The progression of the triple bottom line in supply chains: Investigating barriers and blockchain technology solutions in the luxury fashion sector

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I would like to dedicate this thesis to my late grandparents,
Gwenda and Robert Donaldson.

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Abbreviations

BCT – Blockchain Technology

CSF – Critical Success Factors

DoI – Diffusion of Innovations

ICT – Information Communication Technology

IoT – Internet of Things

IPT – Information Processing Theory

NFT – Non-Fungible Token

RBV – Resource Based View

SC – Supply Chain

SCM – Supply Chain Management

SLR – Systematic Literature Review

SORS – Spatially Offset Raman Spectroscopy

SSCM – Sustainable Supply Chain Management

TBL – Triple Bottom Line

TOE – Technology-Organisational-Environmental

Abstract

The triple bottom line (TBL) is a central concept to the sustainable supply chain management (SSCM) agenda. It proposes firms should strive to balance their economic, environmental, and social performance. Despite the wide acceptance of the TBL concept by researchers, practitioners, policymakers and broader society, a myriad of global TBL supply chain problems exist in practice. There is a general global consensus that rapid change is needed.

The barriers to TBL progression are numerous and complex. Developing a clear business case (BC) for TBL adoption can be a major barrier. The BC, as a key underlying concept of managerial decision-making, is the juncture at which theory is evaluated and either rejected or adopted and acted upon in a practical setting. A lack of supply chain transparency is a perennial problem at the core of many of the SSCM business case development issues. Technologies associated with the fourth industrial revolution (Industry 4.0) such as blockchain technology (BCT) have the potential to enable unprecedented levels of transparency that can help support TBL objectives. However, BCT and many other Industry 4.0 technologies are still in an emergent state and there is a need for a deeper understanding of how they can be effectively deployed to increase the diffusion of TBL in global supply chains.

This research sheds light on the matter through several stages of pragmatic inquiry. A pre-cursory systematic literature review was conducted to examine the use of mid-range organisational theory in TBL-focused SSCM research. This was undertaken to provide a theoretical foundation for the inquiry. It aimed to deepen the understanding of how the research problem has been explained from a theoretical perspective and to see whether the theoretical toolkit for SSCM research could be strengthened. It sought to understand the reported SSCM 'theory-practice gap' by first understanding the theoretical perspectives.

Building on this, an empirical exploration of the business case for SSCM in the luxury fashion sector was undertaken, providing in-depth practitioner and policymaker insights on the barriers to SSCM and TBL progression (paper 1). This paper explored the practice side of the theory-practice gap. The findings highlight that firms face difficulties when trying to develop value-driven business cases for SSCM and the TBL. Although there was an interest in transparency-enhancing information communication technologies like BCT to solve transparency and subsequently SSCM issues, there is currently a large degree of uncertainty regarding how the BCT could be employed and whether there is a business case for its adoption. This reluctancy stems from uncertainty regarding consumer demand for sustainable products and services.

The first paper emphasised that a lack of supply chain transparency coupled with uncertain demand was the root cause of several barriers to TBL progression. However, as highlighted above there was a lack of enthusiasm for ICTs such as BCT that promised to offer remedies to such issues. The quest for solutions to these barriers motivated the second paper: a conceptual exploration of BCT tokenisation, specifically the potential of non-fungible tokens (NFTs), as a means of improving transparency, incentivising good SSCM performance and helping to deliver the value proposition of this to customers. The analysis of the existing concepts offers a series of in-depth insights on the role and impact of emerging BCT innovations. The paper makes the case that the invention of NFTs changes the value proposition of BCT in a way which is understood by customers. Hence, they can be used to overcome the present challenges.

The third and final paper compliments the second by exploring another avenue in which the barrier to BCT for SSCM adoption can be overcome. The existing literature posits that BCT in isolation can be seen as a solution looking for a problem, it is depended on linkages with other technologies for its value to be realised. Existing research has looked at the pairing of BCT with established supply chain technologies such as RFID. However, RFID still leaves the supply chain vulnerable to corruption and counterfeiting. Hence, the third paper explores the adoption of BCT clusters, specifically the pairing of BCT and novel 'tracer technologies', as means of overcoming existing barriers to supply chain transparency. It empirically examines the creation of sustainability-based value in the luxury textiles sector through a collaborative action research project with a heritage UK-based woollen manufacturer which led to the successful implementation of a BCT-based traceability system (FibreTrace®).

The research outcomes from the different stages help to provide new ways of viewing and explaining the research problem and contribute deep insights into the technology solutions that aim to achieve the more rapid diffusion of substantive TBL adoption in supply chains. The research makes several contributions to both theory and practice. These include 1) an in-depth review of the theoretical underpinnings of TBL-focused SSCM research; 2) empirical evidence that provides deep practitioner insight into the drivers and barriers for SSCM business case development; 3) a conceptual exploration of how emerging BCT innovation, NFTs, can be used to create sustainability-based value and overcome the barriers of BCT for SSCM; 4) an empirical exploration of how BCT clusters (BCT and tracer technologies) can support SSCM BCs; 5) a theoretical framework for technology-focused SSCM research; 6) an expanded diffusion of innovation (DoI) theory view of TBL adoption, including the introduction of the 'sustainable innovation cluster' concept.

Chapter 1 – Introduction

1. Introduction to the research

A seminal moment in public awareness of 'sustainability' and 'sustainable development' came in 1987, following the publication of the United Nations-commissioned report 'Our Common Future'. For many scholars, the report initiated the convergence of the 'sustainability' and 'supply chain management' concepts to form 'sustainable supply chain management' (Seuring & Müller, 2008). Sustainable supply chain management (SSCM) has received increasing attention from academics and practitioners in recent years. This is largely motivated by mounting concerns over sustainability issues such as climate change and modern slavery (Kitsis & Chen, 2019; Meehan & Pinnington, 2021). Consumers are reportedly becoming "more mindful with increasing concerns for the environment, fair treatment to employees, and company reputation" (Chavez *et al*., 2020, p. 13).

One of the most popular means of defining and operationalising sustainability in supply chains has been Elkington's Triple Bottom Line (TBL) concept (Elkington, 1999). The TBL encourages business to think beyond their financial bottom line and to consider the social and environmental impact of their business practice. There have been promising TBL benchmarks in some industries, such as food (Cernansky, 2020; Chkanikova & Mont, 2011; Yakovleva *et al*., 2012). The emergence of Benefit Corporations (B Corps), also suggests that balancing the three TBL dimensions is possible for commercial enterprises in practice (Kim *et al*., 2016). However, B Corps currently only account for around $1 billion in sales globally (Elkington, 2018). To put this into context, the revenue of B corps would only amount to 0.02% of the total estimated global sales revenue for the top 250 global retailers (Deloitte, 2020).

Although there has been wide acceptance of the TBL concept by researchers, practitioners, policymakers and broader society, it is not advancing as quickly as theoretically expected (Elkington, 2018; Kirchoff *et al*., 2016; Pagell & Shevchenko, 2014). Its effectiveness in practice has been questioned (He *et al*., 2019) and some have drawn attention to an increasing gap between SSCM theory and practice (He *et al*., 2019; Taticchi *et al*., 2015). Some scholars have warned that sustainability is in danger of becoming a "broad concept with little meaning at a practical level" (Chavez *et al*., 2020, p. 13) and have called for more research that explores specific barriers to its progression in real business contexts (Chavez *et al*., 2020, p. 13). SSCM and the TBL have been

ideologically ambitious yet somewhat unaware of the conflicting pressures that business managers often face when trying to address TBL issues whilst maintaining strong economic performance (Kirchoff *et al.*, 2016). In 2018, Elkington proposed a management concept recall (Elkington, 2018) stating that in the twenty-five years since its inception, the TBL had failed to get businesses to see beyond their financial bottom line. He called for a "new wave of TBL innovation and deployment" (p.5).

The study, motivated by the researcher's experience in the luxury fashion sector and a preliminary study undertaken during their MSc degree programme, began with the observation of the TBL-related problems occurring in the context of the luxury fashion sector. The researcher had started working in the sector at the beginning of 2015, when sustainable development was becoming a big talking point in the industry. Despite the acknowledgement that things needed to change, there was a notable lack of action in practice and the researcher became aware of concerning reports of poor SSCM practice in the sector (Bendell & Kleanthous, 2007; Greenpeace, 2014; Moore, 2011). These continued to emerge (BBC News, 2018; Greenpeace International, 2018).

Many brands were announcing sustainability initiatives publicly, but little seemed to be changing behind the scenes. Furthermore, there appeared to be conflicting messages within the industry. There was pressure for economic growth whilst simultaneously addressing increasing social and environmental concerns, but only a limited discussion about the trade-offs that seemed inevitable to some practitioners. This problematic state spurred the inquiry into what could be done to address the issues that had been observed. Early reviews of the literature confirmed what had been observed in practice with reports that the luxury fashion sector was lagging in its sustainability transformation but was somehow managing to evade scrutiny. It was fast fashion brands that seemed to be receiving the majority of negative media attention (Bendell & Kleanthous, 2007; Carrigan *et al.*, 2013; Fernie & Perry, 2019; Kapferer, 2010; Moore, 2011). Rajeev *et al.* (2017) stated that there was a pressing need for more industry-specific SSCM studies, particularly into the most polluting industries (such as the fashion industry), as sustainability standards can vary across industries.

The initial stages of the inquiry highlighted that supply chain transparency was central to the progression of the TBL (Carter & Rogers, 2008). A lack of it provided businesses with an "alibi for inaction" (Elkington, 2018, p.4). Transparency and traceability have both been identified by the European Union as key priorities to progress SSCM and support the achievement of sustainable development goals (European Commission,

2017). Transparency can give credibility to SSCM claims made by organisations (New, 2010). Therefore, increasing transparency is a key supply chain objective, not only for facilitation of the TBL on a practical level, but for leveraging the latent value in it as a means of developing a clearer business case (BC) for adoption (New, 2010). From a luxury fashion perspective, sustainability was identified as a means to gain competitive advantage, through a differentiation strategy by offering a 'deeper luxury' concept and practice (Bendell & Kleanthous, 2007). However, there seemed to be limited evidence of this happening in practice.

The widening gap between the ideals of the TBL and its execution in practice needs to be addressed and can be logically associated with the question of how the required degree of transparency may be induced in supply chains (SCs) using Information Communication Technology (ICT). There is a strong and long-standing body of literature on the use of ICT/information systems for improving SC transparency, traceability, communication and flow of information, which have been augmented since the advent of the Internet (Lai *et al.*, 2006; Lyons *et al.*, 2012; New, 2010). Whilst ICT has been one of the only realistic solutions for improving SC transparency, the situation is far from ideal due to the limitations of current information systems (Saberi *et al.*, 2019). Furthermore, in certain supply chain contexts (e.g. developing countries) ICT solutions are not always viable due to infrastructure and resource limitations of suppliers (Hannibal & Kauppi, 2019). In summary, achieving a state of 'perfect information' is still a long way off for most industries (Chan, 2016; Granados & Gupta, 2013).

Despite the limitations, technology is developing at a rapid rate. In recent years, the emergence of disruptive technologies associated with the Industry 4.0 movement such as blockchain technology (BCT) (Nakamoto, 2008), the decentralised distributed ledger technology behind the Bitcoin cryptocurrency, have paved the way for new solutions that offer unprecedented levels of transparency. Some believe BCT will power new business models (BMs) based on provenance and sustainable value creation (Nowiński & Kozma, 2017). However, many of these technologies are still in their nascent phase. Whilst they show significant potential for solving TBL-based sustainability problems and achieving global transparency for TBL in SC (Eslami *et al.*, 2019; Garcia-Torres *et al.*, 2019; Guo *et al.*, 2020; Saberi *et al.*, 2019), there are still many barriers to adoption (Bai *et al.*, 2020; Kouhizadeh *et al.*, 2021).

Following a PhD structured as unpublished papers approach, this thesis has two main aims, both of which are related to answering Elkington's call for a new wave of TBL

thinking. Using the empirical setting of the luxury fashion sector as the context for the research, it firstly aims to develop a deeper understanding of why the TBL concept is not diffusing in supply chains on a practical level as quickly as hoped, and why there seems to be an increasing gap between theory and practice. Secondly, it aims to examine how innovative technology solutions may help to close the gap between theory and practice and overcome the present barriers to widespread adoption. The research is guided by a pragmatist research philosophy. Each stage seeks to address specific facets of the overarching research problem, cumulatively seeking to deepen our practical understanding of it and propose possible solutions for moving forward.

There was a need to better understand the reported gap between theory and practice. A solid theoretical understanding of the TBL concept in SSCM research was found to be missing in the literature and so a pre-cursory systematic literature review (SLR) was conducted at the beginning of the inquiry. The use of mid-range theory was examined to deepen the understanding of how TBL SSCM research had been approached. This provided in-depth explanations of the barriers to progression and began to shed light on why the TBL may be failing in practice. It also highlighted some potential weaknesses in the present theoretical toolkit, revealing a lack of theoretical perspectives to support the inclusion of technology as a key facet of the TBL debate.

To complement the SLR examination of the theoretical underpinnings of the TBL, the first paper sought to deepen the understanding of the problem from the practice side of the theory-practice gap. It builds on the outcomes of the pre-cursory SLR by adopting a combined stakeholder theory and institutional theory perspective (two of the most dominant theoretical perspectives that emerged from the SLR). The dominance of instrumental stakeholder theory suggested the importance of the business case as a central underlying concept to organisational decision making related to SSCM. Through the business case lens, a qualitive research design was adopted and semi-structured interviews conducted with a range of stakeholders operating in the luxury fashion sector to understand the challenges with SSCM business case development and adoption more generally.

The results provided a series of in-depth insights that help present a more realistic picture of why TBL was not progressing in certain areas in practice. One of the central emerging themes was that firms were struggling to develop value-driven BCs for SSCM. This was largely hindered by ambiguity about the customer demand and willingness to pay for sustainable products and practices. The findings demonstrate a sectoral awareness

of a need for increased supply chain transparency. However, the findings suggested the sector can be largely described as 'slow adopters' of supply chain technologies. The value of BCT adoption, particularly in its relation to SSCM, seemed unclear to many of the practitioners.

The second paper starts to shift attentions from the research problem to the quest for solutions. Keeping the business case as a central focus, it begins to address how BCs for SSCM can be strengthened given recent innovations in BCT relating to the concept of 'tokenisation', namely the invention and emergence of non-fungible tokens (NFTs), a blockchain based crypto asset. Using the technology-organisation-environmental (TOE) framework view of the barriers to BCT for SSCM by Kouhizadeh *et al*. (2021), it conceptually explores the way in which NFTs may help to motivate better TBL practice and help firms to innovate their BMs by creating, capturing and delivering value from it (Osterwalder & Pigneur, 2010). It focuses on the business case paying specific attention to what value can be derived from NFTs, principally for salient supply chain stakeholders e.g. customers but also for 'synergistic value' (Kurucz *et al*., 2008) for supply chain partners.

The third and final paper is an interdisciplinary collaborative action research study conducted in luxury textile supply chain. It is motivated by the sense that "a theory will remain theory unless it is put into practice" (He *et al*., 2019, p. 449). There was a vast amount of literature emerging theorising how BCT could help improve SSCM (Saberi *et al*., 2019) but a lack of empirical data to see what was possible in practice. Furthermore, scholars were suggesting that BCT relied on other technologies such as RFID in order for its value as a supply chain solution to be realised (Tian, 2016). However, the researcher felt that in certain sectors (e.g. luxury fashion) the partnering of such technologies still had weaknesses and would not offer full protection against supply chain corruption.

Through an associate involved with the Textile Institute, a Dr in Chemistry and 'technical textiles' expert, the researcher became familiar with the latest developments in the field of chemistry. These innovations had significant implications for supply chain practice. One which stood out was Spatially Offset Raman Spectroscopy (SORS), a means of reading the chemical composition of substances in their raw state, through opaque packaging. Successful proof-of-concepts has been conducted in whisky supply chains (Ellis *et al*., 2017), showing promise for reading substances in their raw state (without the needed for an added chemical tracer). These types of technologies have been termed 'tracer technologies' in the literature (Azzi *et al*., 2019) but have received little

attention in SSCM research. The final paper hence seeks to provide empirical data to be able to assess their potential further.

The final paper builds on the previous stages of the thesis. It employs the TOE framework proposed in paper 2 and integrates the combined theoretical framework employed in paper 1. However, based on the output of the SLR and the view that the luxury fashion sector are slow adopters of technology, it integrates the diffusion of innovations (DoI) theory perspective to help support the technology aspect of the study. Building on paper 1 and 2, the paper maintains the business case concept at its core. However, unlike paper 1 which offers a more industry-wide view of SSCM business case development, this paper offers in-depth insight into the decision-making process at a luxury textile supplier (the collaborating organisation). The business model concept becomes a key focus in this paper as the framework for understanding how businesses create value (Osterwalder & Pigneur, 2010) and, therefore, assess the business case for a particular source of action. Furthermore, business model innovation is seen as an essential concept for understanding how value can be leveraged from technology adoption (Chesbrough & Rosenbloom, 2002).

Employing an action research approach, the research, in a collaborative mode with the case firm, evaluates the problem and desired outcomes (the 'pre-step') then proceeds though action research cycles of constructing the issue, then planning, taking and evaluating action at each stage. The action research did not unfold exactly as initially expected. However, it serves as an example of why the adaptable nature of action research cycles are so essential to this form of inquiry and offers a more realistic picture of technology evaluation for SSCM. The action research takes major steps towards achieving the desired practical outcomes. This is achieved by successful proof-of concept trial of BCT paired with a bioluminescent nano-particle photon marker tracer system. The specific research findings and reflections are taken from the local situation and extrapolated to a more abstract theoretical level, as is the aim of action research (Coghlan & Shani, 2018). The research outcomes have theoretical implications that address challenges with the organisational field and wider business communities but also contribute to the grander social challenges at hand related to TBL progression.

