as you test it and things, but it's just the way that we do all our standards and manufacture to a standard product... the problem with the standards, European standards, is that they're a very loose standard because they've got to cater for every one of the European markets. When we had a British standard, it was very tight and rigorous and tested to get that certification. When the European standards came out, because they've got to cater for each country, they are much more loose standard and for instance, they put the standards for [product] they said this is the standard and this has what it's been tested so this is what it's got to do. But if you want a different product, it's up to the specifier to specify around the product you want, but you have to specify around a project because in the UK you cannot specify a product unless you put 'similar approved' and then how do you assess that? It's very difficult, so for us, because all they want -- if you meet the [code number] and it's third party accredited, that's all they will take. So you can see the difference in the quality when they see our product and obviously sometimes it works, and we have unique products otherwise we wouldn't be around, but in general there is an awful lot of products sold from the likes of China and India and it's basically just about price. Probably an instance to give you, what we had to do - there was a law that came in a few years ago - where any covers and grates had a bitumen coating, which is just pretty much cosmetic coating on the products. It wears off and disappears into the drainage and into the water courses and things and what we had to use was a water based coating. I think we spent quarter of a million to put new plant in to do that and conform to the law, yet the product coming in from abroad, we don't believe that that's the water based product that's on there, but, you know, because it comes in from abroad, nobody realizes that. So we haven't gained anything by having this law for the environment which is going to be a point of debate, because this product is coming in and its washed off that product as well as our own. It's not going to do us any good, is it?." (Sales Manager)

5.2.8.3 "*It's a nightmare. I could switch all our sites to green electricity and I could announce to the marketplace that we've done that and aren't we brilliant, and it will cost us about [x] million pounds [per year], and that's why we are not going to do it.*" (Energy buyer)

5.2.8.4 "*A large proportion of our industrial sites can get exemptions from the Climate Change Levy through other schemes. So we have the mineralogical and metallurgical exemptions for various industrial plants. Then we've got Climate Change Agreements at various other sites, which means they pay no or very little Climate Change Levy, but they have to take brown electricity to get that exemption. Any [sites, e.g. offices, that don't] get an exemption from Climate Change Levy, we would take green electricity because it doesn't make any difference in terms of cost, so we have the benefit of the green tariff, but they're fairly small... Exemptions are done at sector level, so if the business doesn't fit into a sector that's got an exemption we might as well take a green tariff... So if we pay the Climate Change Levy, then we might as well pay for the Levy Exemption Certificate [at 10% of the cost].*" (Energy Buyer)

Org 5.3 chemical process services company

Quotation
5.3.1.1 "*we are obviously very proud to be part of the nuclear sector. However, if you looked at our operations they are not of a very toxic nature. They're not ones of radiological nature really, the main hazard is [specific chemical]...It's chemi-toxic. It's a chemical hazard that we have rather than a radiological one. Obviously we have a nuclear licence and we require that nuclear licence to operate as we're part of the nuclear industry...as part of our responsible stewardship of uranium, we're investing in this plant whereby...it converts the uranium element back to U_{308}, which is basically a less radioactive form of how it was...when it was dug out of the ground. And there will probably be about [large volume] tons of [specific chemical] a year, which is sold back into industry and is used for making plastics. So it's a very environmentally responsible full circle*." (Communications Director)
5.3.3.1 "*I think sustainability means different things for different organisations. But ultimately, it's about maintaining the success of the company by your actions today and for the future. So we have our own sustainability definition...For us, basically, sustainability is about ensuring that our business performs today in a manner which delivers long term success in the future. And we have five key areas that we focus on that we determine our key to our future success; so one is to be a supplier of choice, obviously health, safety and security, given the nature of the business that we're in... Education and community, which is one being a good corporate citizen so that we put value and assets back into the community in which we operate, and also the wider piece around education of basically what we do, why we do it and the end game which is the provision of low carbon energy. And for us...if there is no nuclear industry then there is no end game. So...we need people to understand nuclear and be supportive in nuclear and an understanding that nuclear needs to be part of the energy mix. And secondly, and more focused really, is that whole piece on the benefits of nuclear [means] trying to put that into language so that people understand it. Because I think a lot of the focus around energy in general, but more particularly nuclear, is that people switch off because they think they've got to have a masters in science to understand any of it....the other element, of course, is employer of choice. We need to recruit and retain the right calibre of staff so that we can operate efficiently, safely and successfully. And minimising our impact on the environment, so in everything that we do from our day-to-day operations to ultimately fuel that we produce for nuclear power plants.*" (Communications Director)
5.3.3.2 " *we also have sustainability champions for each of those focused areas, so the governance around it basically is quite structured. So we have our sustainability agenda, that's governed by our board committee. We then have a chief cultural officer, sort of oversees the KPIs around it, et cetera... Then we have sponsored group champions, and site champions which work with the group champions, to deliver on the KPIs; and underlying all that is the non-financial KPIs which are focused around each area of those particular initiatives*." (Communications Director)
5.3.3.3 "*customers are part of our supply chain because for our operations we basically supply service. So*

for our customers they source [upstream materials, subsequently delivered to them]... So our customers are certainly a key part of the supply chain at both ends. So we need to show our customers that our activities that we do on site are sustainable because they look for that in their due diligence before they're placing contracts with us or at the time that they are placing contracts with us... And the customer and investor element was probably the start our greater focus on sustainability maybe five or six years ago because once we started going out to the markets there is obviously a great deal of due diligence that is carried out for our investors... once we started engaging with investors it became very apparent very quickly that they needed all these other elements to be satisfied before they would consider investing in us. So we did them all... We follow the GRI indices; it's not an approved reporting system by any stretch of the imagination. It does help with regard to the elements that external parties require because it's really the only global reporting system that's widely accepted. The challenge with it is that it can, if you don't have a clear focus and strategic direction anyway, become a tick box exercise. " (Communications Director)
5.3.3.4 "*we had been reporting on sustainability KPIs for about four years. And frankly, we had not done a very good job of it because sustainability was...frankly more of a public relations thing. Something that had to be done for somebody outside that seemed to want this information. And so it was a task that [communications director] called up once a year and said, "I need this information". And we culled the information together and when you look back, the information we provided is not always very accurate and what one business in [one country] might be reporting with regard to that KPI could be completely different from the way it was pursued with another facility and there wasn't a lot of continuity... when they asked me to take on this role, the first place we went was to the KPIs. When we went through the KPIs and we analysed each and every one trying to clearly understand exactly what we were trying to measure. And frankly we supplemented existing suite of KPIs. We developed a set of internal and external KPIs. External are those KPIs that we share with the rest of the world. Internal KPIs are those that we use just inside, the two work in concert with each other with one set helping to cause the other set to occur, but what we came up with was a detailed list of KPIs that whether you had a sustainability program or not, it would be the right things to monitor, measure and focus on because it's the right way to run a business." (Chairman)*
5.3.3.5 "*We're still very much on our journey because the word sustainability, interestingly, doesn't easily translate into Dutch and German it seems in our experience... Whether it's our people's mindset or whether it's a true fact generally in those countries, but getting that understanding of its sustainability...we're all going to go out and hug a tree sort of thing, is nothing to do with that. It was to do about being a responsive business and basically doing things right. It's what we've always done, it's just it was never labelled as such...the reference to sustainability has gone through many iterations in the years gone by. I know when I started it was called responsibility, then it was called social responsibility, then it was responsible business, then it was sustainability reporting. So it sort of organically changed to cover the elements within the reporting cycle. But for an organisation that has always been doing something in that element anyway, it can look like it's a bit faddy.* " (Communications Director)
5.3.4.1 *"while we have no involvement in the mining upstream or the transportation of our*