This introductory chapter provides context for the research. First, it summarises the research aims and objectives (Section 1.1). Then it provides the background context for the research, including a review of the SSCM discourse and an overview of supply chain transparency and technology (Section 2). The empirical background for the study is then

discussed (Section 3). This is followed by an overview of the pragmatist philosophy which has guided the research and a brief discussion of the use of action research strategies in in operations and supply chain management research (Section 4). Finally, the methodology, findings, and outputs of the pre-cursory SLR are presented (Section 5). The three papers are presented in chapters 2, 3 and 4 respectively. This is followed by some general discussion and final conclusions about the overall research, discussing the limitations and the potential avenues for future research.

1.1 Research aims and objectives

This research aims to contribute to Elkington's call for a new wave of TBL innovation and deployment (2018). It aims to investigate why the progression of TBL in supply chains has been limited to date and aims to better understand the theory-practice gap. The luxury fashion sector is selected as the empirical background for the research as it was a) where the problem was first observed by the researcher; b) identified in the literature as a sector lagging in its sustainability transformation, particularly in comparison to other sectors. It also aims to contribute to the quest for solutions to this problem by exploring novel technologies that show promise for advancing the TBL agenda. The following overarching research question is set to support these aims:

Overarching research question: What factors are preventing the TBL concept from becoming a ubiquitous framework for luxury supply chains contexts and how can they be addressed?

The objectives of the research which have been set to help answer the overarching research question are as follows:

O1. Explore the problem from a theoretical perspective (pre-cursory SLR)

O2. Explore the problem in the practical setting of the luxury fashion sector to compliment the SLR and help understand the theory practice gap.

O3. Examine industry attitudes towards technology solutions like BCT (Paper 1).

O4. Conceptually examine the barriers to BCT and propose solutions of how these barriers may be overcome (Paper 2 & 3).

O5. Empirically assess BCT solutions in practice to see if and how they can contribute to the diffusion of TBL adoption (Paper 3).

2. Research Background

The following sections will provide an overview of the relevant literature and provide background context to the research.

2.1 Sustainable supply chain management and the triple bottom line

Early SSCM studies typically focused on either environmental or social sustainability and rarely a combination of the two (Carter & Easton, 2011; Longoni & Cagliano, 2018; Touboulic & Walker, 2015). Carter and Easton (2011) found that between 1991-2010 environmental supply chain management had dominated SSCM research. From 2001-2010 the scholars noted an uptake in researchers who understood sustainability through the principles of the triple bottom line and began incorporating a social sustainability perspective. The TBL view of sustainability differs because of its holistic view of the environmental, social, and economic dimensions of sustainability. It recognises that these dimensions are interrelated, interdependent and must be balanced through a series of trade-off decisions if sustainability is to be achieved (Pagell & Wu, 2009).

Definitions of SSCM are increasingly incorporating the three pillars of the TBL, indicating that "approaches to SSCM are becoming more integrated and include a broader range of issues" (Touboulic & Walker, 2015, p. 18). A popular definition in the literature comes from Seuring and Muller (2008) who define SSCM as "the management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e., economic, environ- mental and social, into account which are derived from customer and stakeholder requirements".

Another popular definition comes from Carter and Rogers (2008, p. 368) who define SSCM as "the strategic, transparent integration and achievement of an organisation's social, environmental, and economic goals in the systemic coordination of key interorganizational business pro- cesses for improving the long-term economic

performance of the individual company and its supply chains". Although scholars have noted an increasing trend to define SSCM using the principles of TBL it is not known precisely how popular this view has become. This present research intends to take stock of this and develop a deeper understanding of the theoretical toolkit which supports the TBL view of SSCM.

2.2 Supply chain transparency and technology

The lack of supply chain transparency is cited as being the root cause of many TBL issues (Guo *et al*., 2020; Bai and Sarkis, 2020). Transparency can be described as the extent to which information is made readily accessible to other parties in an exchange and to external observers (Awaysheh and Klassen 2010). According to Bai and Sarkis (2022, p.2145), a "lack of transparency can lead to several problems in the supply chain, especially those involving business, environmental and social responsibility issues". There is increasing pressure on businesses to be transparent with supply chain sustainability information (Williams and Gerber 2015). Bai and Sarkis (2022, p.2145) proposed that sustainable supply chain transparency consisted of three different dimensions: i) The range of transparency: including dimensions such as supply chain partner information participation degree, scope of operations, environmental and social supply chain metrics; (ii) Product transparency such as tracking the product back to its raw material origins, tracking product processes and sustainability information from end-to-end of the supply chain (e.g. carbon emissions information); and (iii) Participant transparency, with participant operations, situation information (e.g. about working conditions in manufacturing facilities, and participant sustainability conditions visible. However, at present there is a reported lack of SSCM information transparency and customers are often not equipped to be able to judge a given product or service's sustainability credentials effectively for example, food safety (*Ibid*).

Although achieving transparency and 'perfect information' is still a major challenge in supply chains, technology has been one of the only ways to effectively solve transparency issues to date. Popular technologies and information systems include electronic data interchange (EDI), Enterprise Resource Planning (ERP) and tracking technologies such as barcode technology, radio frequency identification (RFID), all of which have progressed with the widespread adoption of the internet in global business practice (Elkington, 1999; Lyons *et al*., 2012).

Radio frequency identification technology (RFID) eliminates the need for manual barcode scanning, dramatically reducing the associated labour costs (Lai *et al.*, 2006). RFID tags can contain a comprehensive amount of data making it particularly effective at increasing interorganisational transparency and traceability. This has helped to improve inventory management, and has contributed to better environmental SSCM performance through the lean management principle of waste and subsequent cost reduction (Das, 2018). However, RFID has a limited capacity to solve transparency and subsequently TBL issues because of its current dependence on centralised databases and control mechanisms for flow and access to information (Azzi *et al.*, 2019; Saberi *et al.*, 2019). This allows degrees of information asymmetry and power imbalance between organisations and their stakeholders to continue, thus, does not fully solve issues such as greenwashing or counterfeiting.

RFID was rapidly adopted in certain supply chains (e.g. food and healthcare) in the early to mid-2000s (Chen *et al.*, 2008) but in others (e.g. fashion) it is still in an emergent state. For example, Zara only introduced an RFID-based inventory management system in 2014 (Chan, 2016). This indicates the important role that industry context can play in the adoption process. Regulatory pressure is a variable between these sectors. For instance, traceability is a mandatory requirement in many countries for the agri-food sector (Gandino *et al.*, 2009) whereas the fashion industry is largely unregulated (Carrigan, *et al.*, 2013).

Like TBL adoption, developing a clear business case is key for supporting the decision for organisational investment in ICT and information systems. The value of investing in ICT capabilities has been debated in the literature. Mithas *et al.* (2012) found ICT investments positively impacted the profitability and performance of firms. However, the increased availability and standardisation of technology systems has caused some scholars to question whether superior ICT capabilities still translate into competitive advantage and improved performance (Chae *et al.*, 2014). Chae *et al.* (2014) found no discernible link between the two and called for further research, but advised that, as technology was a continuously evolving facet of business practice, it should be approached dynamically and that its value should be reviewed continually (Chae *et al.*, 2014). Others have highlighted that the business model concept is central to unlocking the latent value in technology (Chesbrough & Rosenbloom, 2002).

Although the value of technology is contingent on the context of its intended adoption, the literature generally supports the notion that it is one of the most effective ways to

improve supply chain transparency. Therefore, and in agreement with Eslami *et al.* (2019) and Saberi *et al.* (2019), it seems essential to include technology as a key part of TBL debates, especially as new transparency enhancing technology innovations continue to emerge at a rapid rate.

2.3 Blockchain technology

Emerging technologies associated with the fourth industrial revolution (Industry 4.0) such as blockchain technology have the potential to offer unprecedented levels of transparency (Frederico *et al.*, 2019). This has the potential to positively impact various dimensions of the TBL and subsequently create sustainability-based value, help improve customer willingness to pay and help firms to gain competitive advantage on this basis (Bai *et al.*, 2020; Felsberger *et al.*, 2020; Guo *et al.*, 2020; Nowiński & Kozma, 2017; Saberi *et al.*, 2019). BCT is essentially a means of storing information in databases. However, unlike traditional, centralised databases, it is a digital, distributed ledger, meaning it is decentralised. There is no central owner. The ledger must be shared with, and approved by, all nodes within a network. Its immutability and capacity for complete traceability set it apart from existing SC technologies (Hald & Kinra, 2019).

BCT has received increasing attention from supply chain researchers, its emergence in supply chain management (SCM) research and practice has been well documented (e.g. Wang *et al.*, 2019). Some scholars believe it may revolutionise SCM over the next decade (Hald & Kinra, 2019) and innovate new business models, based upon end-to-end SC transparency (Nowiński & Kozma, 2017). BCT is often referred to as a 'disruptive technology'. However, 'transformative technology' may be more suitable, given its potential to extend RFID capabilities, and integrate with other emerging technologies, such as Internet of Things (IoT) (Saberi *et al.*, 2019). There is no clear definition for BCT within the literature (Viriyasitavat & Hoonsopon, 2019) and no definitive set of descriptive characteristics. Table 1 provides an overview of commonly associated terms found within the literature.

Table 1. Summary of popular terms used in association with BCT

TERM	CORE REFERENCES
Accountability	(Hald & Kinra, 2019; Kshetri, 2018; Saberi *et al.*, 2019; Treiblmaier, 2018)
Assurance	(Kshetri, 2018; Mansfield-Devine, 2017; Vu *et al.*, 2021)
Auditability	(Cole *et al.*, 2019; Kshetri, 2018; Saberi *et al.*, 2019; Viriyasitavat & Hoonsopon, 2019)
Authenticity	(Azzi *et al.*, 2019; Nowiński & Kozma, 2017; Tian, 2016; Treiblmaier, 2018)
Automation	(Hawlitschek *et al.*, 2018; Saberi *et al.*, 2019; Viriyasitavat & Hoonsopon, 2019)

Consensus	(Hawlitschek *et al*., 2018; Nofer *et al*., 2017; Saberi *et al*., 2019; Schmidt & Wagner, 2019; Viriyasitavat & Hoonsopon, 2019)
Decentralisation	(Cole *et al*., 2019; Danese *et al*., 2021; Hawlitschek *et al*., 2018; Nowiński & Kozma, 2017; Queiroz *et al*., 2020; Schmidt & Wagner, 2019; Viriyasitavat & Hoonsopon, 2019; Y. Wang *et al*., 2019)
Efficiency	(Nowiński & Kozma, 2017; Saberi *et al*., 2019; Y. Wang *et al*., 2019)
Immutability	(Danese *et al*., 2021; Hald & Kinra, 2019; Hawlitschek *et al*., 2018; Helo & Hao, 2019; Puthal *et al*., 2018; Saberi *et al*., 2019; Schmidt & Wagner, 2019; Treiblmaier, 2019; Viriyasitavat & Hoonsopon, 2019)
Integrity	(Nofer *et al*., 2017; Saberi *et al*., 2019; Viriyasitavat & Hoonsopon, 2019)
Provenance	(Azzi *et al*., 2019; Cole *et al*., 2019; Danese *et al*., 2021; Hald & Kinra, 2019; L. Koh *et al*., 2020; Schneider *et al*., 2020; Treiblmaier, 2018; Vu *et al*., 2021)
Security	(Hawlitschek *et al*., 2018; Nofer *et al*., 2017; Nowiński & Kozma, 2017; Saberi *et al*., 2019; Viriyasitavat & Hoonsopon, 2019; Y. Wang *et al*., 2019)
Traceability	(Hald & Kinra, 2019; Nofer *et al*., 2017; Schmidt & Wagner, 2019; Y. Wang *et al*., 2019)
Transparency	(Hawlitschek *et al*., 2018; Nofer *et al*., 2017; Nowiński & Kozma, 2017; Saberi *et al*., 2019; Viriyasitavat & Hoonsopon, 2019; Y. Wang *et al*., 2019)
Trust	(Nofer *et al*., 2017; Nowiński & Kozma, 2017; Saberi *et al*., 2019; Viriyasitavat & Hoonsopon, 2019; Y. Wang *et al*., 2019)
Verification	(Hawlitschek *et al*., 2018; Kshetri, 2018; Kurpjuweit *et al*., 2021; Nofer *et al*., 2017; Saberi *et al*., 2019; Schmidt & Wagner, 2019; Y. Wang *et al*., 2019)

Discussion about trust features heavily in the existing BCT literature. BCT is seen as a means of overcoming trust-related issues (Hawlitschek *et al.*, 2018). Trust, whilst a valuable commodity in an interpersonal context, such as in traditional SC buyer-supplier relationships, is not the ultimate desirable state in modern, highly complex, globalised SCs, where building long-term relationships between SC actors is becoming increasingly difficult (Wang *et al.*, 2019). Nofer *et al.* (2017) view trust as the main consequence of decentralisation, since assessing the trustworthiness of the intermediary or other participants in the network becomes unnecessary. However, some scholars view BCT as a 'trust-free' technology due to its ability to create a secure, immutable, consensually agreed, fully auditable record of all prior transactions, approved by the whole network (Hawlitschek *et al.*, 2018). When objective guarantees are possible, assurance replaces trust as the most desirable state. Although trust still has a role to play, not least in consumer perception, with some labelling BCT as a "trust frontier", separating the behavioural layer from the agent layer (Hawlitschek *et al.*, 2018).

The potential of BCT for supporting the objectives of TBL of SSCM has been acknowledged (Bai *et al*., 2020; Kouhizadeh *et al*., 2021; Saberi *et al*., 2019) and it also shows great promise as an anticounterfeit measure, especially when coupled with RFID (Danese *et al*., 2021; Eslami *et al*., 2019; Garcia-Torres *et al*., 2019; Saberi *et al*., 2019; Tian, 2016) or lesser explored tracer technologies (Azzi *et al*., 2019). Advanced

technologies are a viable solution for achieving SSCM goals because they enable firms to effectively trace and manage TBL issues by linking them to economic efficiency (Garcia-Torres *et al.*, 2019). For example, BCT can be used to record and share TBL-related data securely, it can track and trace products by recording key master data including GPS (global positioning system) information securely on the immutable ledger which can help provide assurances that products are being made in approved su0pplier locations with good working conditions (Bai and Sarkis 2020). This type of information can be leveraged to create sustainability based value for customers helping to increase their willingness to pay and help firms to be rewarded for their sustainable practice (Bai *et al.*, 2020; Felsberger *et al.*, 2020; Guo *et al.*, 2020; Nowiński & Kozma, 2017; Saberi *et al.*, 2019).

However, the application of BCT in SCs is still in its nascent phase and faces its own set of adoption challenges. Managers are still unsure of the benefits of adopting BCT for SSCM purposes (Kouhizadeh *et al.*, 2021; Saberi *et al.*, 2019). In certain supply chain contexts (e.g. developing countries) there can be technology accessibility issues (Hannibal & Kauppi, 2019). Adoption barriers are discussed in depth in the second and third paper of this thesis.

3. Empirical background

The luxury fashion sector is receiving increasing attention from researchers (Braglia *et al.*, 2021). It has been identified as an important area for academic research, owing to its strong growth, complex global supply chains, and ongoing sustainability challenges (Chiu *et al.*, 2018; Karaosman *et al.*, 2020). Despite its significant global impact, some have noted that fashion industry research has been lacking in the field of Operations and SCM (Garcia-Torres *et al.*, 2019; Presley & Meade, 2018). When featured, it has predominantly been the fast fashion sector that has been scrutinised for poor SSCM performance (Karaosman *et al.*, 2020; Presley & Meade, 2018). However, both sectors are responsible for significant SSCM failures (Guo *et al.*, 2020) and some scholars have highlighted that luxury fashion brands can no longer hide from scrutiny (Karaosman *et al.*, 2020).

The term ‘luxury’ denotes both a highly subjective concept and a specific macroeconomic sector that are inextricably linked (Berry, 1994; J. N. Kapferer & Laurent, 2016). Providing a brief background on both the conceptual roots of the luxury and the evolution of the industrial sector provides important context to this research and

will be covered in the following sections. This is followed by an overview of key luxury fashion operations and supply chain characteristics and finally a discussion of the relationship between luxury fashion and the TBL of sustainability.

3.1 The concept of luxury and the evolution of the luxury fashion sector

According to Berry (1994), luxury is malleable concept, ever-changing to reflect the time and society in which it exists. The Romans viewed luxury as a corrupting force that could induce a society of weak characters. Sumptuary laws were introduced in attempt to regulate desire, limit excess, and preserve the morality of citizens (*Ibid*). Luxury still had negative connotations throughout the middle ages (Brun & Castelli, 2013). Sumptuary laws evolved during this time and became a means of distinguishing and controlling social status (Hooper, 1915). By the 18th century, attitudes to luxury had changed. It was viewed as a societal force for good and was seen as a hallmark of economically prosperous nations (*Ibid*) and of an upwardly mobile, progressive society. The language of luxury developed to redefine "'excess' as 'surplus', 'vanity' as 'refinement' and its aristocratic associations with wealth, status and power progressed to concerning "commerce, utility, taste and comfort" (Berg & Eger, 2003, p.9). Recent reports suggest that the concept of luxury is on the cusp of yet further conceptual transformation to reflect the values of society who have increasing sustainability concerns (Bain & Company, 2021).

The modern fashion industry consists of two main sectors - luxury fashion and fast fashion. It is the evolution of the luxury fashion sector that has shaped the industry as we know it today. Luxury fashion sets the industry trends which fast fashion typically seeks to replicate on mass at a significantly cheaper price (Joy *et al*., 2012). The luxury fashion sector has its origins in the European courts of the 18th century. Dressmaker to Queen Marie Antoinette, Rose Bertin, is cited as one of the early pioneers of 'haute couture' (Okonkwo, 2007). Literally translated as 'high sewing', haute couture (sometimes referred to as simply 'couture') relates to the creation of bespoke, tailored garments of a quality so high that it transcends dressmaking and becomes like art (Kapferer & Bastien, 2012). Some have even commented on the proximity of haute couture to art, as both are closely associated with hedonism and perceptions of the product that transcend mere functional value (Kapferer & Bastien, 2012).

The first couture fashion house was opened in Paris by Englishman, Charles Frederick Worth, in 1858 and is credited with establishing the foundation of the luxury sector as we

know it today (Okonkwo, 2007). The haute couture business model has given birth to some of the most iconic luxury fashion houses known today with Louis Vuitton, Hermes, Burberry, Gucci, Chanel and Dior all founded between 1850-1950 (Okonkwo, 2007). The first and second industrial revolutions emerged concurrently with the beginnings of the luxury fashion sector. Increasing mechanisation drove significant growth in the textile industry and facilitated larger production runs of high-quality goods. There was also an increase in the customer base due to the increased social mobility of the era (Brun & Castelli, 2013). However, luxury garments largely remained the exclusive privilege of the rich and famous until the 'youthquake' movement of the 1960s (Thomas, 2007).

During the 1960s, luxury fashion brands began changing structurally, diversifying their business models through the introduction of 'pret-a-porter' (ready-to-wear) clothing collections, in addition to their haute couture lines. Ready-to-wear collections differ from haute couture collections because they are made to stock rather than made to order, enabling customers to buy luxury garments in standard sizing, directly 'off the rail' (Waddell, 2004). The emergence of ready-to-wear marks the beginning of brands adopting what is referred to as an 'accumulation of genres' or 'brand extension' strategy. The strategy is commonly visualised through the brand pyramid model presented in Figure 1 (Kapferer & Bastien, 2012).

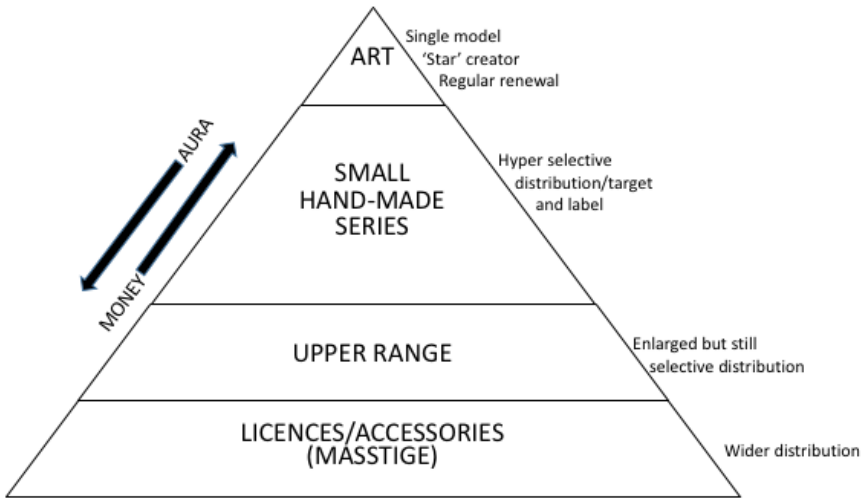

Figure 1. The brand pyramid model (Kapferer & Bastien, 2012, p. 306)

This strategy harnesses the power of a psychological phenomenon, known as the 'halo effect' (Thorndike, 1920). When manifested in business environments, this describes the propensity of customers to make specific judgements about a company based on their general impressions (Rosenzweig, 2007). In essence, luxury fashion brands can trade on their reputations and the aura of 'haute couture' products to develop and launch 'diffusion

lines' or 'brand extensions'. This allows them to sell traditional luxury (haute couture), upper-range (ready-to-wear), and even mass-market products under one brand identity (Fernie & Perry, 2019; Karaosman *et al*., 2020).

By the 1990s, many luxury fashion brands had adopted this and used it to grow their businesses globally on a significant scale. No longer reserved for the wealthy elite, luxury fashion products and experiences became available to aspirational, socially mobile customers. This 'democratisation of luxury' has given rise to an 'accessible luxury' phenomenon (Brun & Castelli, 2013; Dalton, 2005; Fernie & Perry, 2019; Kapferer & Bastien, 2012; Karaosman *et al*., 2020). Whilst this has helped transform the luxury fashion sector into the multi-billion-dollar business that it is today, it has also sparked confusions regarding how luxury is interpreted and perceived in the eyes of the consumer (Fernie & Grant, 2015)

Despite the confusion, there has been some agreement regarding Critical Success Factors (CSFs) of luxury. These include: a global reputation for excellent service, product quality, and end-to-end SC practice heritage of craftsmanship; exclusivity; emotional appeal and the creation of a brand lifestyle and culture; unique and recognisable style and designs; strong association with country of origin; uniqueness; and product innovation (Brun & Castelli, 2013; Caniato *et al*., 2009; Fionda & Moore, 2009; Karaosman *et al*., 2020; Nueno & Quelch, 1998). It is not a requirement for luxury products to include all CSFs. Brands can accentuate emotional appeal rather than product quality and still create a 'luxury experience' for customers (Caniato *et al*., 2009). This explains why luxury fashion brands have been able to leverage the halo effect so successfully. The confusion of luxury has led some to suggest that there needs to be a better way for customers to differentiate between traditional and accessible luxury. It has been suggested that sustainability performance can provide a 'deeper luxury', that is a new way in which traditional luxury fashion brands can differentiate themselves from those seeking to exploit mass market opportunities (Bendell & Kleanthous, 2007). More recently, scholars have suggested that luxury fashion is a perfect setting for testing out new innovations such as BCT that help to leverage value from provenance data and sustainability credentials (Bai *et al*., 2020; Nowiński & Kozma, 2017; Saberi *et al*., 2019).

3.2 Luxury fashion operations and supply chain characteristics

The business models of traditional luxury brands, such as Chanel and Hermes, typically rely on complete end-to-end supply chain control, necessitating vertically integrated

supply chains (Serdari, 2017). They usually own all of their manufacturing facilities (typically located in the country of brand origin) and distribution channels from raw materials through to 'directly operated stores' (DOS) (Caniato *et al*., 2011; Serdari, 2017). This allows them to control quality of the product on one side and the quality of service and the customer experience on the other (Kapferer & Bastien, 2012). However, not all luxury fashion brands exclusively sell through DOS, many have wholesale accounts with multi-brand independent stores or have licencing deals with mono-brand franchise stores (Caniato *et al*., 2011). Additionally, not all luxury fashion brands manufacture all their products in the country of brand origin. Indeed, the trend for more horizontally integrated supply chains coincides with noted trends for offshoring manufacturing in the luxury fashion sector (Robinson & Hsieh, 2016). However, this has brought challenges in terms of brand positioning. Some customers have reacted badly to these types of strategic decisions, leading some brands, such as Burberry, to reshore certain parts of their production that are integral to their strategic priorities (*Ibid*).

Karaosman *et al.* (2020) stated that vertical integration is becoming weaker in luxury fashion supply chains. Whilst this accurately describes the general trend, it is only part of the story. Over the past decade there have been many instances of luxury fashion brands who have become more vertically integrated. For example, upstream in the supply chain brands, such as Hermes, Chanel and the parent companies of Louis Vuitton and Gucci (LVMH and Kering respectively) have all acquired leather tanneries/exotic skin manufacturers (Mellery-Pratt, 2015). This is because the demand for luxury fashion accessories, such as leather handbags and other personal goods, have increased so significantly over the past 15 years that there are fears of it outstripping the world leather supply. As such, there has been a race to control high quality leather producers (*Ibid*).

Slack & Lewis (2017, p. 169) state that "if an activity has long-term strategic importance to a company, it is unlikely to outsource it". This is certainly the case for these types of luxury fashion brands, as luxury fashion leather goods can account for 50% of their total annual revenue (Kering, 2019). Downstream, there is also evidence of luxury fashion companies becoming more vertically integrated. Kering reported that 78% of their revenue came through DOS and were expanding on this as a strategic priority (*Ibid*). Of course, the Covid-19 pandemic has rapidly increased the growth of luxury e-commerce encouraging direct to consumer sales also (BoF and McKinsey & Company, 2020).

The democratisation of luxury has resulted in diversified luxury fashion business

models leading to a more segmented market. Evidence suggests that operations strategies have become more diverse in line with this. Although luxury fashion operations strategies have become increasingly complex and segmented, the evidence in the existing academic and practitioner literature indicates that production is more likely to be offshored and supply chain integration is more likely to become more horizontally integrated towards the base of the pyramid. A model for visualising this is presented in Figure 2.

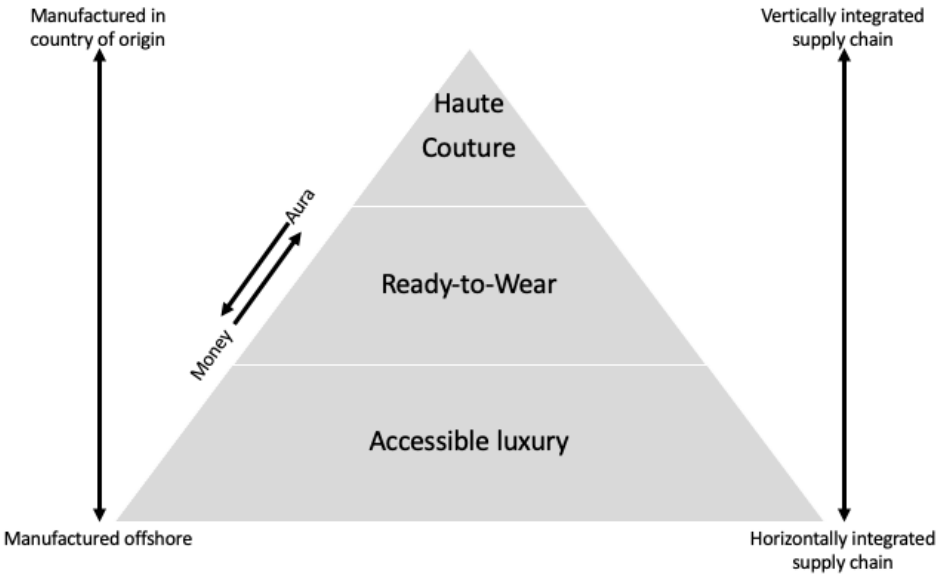

Figure 2. The luxury fashion Operations Strategy pyramid (adapted from Bastien & Kapferer, 2012)

3.3 Luxury fashion and sustainability

There is an ongoing debate as to the compatibility of both luxury fashion and sustainability, and much of the literature suggests that the two concepts are opposed (Achabou & Dekhili, 2013; Hennigs *et al.*, 2013; De Angelis *et al.*, 2017). Luxury is often associated with hedonism, ostentation, and personal excess whereas sustainability induces notions of selflessness, moderation and ethics (Kapferer, 2010; Widloecher, 2010; Hennigs *et al.*, 2013; De Angelis *et al.*, 2017). On the other hand, some scholars have opined that luxury (in its traditional sense) and sustainability have several areas of common interest, which include: a mutual concern for rare and beautiful natural resources; a high regard for skilled craftsmanship and ancestral tradition; a strong commitment to preserving such skills, through the safeguarding of educational curricula to ensure the next generation of talent enters the sector (Cervellon, 2014; Hennigs *et al.*, 2013; Kapferer, 2010); superior quality, durability and timelessness of products that are

not easily replaceable and which offer lasting value, ensuring the long-term use of the item - the antithesis of the throwaway culture of fast fashion (Sheth *et al.*, 1991; Wiedmann *et al.*, 2007, 2009; Kapferer, 2010; Cervellon & Shammas, 2013; Hennigs *et al.*, 2013; Cervellon, 2014).

Some argue that the perceived incompatibility between luxury fashion and sustainability is due to the confusion of luxury, whereby mass-market products are being traded under the pretence of being luxury items (Kapferer, 2010). Whilst these brands are arguably not or no longer following a 'luxury' strategy (Kapferer & Bastien, 2012), it is arguably too difficult for customers to distinguish what is a luxury product and what is not (Bendell & Kleanthous, 2007). Regardless, researchers commented on the beginnings of a "paradigm shift"(Hennigs *et al.*, 2013, p. 27) in the luxury fashion sector some time ago, encouraging brands to appeal to consumers who are shifting from a mode of "conspicuous" to "conscientious" consumption. (Cvijanovich, 2011, p. 1). Marketing reports suggested that customers were reacting negatively to the lack of transparency of the luxury fashion supply chains (Mintel, 2016). This is something that has reportedly intensified during the Covid-19 pandemic (BoF and McKinsey & Company, 2020; BoF and McKinsey, 2021).

Some luxury fashion conglomerates, such as LVMH (Louis Vuitton Moet Hennessey), have been running sustainability initiatives for nearly three decades (LVMH, 2016). According to Kapferer and Bastien (2012, p. 368), "these days there is not a single luxury conglomerate that has not made sustainable development a key strategic concern". Luxury conglomerate, Kering, launched their innovative Environmental Profit & Loss (E P&L) account in 2011, which "makes the invisible impacts of business visible, quantifiable and comparable" (Kering, 2017). However, despite actively integrating sustainable development into their business practices, many luxury brands were slow to publicly announce and communicate initiatives. This is arguably because luxury brands heavily trade on dreams and hedonistic intangible experiences, which are deeply connected to a perceived authenticity (Grayson & Martinec, 2004). Luxury is "like a theatre: backstage work is secret" and is not talked about with the client (Kapferer & Bastien, 2012, p. 363). Furthermore, brands fear being embroiled in reputational scandals and hence may not wish to expose themselves to the risk of criticism and negative media publicity, which may lead to customers boycotts (Cervellon, 2014; Giannakis & Papadopoulos, 2016; Kapferer & Bastien, 2012; Mohr *et al.*, 2001; Rafi-Ul-Shan *et al.*, 2018).

Despite the progress with sustainability in some areas, the luxury fashion sector has been responsible for some extremely poor sustainability practice. The luxury fashion and broader fashion supply chain is widely recognised as being extremely environmentally damaging (Achabou & Dekhili, 2013; Boström & Micheletti, 2016; European Commission, 2019) and is responsible for some unacceptable social sustainability practices (Garcia-Torres *et al*., 2019; Khurana & Ricchetti, 2016; Macchion *et al*., 2018; Perry *et al*., 2015). Garcia-Torres *et al*. (2019) have recently highlighted that the academic peer-reviewed articles on this topic and sector are reasonably limited, despite the notoriety of poor SSCM practice.

The fashion industry has been specifically targeted by both the European Commission and a UK parliamentary inquiry, led by the Environmental Audit Committee (EAC), as an industry that needs to enhance transparency and traceability to develop more sustainable SCs (European Commission, 2019; House of Commons: Environmental Audit Committee, 2019). Fashion SCs are extremely globalised, however, its complete lack of transparency, makes it a challenge to control SSCM issues (Garcia-Torres *et al.*, 2019; Köksal *et al*., 2017; Pedersen & Gwozdz, 2014; Perry *et al*., 2015). Despite increased efforts by some luxury fashion brands to clean up their act, the increasing migration of production to developing countries, with cheap labour, has often resulted in inadequate working conditions for garments workers (de Brito *et al*., 2008; Karaosman *et al*., 2020; Khurana & Ricchetti, 2016; Perry *et al*., 2015; Perry & Towers, 2013; Shen *et al*., 2017). Table 2 provides an overview of SC sustainability issues. These issues are found in both the fast fashion and luxury fashion sectors. However, certain sustainability issues are particularly dominant in luxury fashion, particularly those relating to fraud (e.g. countertfeit or adulterated products), the over-exploitation of rare resources (e.g. exotic skins), animal welfare (e.g. use of fur in luxury goods), and the use of harmful chemicals including mercury in leather tanneries.

There have been some promising sustainability accreditation schemes to emerge in the fashion industry, such as the Global Organic Textile Standards and the Better Cotton Initiative (de Brito *et al*., 2008; Khan *et al*., 2016). However, these have been ineffective at addressing the root cause of sustainability problems in the fashion SC (Boström & Micheletti, 2016). An examination of third party auditing approaches for social sustainability assessment in international multi-tier supply chains, Hannibal and Kauppi (2019) found that auditing processes do not necessarily cover end-to-end of the supply

chain. This limits the information processing capabilities of some auditors. The authors highlight that this may lead stakeholders (e.g. customers) to believe the certification guarantees good practice along the whole chain, whereas in reality the participating firm is vulnerable to reputational risk due to sustainability uncertainties (Perry *et al*., 2015; Rafi-Ul-Shan *et al*., 2018).

The industry needs to develop traceability capabilities to improve SSCM (Garcia-Torres *et al*., 2019). However, an absence of government regulation, both domestically and internationally (Garcia-Torres *et al*., 2019; Khurana & Ricchetti, 2016) means there is a lack of incentive to do so. Unlike the food industry, there is a lack of commonly accepted SSCM standards in the fashion industry, and little in the way of mandatory labelling legislation. Unlike the food industry, Country of Origin (COO) labelling is not compulsory for fashion garments in the UK/EU (UKFT, 2020).