product...downstream, I think that because we're involved in that stream that we have some culpability and responsibility with the whole process...10 to 15 years ago, I think we were knowledgeable about those things, we just didn't do a very good job of communicating about it and so it's difficult for us to influence some of those projects. For instance, on the mining end of it, the material that we process does not belong to us, it belongs to our customer. So our customer is a utility, they buy the material from the mine and then what material they provide to us we process...and we then we give it to a [second chemicals processing company] they select downstream. So we have no direct control or interface with the upstream supplier or the downstream supplier, but we're painted with the same brush and so the only ability to influence is to be very active in the industry and vocal about what we believe the standards and practices should be." *(Chairman)*
5.3.4.2 "*We have a new policy around procurement and sustainability... and that basically focuses on our professional and responsible approach to CSR through our key supplier relationships and collaborations. So the policy highlights [chemical firm]'s initiatives and directives that will deliver our performance target within procurement and supply chain CSR programme...And within that of course they've got KPIs, and it's to focus on ensuring that our supply chain are assessed as part of the supply qualification selection process and in line with what we want and what we expect our suppliers to do in terms of CSR within the supply chain and corrective actions, et cetera... we have key suppliers for IT for example, secondary support on-site so caterers... or when we're looking to appoint a new contractor, we look at the impact on community, the impact on environment, and the suppliers fully understand the impact of their business on the environment, and in doing so have programmes and initiatives in place to prevent pollution, climate change and mitigation, et cetera. Fair, open practices, so in line with what [chemical firm] do, anti-corruption, fair trade policies, human rights and operational and labour practices; so there the key elements that we look at when we scoring it, which would determine whether they are successful in obtaining that contract or not.*" (Communications Director)
5.3.5.1 " *We follow the GRI indices; it's not an approved reporting system by any stretch of the imagination. It does help with regard to the elements that external parties require because it's really the only global reporting system that's widely accepted. The challenge with it is that it can- if you don't have a clear focus and strategic direction anyway - become a tick box exercise.*" (Communications Director) See also 5.3.3.4 above.
5.3.5.2 " *there is a focus on the part of the industry to raise the standard across the entire global industry. There is a clear understanding that we are all bound by the same thought process with regards to the public, but it's especially apparent in the nuclear generating side of the business. One nuclear event on a generating plant anywhere in the world and it's immediately extrapolated to the plant you happen to operate and 'where are you with regards to this' and 'how could this possibly occur?'. And so in this business there is a clear understanding of how bound we are and so that has motivated the industry into normalizing the standards as much as possible*." (Chairman)

5.3.5.3 " *We had very autonomous sites originally and it went through that centralisation period, which many companies go through. And it was that process of centralising the data gathering I suppose and the interrogation of that data, reviewing that data, seeing where the anomalies were, how we could perform better as a group because across the different sites of course there were different experiences. So bringing that together as an executive level focus enabled us to move along our journey in a more productive way. So yeah, don't misunderstand that these things were not already taking place- they were - it was just that the gathering of the data and the interrogation of the data and the governance around it was somewhere that we could improve it to get a better group-wide outcome*" (Communications Director)
5.3.5.4 *"[what we do is] very simple and very standard."* (Communications Director)
5.3.5.5 "*the market is increasingly competitive certainly, as the price of uranium has dropped at the moment, or post Fukushima...whilst the Japanese reactors are off-line there is fuel that is not being used, so the inventories globally have gone up*." (Communications Director)
5.3.7.1 "*[we are] very heavily regulated but we obviously comply with and have processes and procedures that align with our regulatory requirements and we go above and beyond that. So, yes, we obviously need to engage in regulators and they certainly are a key stakeholder audience, but we don't need to educate them. They understand our business...It's a relationship we obviously need to carefully maintain, but it's not an alien audience*" (Communications Director)
5.3.7.2 "*Our focus historically has very much been on educating the communities in which we operate. We are very much an open-door policy...We work very hard to bring people on site so they can see firsthand exactly what we do...we're proud of the fact that we're part of the nuclear sector that provides low carbon energy and that's the reason for our existence., and that seen at first-hand has proved to absolutely invaluable...We also spent 18 months in bringing key business leaders, opinion formers, community leaders and different community groups into our facility in [location] so they could see first-hand what was going to be in their town or their area...It just created that open dialogue and totally created the trust and confidence that we needed to be able to get our licence to operate there.*" (Communications Director)
5.3.7.3 "*We have probably been a little bit frustrated that the industry collectively doesn't do a great job of working together and getting out those messages because everybody's got a different focus. Utilities don't want to wave the flag for nuclear because they wouldn't want it to be detrimental to their oil and gas and renewables. It's a very fine balance I understand for them, but also trying to get all the players singing off the same hymn sheet is quite difficult*." (Communications Director)
5.3.7.4 "*[In relation to nuclear power, the public in Germany are] very emotional, you know. The sentiment is completely negative. We need to support our employers over there as well, because they are considered a bit like bankers and estate agents are in the UK really. So maintaining that morale and pride in what they do every day when they go to work is something that is critical for us....I don't totally understand it because it is totally emotionally led and given the fact that, you know, in Germany a lot of the mindset is logical, scientific, you know, factual. It's a quite against the norm. Even the fact that in recent times it's really hitting the general public's Euro in the pockets, there is still some incredibly strong feeling that they should*

rely totally on renewables; so it's definitely a hard one to crack....I can't quite get into the psyche of it to be honest....And also they're buying nuclear energy from France It's a bit of contradiction in terms really." (Communications Director)
5.3.9.1 "*it's about having that fresh eyes look at processes that we've always done and actually can we do it better. And having a different focus around 'how can we do it better' mindset brings different views. So it's not just about a technical process, it's about the impacts that that technical process provides. And when you look at it in a different way it's all beneficial because efficiency comes into it and then obviously reduced costs. And also a sense of pride that actually we are doing it the right way and our external impacts are at the absolute minimum of what they could be....*" (Communications Director)

Appendix C: data tables from the systematic literature review.