Table 2. A summary of environmental and social issues in the fashion supply chain

	KEY ISSUE	DESCRIPTION	CORE REFERENCE
ENVIRONMENTAL SUPPLY CHAIN ISSUES	Toxic dyes	The use of toxic synthetic dyes (eg. azo dyes which release carcinogenic amines) used during production.	(Brigden *et al*., 2012; Greenpeace, 2014; Greenpeace International, 2018; Jönsson *et al*., 2018; Karaosman *et al*., 2020; Shahid-ul-Islam & Butola, 2018)
	Mercury	The use of mercury for tanning leather skins.	(J.-N. Kapferer & Michaut-Denizeau, 2017; Macchion *et al*., 2018)
	Pesticides	The large volumes of pesticides used in growing natural fibres, for example cotton (the farming of which consumes 25% of all the pesticides used in America), which can lead to water pollution, soil erosion and the emission of greenhouse gases, such as a nitrogen peroxide.	(Achabou & Dekhili, 2013; Caniato *et al*., 2012; Macchion *et al*., 2018; Nagurney & Yu, 2012)
	Water consumption	Excessive water usage to produce cotton fibres.	(de Brito et al. 2008; Kounina At al. 2013; Niinimäki et al. 2020
	CO^2 emissions	The transportation of fibres/textiles/finished garments between all stages of the SC and its impact on carbon dioxide emissions and consumption of finite resources, such as oil.	(Caniato *et al*., 2012; Cervellon, 2014; de Brito *et al*., 2008; Macchion *et al*., 2018; Yang *et al*., 2017)
	Deforestation	The high demand for leather in the industry, that can lead to deforestation caused by cattle ranching.	(Khurana & Ricchetti, 2016)
	Garment maintenance	Laundering clothes uses lots of energy and can release harmful chemicals, such as nonylphenol ethoxylates and nonylphenols (NPEs/NPs), considered to be	(Bechi *et al*., 2009; Brigden *et al*., 2012; Greenpeace, 2014)

		endocrine disruptors, into the water supply.	
	Textile waste	The overproduction and overconsumption of garments. Overconsumption of garments is often cited as being propelled by the fast-fashion sector, and the increased textile waste entering landfills. This is heightened in countries, such as the UK, by a reported lack of basic sewing skills, leading to poor choices when faced with a repair-or-dispose dilemma. Overproduction has been the topic of much discussion in the luxury fashion sector, where recently Burberry were caught burning excess stock to protect perceived brand value.	(Brigden *et al*., 2012; Guo *et al*., 2020; Norum, 2017; Perry *et al*., 2015; Rafi-Ul-Shan *et al*., 2018; Rosser-Davies, 2017)
	Over-exploitation of rare resources	The luxury fashion industry over-exploiting rare resources, such as leather, exotic skins and furs, precious metals, and precious gemstones, such as diamonds.	(Bendell & Kleanthous, 2007; Cervellon, 2014; Fernie & Grant, 2015; Kapferer & Bastien, 2012)
SOCIAL SUPPLY CHAIN ISSUES	Child labour	The use of child labour for textile farming and garment manufacturing.	(Choi & Shen, 2017; Khurana & Ricchetti, 2016; Köksal *et al*., 2017; Pedersen & Gwozdz, 2014; Perry *et al*., 2015; Poddar *et al*., 2012)
	Unsafe working conditions	Working conditions in 'sweatshops' have resulted in some of the worst industrial accidents ever recorded.	(Amatulli *et al*., 2017; Arnold & Bowie, 2017; Choi & Shen, 2017; Giannakis & Papadopoulos, 2016; Khurana & Ricchetti, 2016; Köksal *et al*., 2017; Perry *et al*., 2015)
	Low wages	The low wages of garment workers that are far below what would be deemed a 'living wage'.	(Köksal *et al*., 2017; Pedersen & Gwozdz, 2014)
	Forced labour	Forced labour and excessively long hours.	(Arnold & Bowie, 2017; Pedersen & Gwozdz, 2014)
	Violence against workers	Violence against the workers, particularly against women who, on average, make up around 70% of the garment manufacturing workforce and in some developing countries make up to 90%.	(Allwood *et al*., 2006; Carcano, 2013; Jørgensen & Pruzan-Jørgensen, 2003)
	Law enforcement	A lack of access to legal representation when worker's rights are violated.	(Arnold & Bowie, 2017)
	Animal Welfare	The unethical treatment of animals through the sourcing of raw materials, such as skins and fur.	(Bendell and Kleanthous, 2007; Poddar *et al*., 2012; Giannakis & Papadopoulos, 2016; Kapferer & Michaut-Denizeau, 2017)
	Fraud	Fashion garments being mis sold in the in the UK as 'faux-fur', when they actually were found to be made from real animal fur. Also, there are significant issues with luxury fashion goods and counterfeiting.	(Bass, 2017); Saberi et al. 2019)
	Unemployment	Unemployment due to the relocation of labour to countries where business can access cheap labour.	(de Brito et al., 2008; Mansell; 2016; Rosser-Davies, 2017)

	Skills shortages	The loss of textile and garment manufacturing capability and subsequent skills shortages which block the growth of industry, in the UK/Europe.	(Mansell, 2016; Rosser-Davies, 2017)
	Social impacts of environmental issues	There are several social issues, that occur as a result of environmental issues. These include but are not exclusively limited to: contaminated water sources; severe health issues due to exposure to toxic chemicals used in farming and manufacturing processes; concerns for end-consumer safety as a result of exposure to toxic chemicals in the finished garment.	(Pedersen & Gwozdz, 2014; Khurana & Ricchetti, 2016)

The EAC report on the UK fashion industry urged the UK Government to "change the law to require companies to perform due diligence checks across their SCs" (House of Commons: Environmental Audit Committee, 2019, p. 4). However, all eighteen recommendations were rejected in 2019, prompting the chair of the EAC, Mary Creagh to state that the Government had signalled it was seemingly "content to tolerate practices that trash the environment and exploit workers" and was failing to force fashion retailers to comply with the Modern Slavery Act of 2015 (House of Commons, 2019).

Although fraudulent COO labelling is illegal, the lack of clear regulation provides loopholes. Some luxury brands have been found to manufacture their ready-to-wear lines in China, then only assemble certain elements in Italy to be able to carry the well-respected "Made in Italy" label (Thomas, 2007). An increasingly globalised SC raises questions as to whether garment provenance even matters anymore (Collins & Weiss, 2015). However, provenance is an integral part of the 'value structure' for luxury products (*Ibid*). There have been calls for various government bodies to protect brands which were still making their garments on home soil (Passariello, 2011). However, EU draft regulations for COO have been blocked by some EU countries (Khurana & Ricchetti, 2016) indicating that progress in this area will be slow.

Most of the research on sustainability issues within the fashion industry has largely focused on either the environmental or social dimensions and rarely taken a TBL-based, holistic view (Khurana & Ricchetti, 2016). There are differences of opinion within the literature with regard to which TBL dimension have received the most attention (Khurana & Ricchetti, 2016; Köksal *et al*., 2017). Irrespective of this debate, the list of fashion SSCM issues are vast and there is clearly need for action that addresses the full spectrum of TBL issues in the luxury fashion sector and wider fashion industry.

3.4 Benchmarking fashion against food

Benchmarking has been acknowledged as key management tool for comparative analysis that can occur internally within a company or externally in a specific sector/industry, or across industries (Dubey *et al*., 2017). It is used to measure and understand business performance, in both economic and noneconomic terms, so that certain standards can be achieved and upheld. This can lead to the identification of ‘‘best practice’’ or cross-industry ‘‘best of class’’ models (Fritz & Schiefer, 2008). Some successful SSCM benchmarks have been established in the food industry and the fashion industry trade press has recently suggested looking to food as a ‘blueprint’ for a more transparent, sustainable SC (Cernansky, 2020).

Both food and fashion were among the first industries to focus on SSCM and Corporate Social Responsibility issues (Yakovleva *et al*., 2012). Similarly to the fashion SC, the food SC poses a significant threat to sustainable development and faces a plethora of ongoing SC TBL challenges (Grekova *et al*., 2014; Zhu *et al*., 2018). Both industries are particularly global in their nature and are known for being labour intensive (Huq *et al*., 2014). However, despite a host of ongoing TBL challenges in the food SC (Zhu *et al*., 2018), significant progress with SC transparency and sustainability has been achieved (Yakovleva *et al*., 2012). Key drivers for this include governmental regulation, investor demands, and voluntary industry standards (Teuscher *et al*., 2006), along with pressure from both Non-Government Organisations (NGOs) and consumers (Tian, 2016). Reputation-damaging, food fraud scandals such as the 2013 ‘horsemeat scandal’ (Boyaci *et al*., 2014) have propelled consumer food safety concerns to new heights, increasing the pressure on food companies significantly (Tian, 2016).

Food businesses must adhere to strict government regulations pertaining to transparency and traceability, such as the Food Safety Act of 1990 and the General Food Law Regulation (EC) 178/2002 (European Parliament and Council, 2002; FSA, 2009). A host of sustainability concepts have emerged in support of this, which have infiltrated the SCs of some of the world’s biggest food retailers - see Chkanikova and Mont (2011). The ‘farm-to-fork’ concept is centred around the implementation of end-to-end SC traceability and has become an integral part of the overall “food quality assurance system” (Aung & Chang, 2014, p. 173) and has been actioned through various standards, such as The British ‘Red Tractor’ standard (Assured Food Standards, 2020). Other notable concepts/standards include the ‘food miles’ concept which aims to minimise the number of miles food travels throughout the SC (Yakovleva *et al*., 2012) and the ‘Fairtrade’ series

of certified standards, which originated in the coffee industry, to ensure fair treatment of workers (The Fairtrade Foundation, 2020).

The above initiatives are dependent on SC transparency. As previously highlighted, the food industry has proven itself to be an early adopter of transparency-enabling technologies, such as RFID (Chen *et al*., 2008; Lai *et al*., 2006). It has led the way with piloting innovative technologies, such as Raman Spectroscopy to prove the chemically composition of food samples (Boyaci *et al*., 2014). More recently, it has been part of the first wave of industries to pilot BCT in the SC (Hyperledger, 2019). The primary driver for this is to develop the SC capabilities required to more accurately track and trace products from end-to-end of the SC, to improve food safety, reduce food fraud and guarantee product authenticity (Wang *et al*., 2019). Despite ongoing challenges, other industries can learn from food, as a 'first-mover' on both SSCM initiatives and investing in the necessary ICT to support transparency/sustainability goals.

Looking to the food industry provides a clear picture of how important institutional context is for driving sustainable development. The regulatory environment is much more robust than it is in fashion and the significant and immediate health risks of supply chain failures for the end consumer are arguably more immediate which heightens consumer pressure on food companies to conform to standards and regulation.

4. Research philosophy and strategy

The terms 'research philosophy' or 'research paradigm' are often used interchangeably (Saunders *et al*., 2019) and are used to describe the combination of ontological, epistemological, and methodological assumptions which form the 'basic-belief-systems' that guide research (Guba, 1990; Guba & Lincoln, 1994; Saunders *et al*., 2019). Different research philosophies make different metaphysical assumptions that have important implications for researchers at a practical level. This research is guided by a pragmatist research philosophy which is viewed as an appropriate foundation for both an action research strategy and for conducting sustainability research (Touboulic & Walker, 2016). There is also a strong connection between pragmatism, action research and sustainable development as it "places the process of knowledge creation within the context of human–ecosystem interaction" and all are concerned with "driving change towards a desirable future and contributing to 'human flourishing'" (pp.311-312). Figure 3 presents a visual of the relationship between the three key aspects, which can be seen as the framework that has guided this thesis.

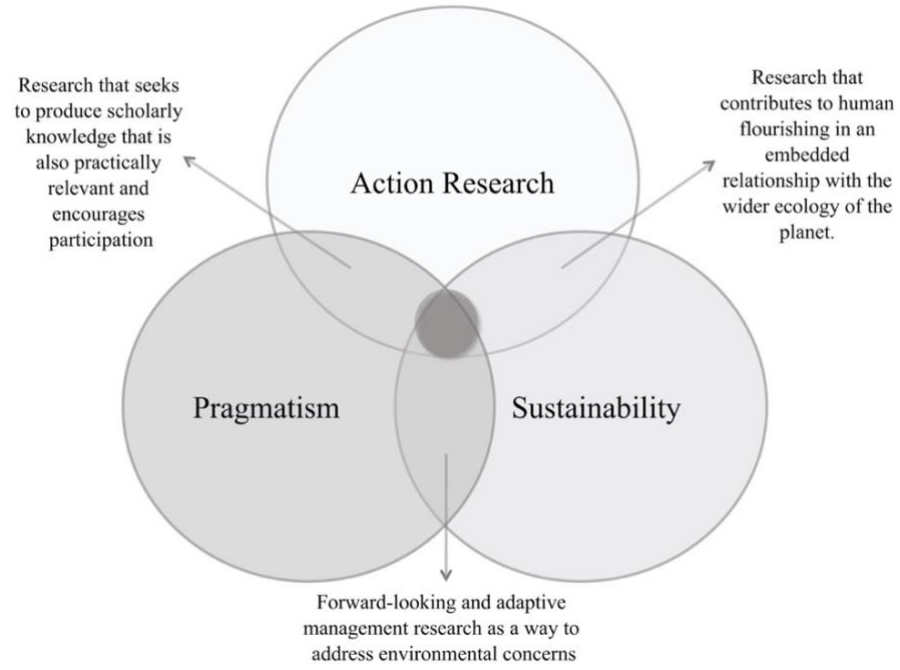

Figure 3. The connection between AR, pragmatism and sustainability

(Touboulic & Walker, 2016).

An overview of the pragmatist philosophy and the action research strategy will be discussed in the next two sections. The research methods employed in the research are detailed in the methodology sections of each paper. To save repetition, they will not be discussed here.

4.1 Pragmatism

Similar to AR, pragmatist research typically starts with a problem (Brinkmann, 2017; Saunders *et al.*, 2019) and is focused on developing knowledge to 'make things happen' in practice (Touboulic & Walker, 2016). Pragmatism is "deeply concerned with the union of theory and practice" (Schwandt, 2022, p. 240). Hence, it provides a suitable foundation for this research, as it aims to understand and reduce the gap between SSCM theory and practice and find solutions to practical problems. The pragmatist philosophy originated in North America in the 19th century, principally through the work of Charles Sanders Peirce, William James, and John Dewey (Mendand, 2002). The pragmatist tradition has been heavily criticised (Morgan, 2014) and treated with a large degree of disdain, with some even labelling it as "a philosophy for people who cannot think" (Haack, 2015, p.25). This assessment seems unjustified given that the founder of the movement, polymath Charles Sanders Peirce, is considered to be one of the greatest thinkers in American history (Everett, 2017; Hartshorne & Weiss, 1931). Peirce originated the concept of semiotics and abductive reasoning. Furthermore, his work on logic also led to early

conceptions of the computer (Haack, 2015). He was greatly influenced by the work of Charles Darwin (Houser & Kloesel, 1992) and he thought human inquiry to be "continuous with animals' explorations of their environment" (Haack, 2015, p. 7).

Critics of pragmatism believe it sets aside abstract considerations of ontology and epistemology to focus on "what works" in practice, implying a disregard for metaphysical considerations. Saunders *et al*. (2019) in their business research textbook warn researchers not to treat pragmatism as an 'escape route' from understanding the positions of other research philosophies. On the contrary, the complex ontological and epistemological roots of pragmatism only intensify the need to thoroughly understand the various philosophical positions to sufficiently justify its adoption. Scholars such as Haack (1976) argue that criticisms of pragmatism are typically based on a grossly inadequate understanding of the philosophy. Crotty (1998, p. 74), states that "the view of culture and society that pragmatism came to adopt is essentially optimistic and progressivist. The pragmatist world is a world to be explored and made the most of, not a world to be subjected to radical criticism".

According to Kaushik and Walsh (2019, p. 4), pragmatists do not cast philosophical arguments aside to get on with their research. Interestingly, the movement emerged from the 'Metaphysical Club', a philosophical debating society in Cambridge, USA, formed with the specific purpose of debating such matters (Mendand, 2002). Peirce, James and Dewey, did not agree on the ontological underpinnings of pragmatism (Haack, 1976). Charles Sanders Peirce (an ontological realist) was so aggrieved by the William James' nominalist interpretation of pragmatism that, towards the end of his career, he attempted to 're-brand' his philosophy as 'pragmaticism' (*Ibid*).

Despite their ontological differences, the founders of pragmatism did all consider meaning to be something which is context dependent and inextricably linked to human experience and needs (Dillon *et al*., 2000). A central tenet agreed upon by all of the classic pragmatists is the concept of 'fallibilism' which posits that our knowledge can never be completely certain (Schwandt, 2007). Peirce commented that a scientific inquirer is a "contrite fallibilist" and is willing to "drop the whole cartload of his beliefs, the moment experience is against them" (Hack, 2015, p.8). We must, therefore, make do with what we have sufficient reason to believe. Hook calls these 'working truths' (Haack, 2015). However, Dewey avoids the term 'truth' which he finds problematic, instead opting to use the phrase 'warranted assertions' (Schwandt, 2015). Warranted assertions are "beliefs strongly supported enough in argument and evidence to be confidently acted

upon" (Schwandt, 2015, p. 320), until evidence arises to the contrary that confronts and challenges, or may even lead us to reconsider or abandon those beliefs entirely (Schwandt, 2007).