PAPERS PER TITLE	TOTAL PAPERS	JOURNAL TITLE
9	9	Journal of Cleaner Production
5	5	Clean Technologies and Environmental Policy;
3	3	International Journal of Logistics Systems and Management
2	10	Applied Mathematical Modelling; Greener Management International; Management Research Review; Social Responsibility Journal;
1	41	Asia Pacific Management Review; Business and Economics Research Journal; Business and Society; Computers in Industry; Ecological Indicators; Economic Systems Research; Engineering Optimisation; Environmental Science & Technology; Environmental Systems & Decisions; IIMB Management Review; Information Management and Business Review; Information Technology and Management; International Food and Agribusiness Management Review; International Journal of Electronic Business Management; International Journal of Management & Decision Making; International Journal of Productivity and Performance Management; International Journal of Services and Operations Management; International Journal of Services Technology and Management; International Journal of Simulation and Process Modelling; International Journal of Sustainability in Higher Education; International Journal of Sustainable Manufacturing; International Journal of Operational Research; Journal of Accounting, Finance and Management Strategy; Journal of Agricultural and Environmental Ethics; Journal of Agricultural and Food Industrial Organisation; Journal of Applied Management and Entrepreneurship; Journal of Fashion Marketing and Management; Journal of Hospital Marketing and Public Relations; Journal of Industrial Engineering and Management; Journal of Information and Computational Science; Journal of Management Development; Journal of Marketing Channels; Journal of Public Procurement; Journal of Scientific and Industrial Research; Leadership and Management in Engineering; Optimisation; Progress in Industrial Ecology; Resources, Conservation and Recycling; Science and Engineering Ethics; Strategic Outsourcing: An International Journal; Sustainability; WSEAS Transactions on Environment and Development; China Population, Resources and Environment.

Table 40: Non-ABS Journal Titles, by number of papers.

ABS SUBJECT CLASSIFICATION	ABS RANK	NO. PAPERS	JOURNAL TITLE
Operations, Technology and Management	4	1	Journal of Operations Management
	4	2	International Journal of Operations and Production Management
	3	2	IEEE Transactions on Engineering Management
	3	17	International Journal of Production Economics
	3	12	International Journal of Production Research
	3	2	Production and Operations Management
	3	5	Production Planning & Control
	3	1	Journal of Supply Chain Management
	3	10	Supply Chain Management: An International Journal
	2	1	Computers & Industrial Engineering
	2	3	International Journal of Logistics Management
	2	8	International Journal of Physical Distribution & Logistics Mgt.
	2	2	Journal of Purchasing and Supply Management
	1	1	Business Process Management Journal
	1	1	International Journal of Agile Systems and Management
	1	2	Flexible Services and Manufacturing Journal
Operations Research and Management Science	4	1	Management Science
	3	1	Decision Sciences
	3	7	European Journal of Operational Research
	3	1	OR Spectrum
	3	2	The Journal of the Operational Research Society
	2	3	Computers & Operations Research
	2	1	Interfaces
	1	1	Computational Management Science
Business Ethics and Governance	3	1	Business Ethics Quarterly
	3	6	Journal of Business Ethics
	2	1	Business Ethics: A European Review
	1	1	Corporate Reputation Review
	1	1	Corporate Social Responsibility and Environmental

			Management
Sector Studies	3	1	Transportation Research Part E, Logistics & Transportation Review
	2	1	Journal of Environmental Management
	1	2	British Food Journal
Social Science	4	1	Environment and Planning A
	3	1	Technological Forecasting and Social Change
	2	3	Journal of Industrial Ecology
Economics	4	1	Journal of Environmental Economics and Management
	3	1	Ecological Economics
Strategic Management	4	2	Strategic Management Journal
	2	1	Business Strategy and the Environment
General Management	3	1	MIT Sloan Management Review
	2	4	Management Decision
	1	1	Measuring Business Excellence
Marketing	2	1	Journal of Business & Industrial Marketing
Information Management	3	3	Decision Support Systems
Organisation Studies	2	1	Journal of Knowledge Management
Public Sector Management	3	1	Journal of Public Policy & Marketing
Entrepreneurship and Small Business Management	1	1	Journal of International Entrepreneurship

Table 41: ABS ranked research relevant to SSCM and Decision Making.

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