Broader philosophical debates underpinning the pragmatist movement are still ongoing (Haack, 2015). One faction can be described as 'ontological relativists' such as Schiller (*Ibid*) and neo-pragmatist Richard Rorty (Putnam, 1995). Scholars such as Sidney Hook and Susan Haack both adopt Peirce's notion of "Critical Common-Sensism" and a philosophical naturalist position that align more with the realist ontological perspective of Peirce. Hook and Haack believe in adopting what Peirce calls a "scientific attitude", by which he means "a genuine desire to find out how things are" and the best way to fixate our beliefs (Haack, 2015, p.6). It is important to mention that Peirce deviated from traditional realists (positivists) in the sense that he felt the world could not be perfectly known. He was a phenomenologist of sorts, although preferred his terms 'phaneron' and 'phaneroscopy' by which he meant "the collective total of all that is in any way or in any sense present to the mind, quite regardless of whether it corresponds to any real thing or not" (Peirce, 1905).

Coleman states that "action researchers find themselves in particularly complex epistemological territory" (2015, p. 4). Epistemologically, pragmatism (as a suitable philosophical underpinning of an action research strategy) differs from other positions such as positivism or even critical realism, the latter with which it has more in common. The pragmatists favour an 'epistemology of the hand' as opposed to an 'epistemology of the eye', the latter of which Dewey calls 'spectator theory' (Brinkmann & Tanggaard, 2013). As William James' book title, 'Pragmatism – a new name for some old ways of thinking' suggests, pragmatism has deep historical roots (James, 1907). Action research and pragmatism can be traced back to the broader Aristotelian view of knowledge where epistemology is just one form of several ways of knowing (gnoseology) (Eikeland, 2007). Eikland and other authors on social science such as Flyvbjerg (2001) have made the case for 'phronetic' research that is concerned with ethics and the "deliberation about values with reference to praxis" that is "pragmatic, variable, context-dependent and orientated toward action" (p.57). Eikland (2007) has highlighted the similarity between the action research approach and the Deweyan pragmatist approach to inquiry.

This present research aligns well with the five-stage approach for pragmatic inquiry proposed by Dewey (1910) and can be described as follows:

1. The first stage, as highlighted above, involves the identification of an unresolved problem (as was detailed in the abstract and introduction of this research).
2. The second stage involves the researcher either loosely or systematically gathering data regarding the problem so as to more clearly specify it (Brinkmann, 2017). In this thesis, systematic gathering of information occurs through the undertaking of the SLR presented in Chapter 1, Section 5. In the first paper (chapter 2) the researcher adopts a more exploratory (as a proxy for 'loosely') approach to gathering data.
3. The third stage, once the problem has been more clearly understood, involves the researcher hypothesising or making propositions regarding how the problem may be solved *(Ibid)*. Propositions have been put forward in all three papers. However, the insights and propositions from paper 1 led to the conceptual exploration of how the problems (e.g. lack of value-driven business case for SSCM, lack of supply chain transparency, reluctant attitude towards Industry 4.0 technology adoption) could be addressed.
4. During the fourth stage the proposed solutions may be deliberated further and compared with alternate solutions to the identified problem, the possible consequences of which are closely considered *(Ibid)*. This stage is evidenced in both the second conceptual paper and the third paper (AR project).
5. In the fifth and final stage, the proposed solutions are put into practice. The researcher conducts empirical research to ascertain whether the desired consequences meet expectations and solve the problem. This has been the case in the third paper which empirically tests the viability of BCT clusters in a real business setting. This then led to the discussions and final conclusions of this thesis.

The Deweyan mode of inquiry adopted for this thesis is presented in Figure 4. It is holarchical in nature as opposed to hierarchical, where each distinct stage of the research can simultaneously be seen as being whole in and of itself as well as part of a larger whole. The concept of a 'holon' was first coined by Koestler as an "interesting way to overcome the dichotomy between parts and wholes" (Koestler, 1969). The concept of holarchy has recently been used in corporate social responsibility research to avoid hierarchical progressions (Kurucz *et al*., 2008), where there is a sense of order and status in relation to an exact top or bottom. This thesis follows a holarchical progression where

each stage or paper can stand alone to address specific facets of the overarching research problem, yet cumulatively seeks to deepen our understanding of it and propose possible solutions for moving forward that address the grander challenge.

As indicated by Dewey (1920, p. 123) the change in knowledge and philosophy from contemplative to operative does not entail "lowering in dignity of philosophy from a lofty plane to one of gross utilitarianism. It signifies that the prime function of philosophy is that of rationalising the possibilities of experience, especially collective human experience". He believed philosophers should spend their time "facing the great social and moral defects and troubles from which humanity suffers, to concentrate its attention upon clearing up the causes and exact nature of these evils and upon developing a clear idea of better social possibilities" (p.125). Dewey's argument resonates, given that the aims and objectives of this research to contribute towards the broader sustainable development effort to ensure we do not compromise the ability for future generations to meet their own needs (World Commission on Environment and Development., 1987).

In summary, a deeper exploration of the literature suggests that classic pragmatism, particularly that of Peirce and Dewey, has a lot more to offer than many have led us to believe. The pragmatists champion practical knowing as a valid form of knowledge and believe it is best acquired through participatory, democratic and collective inquiry. It is a philosophy that avoids polarity and is perhaps the most moderate and diplomatic of all the philosophical positions. It transcends the 'paradigm wars' (Gage, 1989), not because it finds metaphysical debates unnecessary or unimportant, but because it believes that prioritising the progression of society, and addressing its problems, is the most important endeavour to which philosophical minds can contribute their time.

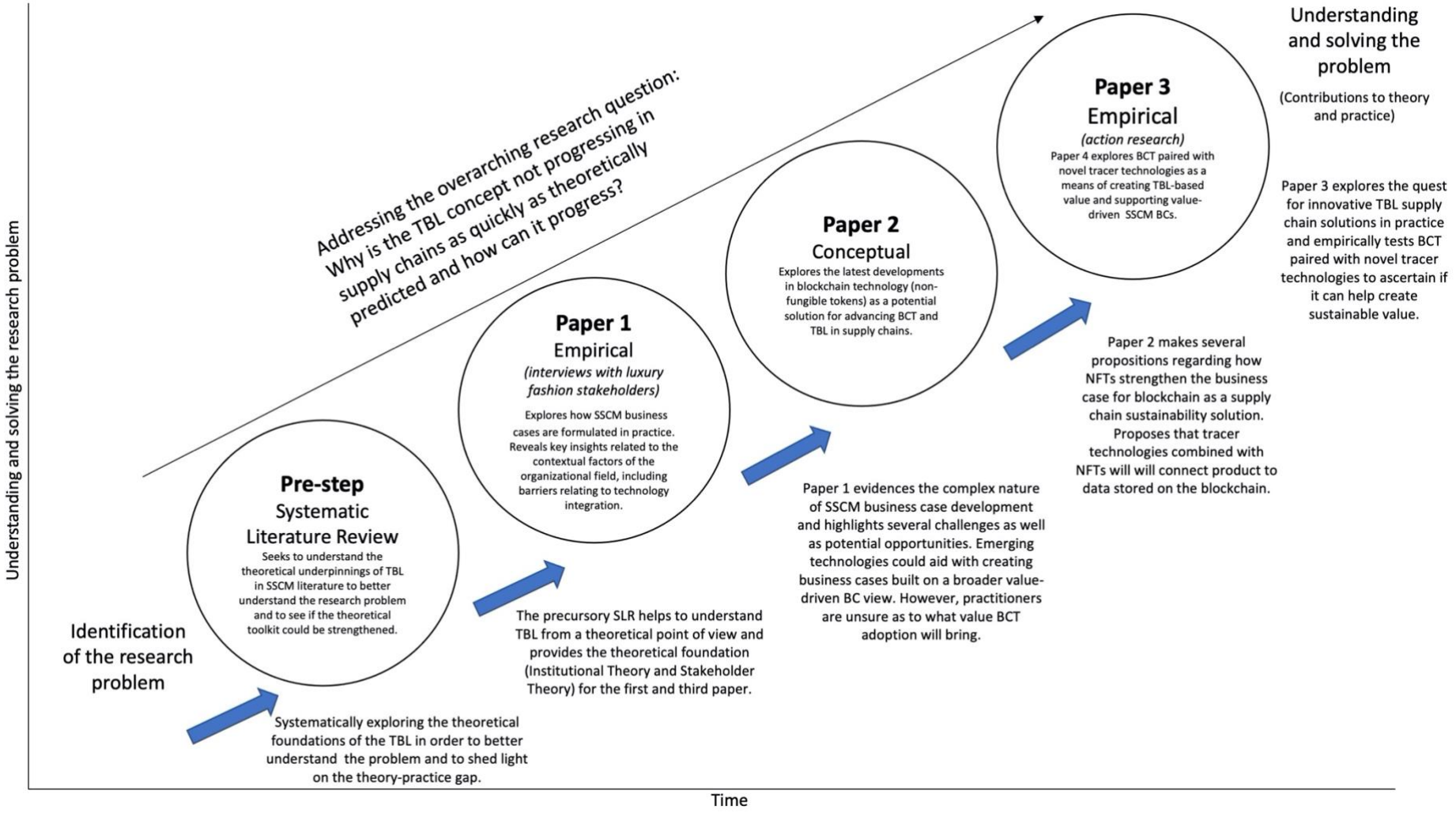

Figure 4. Holarchical (Deweyan) structure of the thesis

4.2 Action research in the field operations and supply chain management

The third paper of this research adopts an action research approach. The specifics of the approach will be discussed in the methodology of the third paper (Chapter 4). This section will provide a brief overview of the use of action research strategies in SCM research.

Researchers are inclined to select the action research approach because of its propensity for 'getting things done', sparking change, and making a difference (Coleman, 2015). It has become increasingly popular in organisational research and is described as a "rigorous, reflective and relevant methodology for research in OM [Operations Management]" (Coughlan & Coghlan, 2016, p. 264). SCM has been highlighted as a good field of research in which to conduct action research projects (Müller, 2005). Further to this, is has been identified as a popular approach for researching SSCM (Benstead *et al*., 2018; Touboulic & Walker, 2016), making it an appropriate methodological choice for this present research.

Although the popularity of action research has been increasing in the fields of OM and SCM, it has not been as prevalent as other research strategies (Coughlan & Coghlan, 2002; Müller, 2005). This has been attributed to the relative dominance of positivistic paradigms in the field (Müller, 2005). Some scholars believe this also explains why the action research approach has received a lot of criticism (Coughlan & Coghlan, 2002; Müller, 2005; Näslund *et al*., 2010). It all comes down to a difference in philosophical assumptions (Müller, 2005). Objectivity is one of the key assumptions of the positivist position; the participatory nature of action research (and an underlying pragmatist philosophy) conflicts sharply with this. Pragmatism repudiates the value-free stance of positivism and rejects object-subject separation (Touboulic & Walker, 2016). Although problematic to those who assume a positivist position, many view the participatory nature of action research to be a virtue (Easterby-Smith *et al*., 2012).

Pagell and Shevchenko (2014, p.51) believe action research enables SSCM researchers to be proactive and help guide practice, rather than react to it. The following quote is particularly meaningful for the aims and objectives of this present research:

> "The gap between the laboratory and the workplace in fields focused on interventions or introducing new technologies is often partially explained by noting that what is developed in the laboratory/controlled studies does not account for workplace realities. Partnering in such participatory studies would be a way for supply chain researchers to improve the odds of

> innovations moving from the laboratory to practice and hence to lead practice. Participatory studies could assist the process of developing new business models or developing new tools to measure the supply chain's impact."

Essentially, they posit that to speed up the quest for solutions SSCM researchers should collaborate with supply chains to find out what works in practice rather than waiting for supply chains to figure it out themselves (*Ibid*). They warn of the research design trade-offs in selecting an action research approach. However, they highlight that this is the issue with any research design decision and suggest that the trade-offs may be worth it for the new insights that it offers.

5. A review of mid-range organisational theory usage in triple bottom line-focused sustainable supply chain management research

To understand how innovative solutions are best prescribed, there is a need to first better understand why the TBL agenda still faces barriers to achieving the desired level of progression. In short, we need a clearer theoretical foundation so we can evaluate where we are, so that we may better predict how we can progress.

Theory is viewed as the bedrock of knowledge, as knowledge is generated by "building new theories, extending old theories and discarding either theories or certain aspects of theories that do not stand up to rigorous empirical research" (Handfield & Melnyk, 1998, p. 321). The use of theory can increase understanding of a given phenomenon and strengthen conclusions and lead to future theory development (Barratt *et al*., 2011; Sarkis *et al*., 2011). Several scholars have commented upon the lack of theory usage in SSCM research (Carter & Easton, 2011; Sarkis *et al*., 2011; Sartor *et al*., 2016; Touboulic & Walker, 2015). This observation is consistent with the field of operations and supply chain management research more generally which has been found to be lacking a solid theoretical foundation (Cousins *et al*., 2006; R. Hahn & Kühnen, 2013; Storey *et al*., 2006).

Touboulic and Walker (2015) noted that discussions about theory usage have largely been limited to subsections of broader SSCM literature reviews (see Carter and Easton, 2011). Furthermore, they are usually focused on either green supply chain management (see Sarkis, 2011) or social supply chain sustainability (see Zorzini *et al*., 2015; Sartor, 2016). Toubloulic and Walker (2015) conducted the first systematic review which specifically evaluated theoretical perspectives used in SSCM research. They categorised

papers in accordance with which dimension of the TBL the papers had researched. However, the authors noted there were signs that SSCM research was beginning to take a more holistic, TBL view of SSCM.

A specific understanding of the theoretical threads of the TBL in SSCM research was found to be missing which provides the main motivation for the SLR. It aims to establish how common the TBL view of sustainability has become within the field of SSCM and specifically aims to establish what the most popular theories have been in 'TBL-focused SSCM research' – that is, SSCM research which clearly views sustainability holistically in terms of the three interrelated pillars of the TBL paradigm (economic, environmental, social) rather than viewing environmental supply chain issues in isolation from social issues. The term 'theory' can be used to describe anything from "minor working hypothesis' to 'axiomatic systems of thought' (Merton, 1968, p. 39). In this SLR, theory is taken to mean 'middle-range theory', that is, theory or theories that consist of "limited sets of assumptions from which specific hypotheses are logically derived and confirmed by empirical investigation" (*Ibid*). These types of theories are deemed abstract enough to transcend "sheer description or generalisation" whilst being close enough to the "observed data to be incorporated into propositions that permit empirical testing" (p.39).

This SLR can be viewed as an important groundwork for addressing the overarching research question and laying the foundation for subsequent study. Understanding the requirements for potential solutions that address the TBL adoption barriers and ensuring that SSCM researchers are equipped with a robust theoretical toolkit for this type of inquiry is needed. The following research questions have been set in support of the research aim:

RQ1. What are the dominant theoretical perspectives that underpin the TBL view of SSCM, and how have they been employed in the existing research?

RQ2. Does the theoretical toolkit for TBL-focused SSCM research adequately equip researchers for the next phase of TBL innovation and deployment? If not, how may it be strengthened?

The next section will provide an overview of theory usage in existing SSCM and operations and supply chain management research more broadly. The findings are then presented, and their implications for the next phase of inquiry discussed.

5.1 The use of mid-range theory in sustainable supply chain management and operations and supply chain management research

Organisational theory can be difficult to define, as it has roots in several social science research fields. However, it can be defined as a "management insight that can help explain or describe organisational behaviours, designs, or structures" (Sarkis *et. al.*, 2011, p.2). Cousins *et al*. (2006, p. 701) found that SCM had been studied from a "wide range of academic disciplines and diverse theoretical perspectives" which had encouraged interesting debates, but had also caused the literature to become fragmented to the point that it fails to generate consistent findings. There have even been questions regarding the validity of SCM as a discipline in its own right, with some scholars having commented that it was still in an emerging state (Cousins *et al*., 2006; Storey *et al*., 2006). Storey *et al*. (2006, p.755) stated that if SCM was to "mature as a discipline", further clarification regarding "its domain, its central problems, its core components, its theories and its theoretical map" were required.

Sustainability has been an emerging discourse within the SCM field which has posed additional challenges and created further complexity to the research domain. Rajeev *et al.* (2017) found that, from a theory building perspective, SSCM research was far from reaching theoretical consolidation. Indeed, several scholars have found there to be a paucity of theoretical underpinnings in sustainability and SSCM research (Carter & Easton, 2011; R. Hahn & Kühnen, 2013; Rajeev *et al*., 2017; Sartor *et al*., 2016; Zorzini *et al*., 2015). Carter and Easton (2011) found that, despite the absence of theory in most papers they reviewed in their study, there had been an increasing trend for integrating theory into SSCM over the decade prior to their publication.

Whilst some scholars have been in favour of employing a theoretical lens, to ground OM research and deliver stronger insights (Barratt *et al*., 2011), others have questioned the applicability of theory in OM research altogether (Schmenner *et al*., 2009). Zorzini *et al*. (2015) found that the use of theory varied greatly in social sustainability research and proposed four categories of theory usage. The first was 'theory dressing', which relates to the superficial inclusion of a theory without clear explanation of its links to the research. This bears similarities to Schmenner *et al.* (2009) who have taken issue with the use of 'vacuous theory' which they argued should be challenged, as it does little to advance academic understanding. The second was 'theory matching', where research findings were linked to theory to provide validation to arguments. The third category proposed was 'theory suggesting and explanation' where theory was employed to develop

hypotheses and to aid in the explanation of empirical findings. Finally, the fourth category, deemed the most valuable, was 'theory expansion', which aids in the understanding of a given phenomenon and enables managerial implications to be derived from the theoretical perspective.

The application of combined theoretical perspectives are even scarcer in the SSCM literature (Carter & Easton, 2011). This is supported by Hahn and Kühnen (2013) who, in their research on sustainability reporting, found that, when present, theory was usually treated in isolation as opposed to "holistically embracing different theoretical explanations" (p.14). Fernando and Lawrence (2014) opined it was insufficient to use a single theory in isolation and suggest that using an integrated theoretical framework enables a more complete understanding. Zorzini *et al*. (2015, p. 86) warn of the "inherent danger when selecting theories, i.e. that using one theory alone may introduce bias to the conclusions". Carter and Easton (2011, p. 55) suggest that the "blending of diverse, complementary, and even overlapping theories can help to better develop hypotheses, add rich insights to the interpretation of findings, and help better understand the boundaries of where these theories apply".

Another prominent discussion related to theory in the operations and supply chain management literature that has already been mentioned in the introduction of this thesis, is the substantial gap that exits between theory and practice (Slack *et al*. 2004; Storey *et al*. 2006). Slack et. al. (2004) posed the question of whether OM research should even try to "originate novel ideas" and suggested that the primary role of OM could instead be to "continually seek a point of research/practice reconciliation". However, recent calls for OM research to bridge the gap between theory and practice suggests that there is value to be gained from applying theory in real business scenarios. Many scholars have advocated theory usage as a means to ground OM research and deliver stronger insights, to increase understanding, strengthen conclusions and lead to future theory development (Barratt *et al*., 2011; Sarkis *et al*., 2011). The dialogue between theory and practice (and between researchers and practitioners) and the tensions that may arise as a result, may have its own merit and may be seen as a catalyst for change and progression. Storey *et al*., (2006) stated that theory-building can be aided by the study of practice and that by understanding the expectations and goals of management can help understand the barriers to realising "idealistic notions".

5.2 Systematic literature review methodology

Literature reviews enable researchers to evaluate and map the 'intellectual territory' of an existing field and generate research questions that will increase the knowledge further and help inform practice and policymaking (Tranfield *et al*., 2003). Narrative management reviews have often been criticised for their lack of rigour (*Ibid*). Systematic reviews have been seen to remedy the shortcoming of narrative reviews by increasing transparency and replicability and reducing the potential for research bias (Carter and Easton, 2011; Tranfield *et al*., 2003). The outputs of a systematic review are methodologically sound enough for researchers to develop propositions that can be empirically tested whilst also providing a reliable knowledge base for practitioners (Tranfield *et al*., 2003). Therefore, the systematic review methodology is seen to exist at the "core of 'pragmatic' management research, which aims to serve both academic and practitioner communities" (p.220).

The methodological approach used in this paper is based upon the three macro stages for systematic literature reviews proposed by Tranfield *et al*. (2003) (Stage I−Planning the review, Stage II−Conducting a review, Stage III−Reporting and dissemination) and the content analysis approach that has been popularised in the field of SCM by Seuring and Gold (2012). Content analysis approach was employed for phase two of conducting the review. It has been identified as a suitable approach for analysing SCM literature as it provides analytic flexibility, allowing for analysis at two levels (Duriau *et al*., 2007). At one level, 'descriptive analysis' can occur where the content of the text can be analysed quantitively (e.g. the frequency of phase occurrence, number of publications in a given year) and can be reported using statistics (e.g. distribution of papers by publication etc) (Duriau *et al*., 2007; Seuring & Gold, 2012). At a second level, the researcher can engage in 'material evaluation', qualitatively analysing latent content (Seuring & Gold, 2012) and evaluating the "deeper meaning embodied in the text, which may require more interpretation" (Duriau *et al*., 2007, p. 6).

The initial 'scoping study' (Tranfield *et al*., 2003) found that explorations of theory usage in SSCM had been conducted more generally (Touboulic and Walker, 2015). However, a focused theoretical study of the TBL view was found to be missing from the existing literature which provided the motivation for the review. Furthermore, although many scholars had commented on the increasing popularity of the TBL view of SSCM, there was no substantive evidence which clarified exactly how popular the TBL view of

SSCM has become. From this the review protocol was developed which outlined the criteria for material inclusion and exclusion which provided the basis for the material collection process.

An overview of the material collection process is outlined in Figure 5. To limit the search to a manageable number of papers, only papers from the following Operations and Technology Management journals, published between 2009 and 2019 were included:

1) *Journal of Operations Management*
2) *International Journal of Operations and Production Management*
3) *Production and Operations Management*
4) *Computers in Industry*
5) *IEEE Transactions on Engineering Management*
6) *International Journal of Production Economics*
7) *International Journal of Production Research*
8) *Journal of Supply Chain Management*
9) *Production Planning and Control*
10) *Supply Chain Management: An International Journal*

These journals were selected because they are reputable, peer-reviewed publications and due to their inclusion and ranking (3-4 star) in the CABS journal guide (Chartered Association of Business Schools, 2015). We do not claim this review to be an exhaustive representation of the theories used in TBL focused SSCM research but endeavour to offer findings that present a realistic overview of the current state of play.

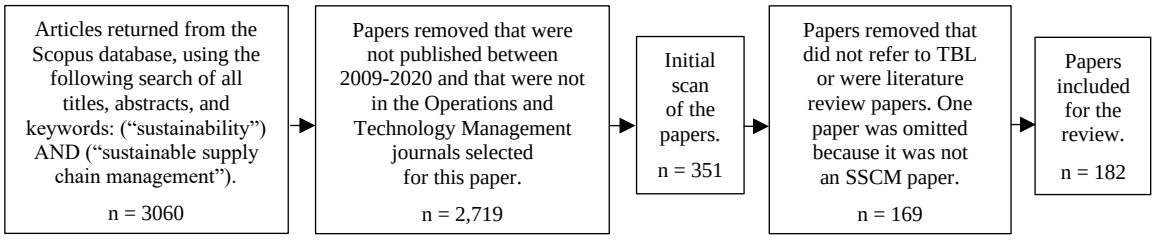

Figure 5. Material collection process

The abstracts and keywords of 351 papers were scanned as part of the initial screening process (see Figure 1). Literature review papers were removed and a paper which was not an operation or SCM paper was also removed (n=14). The remaining 337 papers were scanned in closer detail. Terms such as "triple bottom line", "TBL" and "3BL' were applied as an in-text search to see if the paper explicitly referred to the TBL. The papers

referenced the TBL in varying degrees. For some, the TBL was the sole focus of the paper, where some simply mentioned it to establish an operational definition for sustainability. For this study, all papers which referenced the TBL as being the lens through which sustainability is defined, understood and applied were included. Papers that did not reference the TBL were removed at this stage (n = 155).

The contents of the final selection of papers (n=182) included for review were then analysed in more depth paying specific attention to the use of theory. Terms, such as "theory" and "theoretical" were then applied to ascertain whether the paper had a clear theoretical underpinning or not. This information was then recorded in a Microsoft Excel database. If a paper had a clear theoretical underpinning, the theory or theories used were recorded in the database so that the researcher could start getting a sense of the dominant theories in the field. Papers which appeared to merely mention a theory or theories in passing or those that appeared to be 'theory dressing' (superficial use of theory) (Zorzini *et al*. 2015, p. 83) were recorded in the database as missing a clear link to theory. Information about the number of SSCM papers that have adopted a TBL perspective over time, the range and popularity theories used and whether they were used in isolation are all presented in the following chapter. The distribution of the articles adopting a combined theoretical perspective across various journals is also presented.

The descriptive analysis stage revealed the most popular theories used in the literature. These were analysed in more detail to develop a deeper understanding of how the most popular theories had been used. A summary of theory use in each paper was added to a Microsoft Excel database to assist with the analysis featured in the discussion section of this paper. These findings are presented as a series of tables in the subsequent section.

5.3 Systematic literature review findings and discussion

This section begins by presenting some of the general findings of the literature review. This is followed by discussions around the use of the most dominant theoretical lenses to see how the theory has been used.

5.3.1 Use of theory within the existing literature

Out of 337 papers that were initially screened, 182 (53%) of papers defined or viewed sustainability and SSCM using the TBL concept and so were included for the review (see Appendix 1 in the 'Appendices' section at the end of the thesis for the full reference details of papers included in the review). This is a trend which has increased significantly over the past decade (see Figure 6). It is also worth noting that since 2015 there has been

a strong upward trend in terms of the percentage of overall papers that have viewed SSCM through the lens of TBL. In 2015, 39% of the papers including in the initial stages of our review referred to the TBL. By 2020, this had risen to 60%. This suggests that viewing sustainability in terms of the TBL is becoming increasingly popular, indicating the beginning of a consensus regarding how sustainability in supply chains is understood.

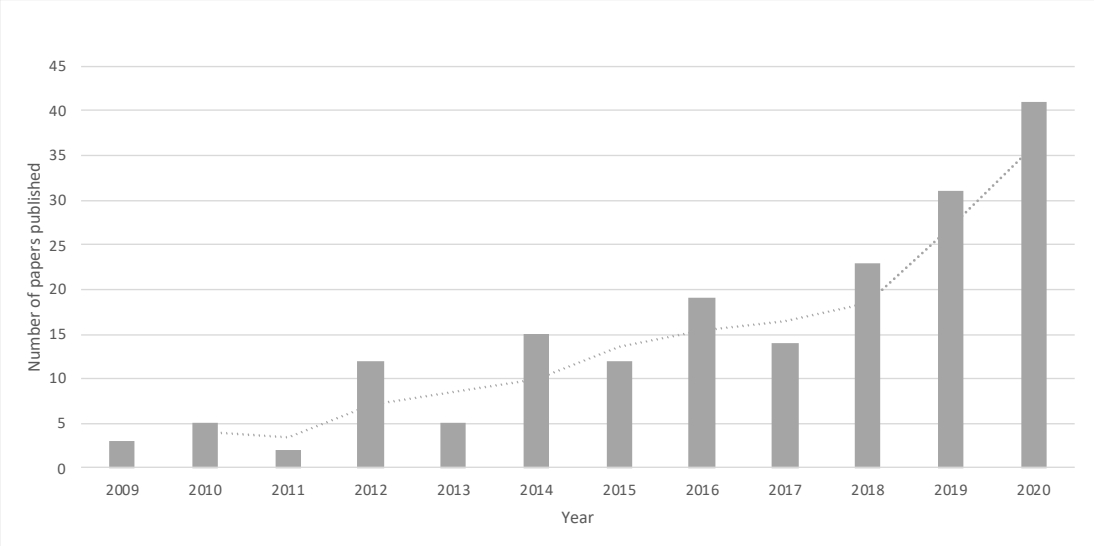

Figure 6. Number of TBL-focused SSCM papers published between 2009-2020

The findings suggest that the majority of TBL-focused SSCM research lacks a clear theoretical underpinning (65% of the papers included for final review did not employ theory). This aligns with prior reviews of SSCM research more generally (Carter & Easton, 2011; Sarkis *et al*., 2011; Touboulic & Walker, 2015). However, in their study, Carter and Easton found that there had been an increasing trend to integrate theory over time, with only 33% of papers lacking a theoretical lens between 2001-2010 as opposed to 87% between 1991-2000. Incidentally, the initial screening phase suggested that 59% of papers lacked a clear theoretical lens. This is more in line with the average of Carter and Easton's findings of 55%. When we narrow the focus to just SSCM research viewed through the lens of TBL, findings suggest that authors are even less likely to employ a theoretical lens.

Analysis of the final 182 papers revealed that 64 articles (35%) employed middle-range theory. TBL-focused supply chain research has been approached from a vast range of theoretical perspectives (32 different theoretical perspectives in total – see Table 3). Stakeholder theory, Resource Based View (RBV) (plus variants) and institutional theory

are the dominant theoretical perspectives in TBL-focused supply chain research and are the most likely to be used in conjunction with one another as part of a combined theoretical approach. This finding is similar to what Touboulic and Walker (2015) found. However, this research finds stakeholder theory to be the most popular, as opposed to RBV (Touboulic and Walker, 2015). The integrative nature of stakeholder theory is perhaps more closely aligned with the integrative nature of the TBL (Sodhi, 2015) and may be considered a more appropriate lens for exploring social sustainability and subsequently a holistic TBL view of SSCM. Our findings suggest that institutional theory significantly increased in popularity between 2015-2020, although it was not a dominant theory in Carter and Easton's review (2011). TCE was found to be a dominant theory in SSCM more generally by both Carter and Easton (2011) and Touboulic and Walker (2015). However, in this review it was only the 6th most popular theoretical lens.

Table 3 – Theoretical perspectives used in TBL-focused SSCM research

Theory	**No. of papers**	**% of total papers**	**References**
Stakeholder Theory	19	10.4%	(Busse, 2016; Ghadge *et al*., 2019; Gouda & Saranga, 2020; Govindan, 2018; Huq *et al*., 2016; Kannan, 2018; Katiyar *et al*., 2018; Mani *et al*., 2018b; Modgil *et al*., 2020; Montabon *et al*., 2016; Nunes *et al*., 2020; Pagell *et al*., 2010; Pagell & Shevchenko, 2014; Schrettle *et al*., 2014; Shafiq *et al*., 2020; Sodhi, 2015; Thornton *et al*., 2013; Z. Wang *et al*., 2015; Wu *et al*., 2014)
Resource Based View (including extensions Natural Resource Based View and Stakeholder Resource Based View)	17	9%	(Blome *et al*., 2014; Brockhaus *et al*., 2019; Chavez *et al*., 2020; Felsberger *et al*., 2020; Fung *et al*., 2020; Gouda & Saranga, 2020; He *et al*., 2019; Hollos *et al*., 2012; Mani *et al*., 2018a, 2020; Marshall *et al*., 2015; Pagell *et al*., 2010; Pullman *et al*., 2009; Shafiq *et al*., 2020; Shibin *et al*., 2018; Sodhi, 2015)
Institutional Theory	8	4.4%	(Dubey *et al*., 2017; Fung *et al*., 2020; Govindan, 2018; Shibin *et al*., 2018; Silvestre, 2015; Silvestre, Viana, *et al*., 2020; Wilhelm *et al*., 2016; Wu & Jia, 2018)
Dynamic Capabilities	7	3.8%	(Felsberger *et al*., 2020; Geyi *et al*., 2020; Ghadge

Theory			*et al*., 2019; Govindan, 2018; Kumar *et al*., 2018; Reuter *et al*., 2010; Wong, 2013)
Agency Theory	5	2.7%	(Cole & Aitken, 2019; Lechler *et al*., 2019; Ramanathan *et al*., 2020; Shafiq *et al*., 2017; Wilhelm *et al*., 2016)
Transaction Cost Economics	4	2.2%	(Adhikary *et al*., 2020; Goebel *et al*., 2018; Huq *et al*., 2014; Pagell *et al*., 2010)
Information Processing Theory	2	1.6%	(Busse *et al*., 2017; Wiengarten *et al*., 2017)
Contingency Theory	2	1.1%	(Silvestre, Silva, *et al*., 2020; Zarei *et al*., 2019)
Evolutionary Theory	2	1.1%	(Silvestre, 2015; Silvestre, Silva, *et al*., 2020)
Resource Dependence Theory	2	1.1%	(Hollos *et al*., 2012; Mani *et al*., 2018a)
Systems of Systems Theory	2	1.1%	(Lechler *et al*., 2019; Orji & Liu, 2020)
Systems Theory	2	1.1%	(Alblas *et al*., 2014; S. C.L. Koh *et al*., 2016)
Complexity Theory	1	0.5%	(Silvestre, 2015)
Critical Success Factor Theory	1	0.5%	(Kannan, 2018)
Decision-Making Theory	1	0.5%	(Fung *et al*., 2020)
Knowledge Based View Theory	1	0.5%	(He *et al*., 2019)
Legitimacy Theory	1	0.5%	(Mani *et al*., 2018b)
Organizational Integration and Process Innovation Theory	1	0.5%	(Golini & Gualandris, 2018)
Performance Chain Theory	1	0.5%	(Hong *et al*., 2019)
Performance Frontier Theory	1	0.5%	(May & Stahl, 2017)
Profile Deviation Theory	1	0.5%	(Kumar *et al*., 2018)
Resource Orchestration Theory	1	0.5%	(Chavez *et al*., 2020)
Schema Theory	1	0.5%	(Longoni *et al*., 2019)
Social Exchange Theory	1	0.5%	(Davis-Sramek *et al*., 2020)
Social Network Theory	1	0.5%	(Adhikary *et al*., 2020)
Stakeholder RBV	1	0.5%	(Mani *et al*., 2020)
Strategic Intent Theory	1	0.5%	(Hong *et al*., 2019)
Structuration Theory	1	0.5%	(Pullman & Dillard, 2010)
Supply Network Theory	1	0.5%	(Meqdadi *et al*., 2020)
Theory of Constraints	1	0.5%	(S. C.Lenny Koh *et al*., 2017)

Upper Echelons Theory	1	0.5%	(Hong *et al*., 2019)
Utility Theory	1	0.5%	(Sodhi, 2015)

In the research background of this paper, it was highlighted that there had been several calls for research to adopt a combined theoretical perspective. Findings of the SLR show that theories are still typically mainly used in isolation (24% of paper adopted a singular theory). The most used theory in isolation was Stakeholder Theory (6% of reviewed papers). Only a limited number of papers employed a combined theoretical perspective. Papers using a combined theoretical perspective, consisting of two theories, accounted for 9% of the final papers included for review, whereas only 3% used a combined theoretical perspective consisting of three theories. Incidentally, 73% of the papers adopting a combined theoretical perspective had been published since 2018, suggesting researchers are increasingly turning to combined theoretical frameworks for TBL-focused SSCM research. The full list of combined theoretical perspectives is detailed in Table 4. The *International Journal of Production Economics* emerged as the journal with the most papers that employed a combined theoretical perspective, followed by *Production Planning and Control* (see Figure 7). Stakeholder Theory and RBV (and its extension NRBV) were the most frequently used in conjunction with each other (4 papers). Whereas RBV (including its extensions NRBV) was the most used theory in combined theoretical papers overall (13 papers included RBV and/or its variation NRBV as part of combined theoretical framework).

Table 4 – Papers employing a combined theoretical perspective

Year	Theory combination	References	Journal
2020	Stakeholder Theory and NRBV	(Gouda & Saranga, 2020)	International Journal of Production Research
2020	TCE and Social Network Theory	(Adhikary *et al*., 2020)	International Journal of Production Economics
2020	Institutional Theory, RBV, and Decision-making Theory	(Fung *et al*., 2020)	Production Planning and Control
2020	Stakeholder Theory and RBV	(Shafiq *et al*., 2020)	International Journal of Production Economics
2020	Contingency Theory and Evolutionary Theory	(Silvestre, Silva, *et al*., 2020)	International Journal of Operations and Production Management

2020	RBV and Dynamic Capabilities Theory	(Felsberger *et al*., 2020)	Production Planning and Control
2020	NRBV and Resource Orchestration Theory	(Chavez *et al*., 2020)	Production Planning and Control
2019	Upper Echelons Theory, Performance Chain Theory, and Strategic Intent Theory	(Hong *et al*., 2019)	International Journal of Production Economics
2019	Stakeholder Theory and Dynamic Capabilities Theory	(Ghadge *et al*., 2019)	International Journal of Production Research
2019	NRBV and Knowledge Based View	(He *et al*., 2019)	Production Planning and Control
2018	Dynamic Capabilities Theory and Profile Deviation Theory	(Kumar *et al*., 2018)	International Journal of Production Economics
2018	RBV and RDT	(Mani *et al*., 2018a)	International Journal of Production Economics
2018	Stakeholder Theory and Legitimacy Theory	(Mani *et al*., 2018b)	International Journal of Production Economics
2018	Stakeholder Theory, Institutional Theory and Dynamic Capability Theory	(Govindan, 2018)	International Journal of Production Economics
2018	Stakeholder theory and Critical Success Factor Theory	(Kannan, 2018)	International Journal of Production Economics
2018	Institutional Theory and RBV	(Shibin *et al*., 2018)	Production Planning and Control
2016	Institutional Theory and Agency Theory	(Wilhelm *et al*., 2016)	Journal of Operations Management
2015	Stakeholder theory, RBV and Utility Theory	(Sodhi, 2015)	Production and Operations Management
2015	Institutional Theory, Complexity Theory and Evolutionary Theory	(Silvestre, 2015)	International Journal of Production Economics
2015	RBV and NRVB	(Marshall *et al*., 2015)	Production Planning and Control
2012	RBV and Resource Dependence View theory	(Hollos *et al*., 2012)	International Journal of Production Research
2010	Stakeholder Theory, RBV and TCE	(Pagell *et al*., 2010)	Journal of Supply Chain Management

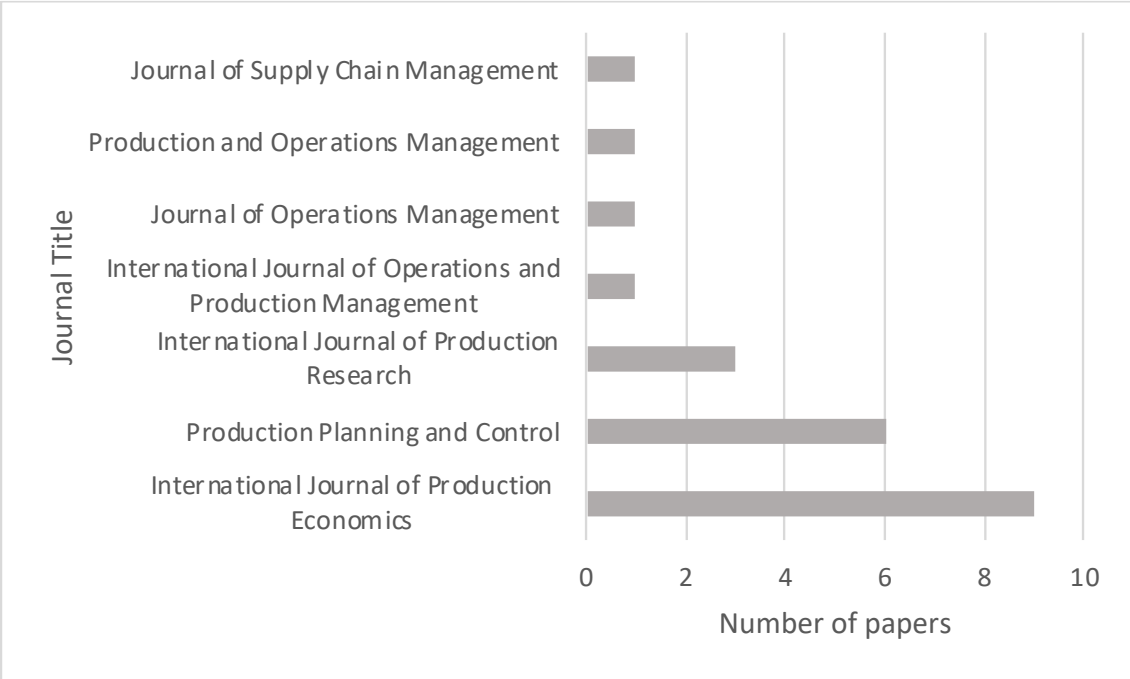

Figure 7. Number of papers featuring combined theoretical perspective by publication title

The following sections will discuss the usage of the three most dominant theories within the literature, Stakeholder Theory, RBV (and its extensions NRBV and SRBV) and Institutional theory.

5.3.2 Stakeholder Theory

Stakeholders can be defined as "groups or individuals who can affect or are affected by the achievement of an organization's mission" and can be either external or internal to the company" (Freeman *et al.*, 1984, p. 52). The theory seeks to explain why organisations go beyond creating financial returns for shareholders and look to integrate and satisfy the demands of other stakeholder groups (Freeman, 2010; Katiyar *et al.*, 2018). Some scholars have highlighted that sustainability is "inherently integrative" and that the TBL is "conceptually integrative" (Montabon *et al.*, 2016, p. 13), with its mission to consider all effects that business activities have on its stakeholders, thus, aligns well with stakeholder theory which is described as an integrative theory (Modgil *et al.*, 2020) (Modgill *et al*. 2020). The prerogative of stakeholders is to encourage firms to reduce the negative impacts of the 'externalities' that they produce and increase positive ones (Sarkis, 2011; Freeman, 1984). Stakeholder theory aligns well with the objectives of the TBL concept, which seeks to maximise the positive social, environmental and economic impacts of business practice for stakeholders (including the environment), whilst minimising the negative ones.

Table 5 summarises the papers in our review that have adopted stakeholder theory (either in isolation or in conjunction with other theories). Although it was the most common theoretical lens used in TBL-focused SSCM research, scholars seem far from reaching a consensus regarding interpretations of the theory. There are different opinions about which variant of the theory is the most suitable lens for SSCM research. There are three key variants of stakeholder theory: descriptive, normative, and instrumental (Donaldson and Preston, 1995; Busse, 2016). Donaldson and Preston (1995, p. 66) describe these three aspects as being "mutually supportive" despite their "critical differences". Normative stakeholder theory is concerned with understanding why firms should consider stakeholder needs from an ethical perspective (Busse, 2016). Instrumental stakeholder theory, on the other hand, is concerned with the self-interest of the firm and proposes that it is in the best interests of the organisation to be 'doing good' (value creation) (*Ibid*). Thornton *et al.* (2013) suggest that, at the very least, businesses should avoid causing harm to people and the planet, as there are large amounts of reputational risk involved when SSCM fails and when ethics are cast aside in favour of profit maximisation. Similarly, Katiyar *et al.* (2018, p.313) warn that if external stakeholder requirements are not met, then it poses critical risk to supply chains and the future of the entire company. Thus, avoiding these types of risks can be a strong driver for TBL implementation. Descriptive stakeholder theory explains how firms may be driven to consider stakeholder interests, motived by both normative and instrumental drivers (Busse, 2016).

Although Dondaldson and Preston suggested the different variants of stakeholder theory may be mutually supportive, the papers in our review hold somewhat opposing views on how stakeholder theory should be interpreted and employed. Pagell and Shevchenko (2014) have criticised the narrow view of stakeholder theory (instrumental variant) that has given primacy to profits and to 'economic stakeholders' that have an economic stake in the chain (e.g. shareholders). Montabon *et al.* (2016) argued that employing instrumental stakeholder theory only explains how to reduce the harm caused by unsustainable supply chains and will not lead to the development of truly sustainable supply chains. They stated that to achieve true supply chain sustainability, the needs of all stakeholders, including the environment and society, would need to be prioritised above customer demands and profit goals. The scholars posited that achieving this would require a fundamental shift in logic.

On the other hand, Nunes *et al* (2020) highlighted that both stakeholder theory and the TBL had been viewed as overly utopian, idealistic and unrealistic for practicing supply chain managers. They drew upon the work of Milton Friedman (1970), who considered proponents of the social responsibility of businesses beyond profit goals (e.g. provision of employment, elimination of discrimination, avoidance of pollution) to be preachers of "pure unadulterated socialism" (p.5). He opined that subscribing to this view involved the acceptance of the socialist view that "political mechanisms, not market ones – are the most appropriate ways to allocate scarce resources to alternative uses" (p.6). Nunes *et al.* (2020) researched sustainability trade-offs which they defined as "the meeting of one goal (i.e. economic, social or environmental) at the expense of another" (p. 1346). Whilst the authors acknowledged the very notion of a trade-off conflicts with the prescribed goals of TBL (to achieve balance between social, economic, and environmental dimensions) they aimed to contribute to a more "realistic and practicable management of sustainability issues" and found that the "exposition of social and economic trade-offs may positively influence stakeholders' perception" (p.1359).

Sodhi (2015) viewed stakeholder theory is an 'integrative theory' that is concerned with understanding how business integrates societal demands based on the assumption that firms depend on society for its continued existence and growth. For example, Mani *et al*. (2018) found that self-interested firms can use socially responsible supply chain practices to forge good relationships with stakeholders to gain the legitimacy required to survive within the industry. Sodhi (2015) combined stakeholder theory with RBV and utility theory (both inherently instrumental in nature) and presented 'stakeholder resource-based view' (SRBV) to provide (a) a descriptive framework for qualitative research, (b) an instrumental framework for empirical research, and (c) a normative framework for analytical research.

Stakeholder theory had been used in more conceptual papers (37% of total papers employing the theory) than both RBV and institutional theory (12% and 13% respectively). Furthermore, the papers that had adopted a normative stakeholder theory perspective were all conceptual in nature, suggesting the need for more empirical research which explores the practicalities of this perspective. Sodhi (2015) suggests that ethical theories tend to focus on what 'should be' as opposed to 'what is'. Therefore, it is logical that papers which have adopted a normative (ethical) view of stakeholder theory have been more conceptual in nature. However, normative stakeholder theory requires extensive empirical research to uncover any barriers to its 'idealistic notions' (Storey *et*

al. 2006). Otherwise, it runs the risk of being confined to theory with little practical application. As stated in the research background, it feels like the dialogue between research and practice is key to uncovering tensions and barriers, and that the acute focus on theory without considering the implications of its application in practice may be limiting the progression of the TBL and SSCM more generally.

Table 5. Summary of papers adopting a stakeholder theory perspective

Author	Paper Type	Theory	Notes on method and data types	Keywords	Summary of theory usage
Gouda and Saranga (2020)	Empirical	Stakeholder Theory and NRBV	Likert-scale questionnaires	cost performance, customer willingness to pay, green manufacturing, quality performance, stakeholder pressure, sustainable manufacturing	Explores the antecedents and consequences of sustainable manufacturing in both developed and emerging countries. The study uses Stakeholder Theory to explain how managers attempt to satisfy stakeholder pressure through creating value through sustainable business models. It combines this with NRVB which is uses to explain the conceptual relationships between sustainability performance and operational performance (quality and cost) to gain competitive advantage.
Modgil *et al*. (2020)	Empirical	Stakeholder Theory	Semi-structured interviews	sustainable development goals, modern information decision support systems, stakeholder theory, sustainability	Focus on how the United Nations, Sustainable Development Goals, can be achieved. Uses stakeholder theory as an integrative theory for explaining how a value chain integrates societal demands. Proposes that sustainable development needs to be accepted by the entire value chain and that stakeholders need a shared vision and joint understanding of common goals to move towards achieving Sustainable Development Goals.
Shafiq *et al*. (2020)	Empirical	Stakeholder Theory and RBV	Survey	supply chain analytics capability, stakeholder theory, responsible supply chains, supply chain transparency, code of conduct	Employs stakeholder theory and RBV to explore how supply chain analytics capability (SCAC) and customer firm pressure for ethical conduct (CPEC) influences the adoption of socially and environmentally responsible practices by suppliers. Whilst responding to the demands of salient stakeholders (e.g., customers) is a priority for most firms, the research highlights that stakeholder demands do not always align with corporate goals. This highlights how stakeholder pressure for more sustainable practice can add further complexity to supply chains that are already challenging to manage.
Nunes *et al*. (2020)	Empirical	Stakeholder Theory	Vignette-based experiment set	corporate credibility, cross-insurance	Addresses criticisms of the use of stakeholder theory and TBL

			in the context of the food supply chain. Participants asked to complete questionnaire in response to assigned scenario.	mechanisms, food supply chain, inertial effect, sustainability trade-offs, sustainable supply chain management	within the existing literature and highlights that supply chains misalignment between various TBL dimensions or between various interests of stakeholders result in trade-offs, has not receive much attention in the existing literature. The authors suggest this may explain the limited progression of SSCM in practice. The research finds that stakeholders may accept 'environmental losses' if gains can be made from a social and economic perspective, suggesting a realistic path forward with SSCM, TBL and stakeholder theory.
Ghadge *et al*. (2019)	Empirical	Stakeholder Theory and Dynamic Capabilities Theory	Hierarchical multiple regression analysis (secondary data)	sustainable procurement, supplier selection, large enterprises, regression analysis, multi-tier supply chains, dynamic capabilities view, stakeholder theory	Uses stakeholder theory and dynamic capabilities theory to generate hypothesis regarding sustainable procurement performance across multiple supply chain tiers, and in different geographic locations. These are then empirically tested using data from the sustainable procurement guidelines and policies for suppliers/stakeholders issued by 83 large global enterprises. Finds that sustainability performance varies across stakeholders within a supply chain network. Stakeholders that are closer to the end customer are more likely to have stricter sustainable procurement criterion.
Mani *et al*., (2018)	Empirical	Stakeholder Theory and Legitimacy Theory	Content analysis (secondary data)	content analysis, social sustainability, supply chain social sustainability, sustainability reporting	Applies stakeholder theory and the pragmatic form of legitimacy theory to explain social supply chain sustainability in Portuguese manufacturing firms. Through socially sustainable practice, self-interested firms can maintain good relationships with stakeholders and gain the legitimacy required to continue existing within the industry.
Katiyar *et al*., (2018)	Empirical	Stakeholder Theory	Survey	analytic hierarchy process, partial least squares, supply chain, supply chain performance index, sustainability.	Stakeholder theory is not mentioned explicitly upfront in the paper. However, the findings support the notion that if companies comply with the sustainability requirements of external stakeholders, they can improve their sustainability performance and subsequently their overall supply chain performance. Performance is mainly measured in terms of cost reduction.
Govidan (2018)	Conceptual	Institutional Theory, Stakeholder Theory, and Dynamic Capabilities Theory	Precursory literature review to guide study	sustainable consumption and production, theory development, food supply chain, conceptual framework	See Table 7 for summary
Kannan (2018)	Empirical	Stakeholder Theory and Critical	Case Study	stakeholder theory, critical success factor, triple bottom	Stakeholder theory and Critical Success Factor (CSF) Theory provide a theoretical backdrop

		Success Factor Theory		line, sustainable supplier selection, multi criteria decision making, fuzzy delphi, ism, anp, copras-g	for the paper. The authors propose that achieving a sustainable supply chain requires organisations to consider various stakeholder perspectives and to consider the CSFs of suppliers in accordance with the three dimensions of the triple bottom line. The paper proposes a framework for aiding companies with the identification of the most important TBL-related CSFs to help them with the sustainable supplier selection process (determine the best suppliers in accordance with the CSFs).
Huq *et al*. (2016)	Empirical	Stakeholder Theory	Longitudinal case study (semi-structured interviews)	social sustainability, supply chain, capabilities, clothing industry, longitudinal case study, stakeholder theory	This research focuses on social sustainability however views this in the broader context of the TBL. It adopts a stakeholder theory perspective to provide a theoretical foundation for examining how buyers and suppliers develop social management capabilities in response to stakeholder pressure in the clothing industry. Findings suggest that intense pressure from stakeholders such as customers, NGOs and the media resulted in firms engaging in third party social sustainability audits.
Busse (2016)	Conceptual	Stakeholder theory	-	sustainable supply chain management, corporate social responsibility, supply chain risk, stakeholder theory, conceptual theory building	Draws upon instrumental stakeholder theory which posits that it is in the best interests of the firm to respond to stakeholder needs as they can either positively or negatively influence their economic performance. Devises a conceptual framework as a foundation for understanding how changes in supplier sustainability-related conditions impacts the economic performance of the buyer, as a foundation for business case development and related decision making. Suggests that while descriptive stakeholder theory posits firms should be driven by ethical motives, ignoring their 'self-interest' may prevent positive changes with SSCM from occurring.
Montabon *et al*. (2016)	Conceptual	Stakeholder Theory	-	sustainability; sustainable supply chain management; environmental issues; social responsibility; human judgment and decision making	This paper questions managerial decision-making driven by the instrumental stakeholder theory perspective and asks whether supply chains can ever be truly sustainable if this is the dominant logic. The authors present and ecologically dominant logic (rooted in normative perspective of stakeholder theory) which suggests that the economic pillar of the TBL should only be considered once the environmental and then the social dimension of the TBL have been attended to. This is a

					departure from much of the existing literature which suggests that the environmental and social dimension will only be considered if they align with economic goals of the firm.
Sodhi, (2015)	Conceptual	RBV, Stakeholder Theory, and Utility Theory	-	social responsibility; sustainability; resource-based view; stakeholder theory; utility theory	See Table 6 for summary
Wang, *et al*., (2015)	Empirical	Stakeholder Theory	Case Study	green; lean; social; sustainable manufacturing practices; composite framework; performance; measures.	Uses stakeholder theory and the TBL to explore composite sustainable manufacturing practices in Chinese auto-part suppliers. They integrate stakeholder theory to help explain the different drivers and issues and posit that stakeholders' considerations are paramount to sustainable supply chain management performance.
Schrettle *et al*., (2014)	Conceptual	Stakeholder Theory	-	sustainability; sustainability drivers; decision-making; new manufacturing technologies; green products; green supply chain management; knowledge management.	Uses stakeholder theory to explain the exogenous drivers that impact the decision-making connected to sustainable manufacturing and creates a conceptual framework to help guide future empirical research.
Wu *et al*., (2014)	Empirical	Stakeholder Theory	Case Study/Qualitative interviews	stakeholder theory; energy efficiency; buyer–supplier relationship; government influence; environmental decision-making; sustainability, case study; supply management; china	The paper questions a commonly held assumption in SSCM research that stakeholder groups can be understood as one unified voice. They posit that stakeholder demands can be multidimensional, competing, and conflicting in reality which places different demands on the managerial decision-making. This research specifically looks at the differences between two salient stakeholder groups, buyers and the government and found that they can place dualistic and potentially competing demands on suppliers.
Pagell and Shevchenko (2014)	Conceptual	Stakeholder Theory	-	supply chain management; sustainability; sustainable supply chain management	Criticises the narrow view of stakeholder theory and the primacy of profits that the authors state has dominated the existing literature. Authors state that to achieve truly sustainable supply chains both economic stakeholders and non-economic stakeholders need to be treated equally.
Thornton *et al*., (2013)	Empirical	Stakeholder Theory	Survey	corporate social responsibility; global procurement; global sourcing; purchasing; socially responsible supplier selection; supplier selection; sustainability	Stakeholder theory is used to derive the research question which focuses on whether it "pays" to engage in socially responsible supplier selection (SRSS). Although findings showed there may be potential for this there was uncertainty with regards to whether this would always be realised particularly in developing nations. The authors suggested

					it may be part of longer-term strategic decision making as societal norms continue to change.
Pagell *et al.*, (2010)	Conceptual (based on previous empirical paper by the authors)	Stakeholder Theory, RBV, and Transaction Cost Economic (TCE) theory	-	environmental issues; procurement/purchasing processes; supplier management; sustainability; social responsibility.	A combination of TCE, RBV and stakeholder theory is used to explain observations made during case study research that companies who employed managers that were thought leaders in SSCM were not using the Kraljic matrix as was originally intended. Based on the above-mentioned theories, the authors proposed amendments to purchasing portfolio models to accommodate the needs of sustainable supply chain managers.

5.3.2 Resource-based view and variants

RBV posits that sustained competitive advantage can be achieved by the unique employment of resources that are valuable, rare, imperfectly imitable and non-substitutable (Barney, 1991). It specifically focuses on the links between the internal characteristics of the firm and their performance (performance objective being competitive advantage) (*Ibid*). The natural resource-based view (NRBV) is a variant of the theory that has emerged (Hart, 1995). Prior to its development, the RBV had not considered the natural environment as a source of competitive advantage (Gouda & Saranga, 2020). NRBV posits that sustained competitive advantage by three strategies namely, pollution prevention, product stewardship, and sustainable development (*ibid*). This variant was used in 5 of the papers reviewed for this paper, the majority of which have been published in the last 5 years.

RBV aligns well with the instrumental aspect of stakeholder theory as human capital resources (including interpersonal relationships) are a key source of competitive advantage. Furthermore, legitimacy and corporate image and reputation is considered a significant resource overall (Barney, 1991; Sarkis 2011), thus RBV aligns well with both the stakeholder theory and institutional theory in that regard, all being concerned with legitimacy. For example, Shafiq *et al.* (2020, p. 225) discussed customers as 'salient stakeholders', noting that "firms recognize that satisfying the concerns and demands of their customers, as a salient stakeholder group, will result in higher legitimacy for the focal firm that will eventually result in improved profitability".

RBVs focus on competitive advantage suggests an incompatibility with the ethical normative interpretation of stakeholder theory, as outlined by Pagell and Shevchenko (2014) and Montabon *et al.* (2016) (see section 4.1.1). Thus, it may be limited to

addressing social sustainability from a purely instrumental perspective. Scholars such as Sodhi (2015) have sought to moderate RBV by integrating stakeholder theory (see Table 6), and along with the integration of Utility Theory they developed the 'Stakeholder Resource Based View' (SRBV). However, even this adaptation is not fully compatible with the view of stakeholder proposed by Pagell and Shevchenko (2014) and Montabon *et al*. (2016), as it is still instrumental in nature. SRBV posits that individual stakeholders have a desire to improve their own 'utility' therefore suggests that firms should seek to improve the utility of their stakeholders irrespective of their economic status within the firm, which in turn can be instrumental to the firm's success. This view is still focused on achieving competitive advantage, albeit indirectly and a seemingly more egalitarian manner.

RBV's intraorganisational focus has led scholars such as Shibin (2018) to integrate theories such as institutional theory which links the firm to the external macro environment. Other criticisms of RBV and NRBV is its narrow focus on firm-specific rents as opposed to relational-rents. Geyi *et al*. (2020, p.222) chose to adopt a dynamic capability theory lens because it provided a deeper understanding of what "drives cooperation for value creation and what leads to competition for value capture" something they felt NRBV failed to do. Indeed, the dynamic capabilities perspective has become increasingly popular in TBL-focused SSCM research. It was the fourth most used theory in this review with most papers employing this lens having been published between 2018-2020. Felsberger *et al*. (2020) used it in combination with RBV to explore how industry 4.0 technologies can lead to sustainable value creation. Ghadge *et al*. (2019) and Govindan (2018) view the dynamic capabilities as being derived from the RBV, highlighting that it differs due to its focus on external dynamics and speed in which a firm can respond to them to gain competitive advantage. In essence, it helps overcome both the narrow intraorganisational focus and static nature of RBV, whilst maintaining its central tenets. The dynamic capability view could easily supersede RBV in TBL focused SSCM research given the rapidly changing nature of both supply chain sustainability, and the technologies associated with Industry 4.0 that may help provide sustainable value creation (Felsberger *et al.*, 2020).

Table 6. Summary of papers adopting an RBV or Dynamic Capabilities perspective

Author	Paper Type	Theory	Notes on method and data types	Keywords	Summary of theory usage
Gouda and Saranga (2020)	Empirical	Stakeholder Theory and NRBV	Likert-scale questionnaires	cost performance, customer willingness to pay, green manufacturing, quality performance, stakeholder pressure, sustainable manufacturing	Explores the antecedents and consequences of sustainable manufacturing in both developed and emerging countries. The study uses Stakeholder Theory to explain how managers attempt to satisfy stakeholder pressure through creating value through sustainable business models. It combines this with NRVB which is uses to explain the conceptual relationships between sustainability performance and operational performance (quality and cost) to gain competitive advantage. Findings show that in certain geographical territories, stakeholder pressure has little impact on firm social and environmental sustainability efforts. Willingness to pay for sustainable products has a positive impact irrespective of geography. The research finds a positive correlation between improving sustainable manufacturing practices and cost reduction and quality improvement.
Fung *et al*. (2020)	Empirical	Institutional Theory, RBV, and Decision-making Theory	Case study (secondary data)	Sustainable supply chain management, operations management theories, triple bottom line, sustainable planning strategy, case study, fashion company	See Table 7 for summary
Mani *et al*. (2020)	Empirical	Stakeholder Resource Based View	Interviews, Survey, covariance-based structural equation modeling	social sustainability Small and medium enterprises (SMEs) Sustainable performance Sustainable supply chain management Sustainable development BRICS	Adopts SRBV (Sodhi, 2015) as the theoretical model for the research and illustrated the applicability of this perspective by emphasising how the effective management of social sustainability issues related to the direct and indirect stakeholders can contribute to improved supply chain performance.
Shafiq *et al*. (2020)	Empirical	Stakeholder Theory and RBV	Survey	supply chain analytics capability, stakeholder theory, responsible supply chains, supply chain transparency, code of conduct	See Table 5 for summary
Felsberger *et al*., (2020)	Empirical	RBV and Dynamic Capabilities Theory	Case Study	Industry 4.0; operations management; dynamic capabilities; case study research;	Adopts RBV perspective to explore Industry 4.0 technologies, the dynamic capabilities of the firm and distinct dimensions of sustainability. The study finds that Industry 4.0 technologies can

				manufacturing industry	help companies to leverage and create differential TBL-based value.
Chavez *et al*., (2020)	Empirical	NRVB and Resource Orchestration Theory	Survey	Internal lean practices; sustainability performance; triple bottom line; social performance; Chile	Explains NRBV as a modification of RBV and suggests that whilst NRVB is concerned 'what' resources can lead to competitive advantage, the use of Resource Orchestration Theory, can provide a lens for understanding 'how' resources can be combined to gain competitive advantage. The theories are used to ground the conceptual model that explores whether internal lean practices (ILP) have the potential to improve environmental and social performance in addition to operational performance.
Brockhaus *et al*., (2019)	Empirical	RBV	Semi-structured interviews and some secondary analysis	New product development; Resource-Based-View; Sustainability	Adopts RBV to explore the role of sustainable product development as a source of competitive advantage. It extends the theory by proposing that 'scalability' is important aspect of sustainable product development for competitive advantage. Thus, proposes the notion of VRINS resources to include scalability.
He *et al*. (2019)	Empirical	NRBV and Knowledge Based View	Survey	Knowledge management; natural-resource-based view; operational improvement; sustainable supply chain management; triple bottom line.	NRBV theory is combined with Knowledge Based View to develop propositions related to the link between knowledge management and the development of SSCM. The authors acknowledge that TBL is aiding the next generation of SSCM concepts however question the extent to which practicing managers are able to execute TBL principles practice. The research suggests that practitioners are not fully convinced of the feasibility of TBL in relation to supply chains and note a gap between the voice of the 'Captains of Industry' and senior practitioners which they warn does not bode well for the widespread adoption of TBL.
Shibin *et al*. (2018)	Empirical	Institutional Theory and RBV	Conceptual framework presented and empirically validated via a Delphi Study which was triangulated with secondary data (e.g., Corporate Social Responsibility reports).	Frugal innovation, sustainability, sustainable supply chain, TISM, MICMAC analysis, confirmatory factor analysis (CFA), structural equation modelling (SEM)	See Table 7 for summary
Mani *et al*. (2018a)	Empirical	RBV and Resource Dependence Theory	Survey (and follow up semi-structured interviews	supplier social sustainability, supply chain management, social sustainability, supply chain sustainability, sustainability in emerging	The paper "explores the moderating role of buyers' commitment and investment on suppliers' social sustainability initiatives in developing nations" (pg. 264), based on RDT and RBV theory.

				economies	
Sodhi (2015)	Conceptual	RBV, Stakeholder Theory, and Utility Theory	-	social responsibility; sustainability; resource-based view; stakeholder theory; utility theory	The author proposes using an integrative theory like stakeholder theory in addition to RBV and utility theory which are both instrumental in nature. They propose a 'stakeholder resource-based view' (SRBV) for conceptualising social responsibility to be used as a framework to inform the decision-making of managers of a company towards maximizing their utility not only by developing their own organization's dynamic capabilities, resources, and routines but also by developing those of the company's stakeholders thereby improving their respective utilities as well" (p.1381). SRBV proposes that researchers should treat all stakeholders as being on a par with on another irrespective of power to avoid adopting a biased company viewpoint.
Marshall *et al*., (2015)	Empirical	RBV and NRBV	Survey	construct development; environmental sustainability; social sustainability; sustainable supply chain management	Uses combination of RBV and NRBV to devise the theoretical framework for the research. The authors developed a set of practices based on four underlying sustainable supply chain management practices: monitoring, implementing systems, new product and process development and strategy redefinition that can be used by practitioners to identify capabilities or weaknesses in current practice and develop strategies for developing environmental and social supply chain capabilities.
Blome *et al*., (2014)	Empirical	RBV (and its extensions: KBV and Relational View)	Survey	Sustainability, Supply chain management, Survey, Learning, Buyer-supplier relationships, Sustainable supply chain management, Supplier collaboration, Customer collaboration, Profile deviation	RBV and its extensions to explore the performance benefits related to the alignment of sustainability-related upstream and downstream collaboration. The findings suggest that firms must simultaneously pursue internal sustainability practices as well as sustainable supply chain collaboration to reap long term performance benefits from adopting sustainable practices.
Hollos *et al*., (2012)	Empirical	RBV and Resource Dependence Theory	Survey	sustainability; supplier co-operation; sustainable procurement; triple bottom line; structural equation model	Uses a combined theoretical perspective of RBV and RDT to explore sustainable supplier co-operation through the principles of TBL. RBV was used as supplier sustainability can be viewed as a resource that is valuable. RDT helps to explain why firms my mitigate uncertainties surrounding supplier sustainability as a resource through effectively managing supplier co-operation.
Pagell *et al*., (2010)	Conceptual (based on previous	Stakeholder Theory, RBV, and Transaction Cost	-	environmental issues; procurement/purc	A combination of TCE, RBV and stakeholder theory is used to explain observations made during

	empirical paper by the authors)	Economic (TCE) theory		hasing processes; supplier management; sustainability; social responsibility.	case study research that companies who had managers that were thought leaders in sustainable supply chain management were not using the Kraljic matrix as was originally intended. Using the above-mentioned theories, the authors proposed amendments to purchasing portfolio models to accommodate the needs of sustainable supply chain managers.
Pullman *et al*., (2009)	Empirical	RBV	Mixed methods (Surveys and interviews)	Path analysis; Social responsibility; Supply chain management; Survey methods; Sustainability	Uses RBV to connect sustainability practices directly to performance outcomes e.g. competitive advantage. Findings showed that indirect effects of sustainability practices on performance outcomes show some evidence of supporting the natural RBV.

5.3.3 Institutional Theory

The use of institutional theory has gained popularity in SCM research (Shibin *et al.*, 2018). It posits that firms strive to gain legitimacy in addition to economic success to ensure their survival within their organisational field, that is, the "totality of relevant actors" associated with a particular area of organisational life (DiMaggio & Powell, 1983, p. 148). Legitimacy is gained by conforming to three categories of external pressures: coercive i.e. government regulation or consumer pressure; mimetic i.e. the imitation of more successful competitors; normative i.e. 'professionalisation' occurring from the education of business professionals and development of organisational networks (DiMaggio & Powell, 1983; Meyer & Rowan, 1977). These 'isomorphic' pressures can cause firms to develop homogenous characteristics over time (DiMaggio & Powell, 1983). Institutional theory helps researchers understand why firms aim to implement "best practices with operations and SCM concepts" (Dubey *et al.*, 2017 p.5), hence, it a suitable theoretical perspective for examining why firms may incorporate the TBL concept within SSCM (Li *et al*., 2019).

A summary of the papers from the SLR that have used institutional theory are provided in Table 7. The theory has been used to examine how external pressures impact organisational decision-making in industries with globally complex supply chains, such as fast fashion (Fung *et al*., 2020) and food (Govindan, 2018). It is a versatile theory in that it can explain why companies will engage with TBL in supply chains, whilst also helping to explain the barriers to its progression. For example, both Silvestre (2015) and Wu and Jia (2018) used it to help identify 'institutional voids' (deficiencies in institutional structures), such as weaknesses in government law and enforcement that can present

barriers to TBL progression (Silvestre, 2015; Wu & Jia, 2018). Hence, it is particularly useful for identifying differences in institutional environments, making it useful for researchers investigating supply chains that span multiple geographic locations (Wu and Jia, 2018).

'Decoupling' is another aspect of institutional theory can help to paint a realistic picture of organisational behaviour related to TBL and sustainability. Decoupling occurs when conforming to external pressures to gain legitimacy conflicts with other organisational objectives, such as efficiency and profitability (Meyer & Rowan, 1977). In a sustainability context, this means that organisations may superficially adopt sustainability standards without implementing them in practice (Silvestre, Viana, *et al.*, 2020; Wilhelm *et al.*, 2016). Wilhelm *et al.* (2016) used it to examine how suppliers can engage in 'mock compliance' with the sustainability standards of buying firms. Similarly, Silvestre *et al.* (2020) used decoupling logics to explain how companies may circumvent SSCM standards and engage in SC corruption.

Despite its versatility as a theoretical lens for TBL-focused supply chain research, the theory is not without its limitations. For example, Dubey *et al.* (2017) highlighted its shortcomings in explaining why firms under the same external isomorphic pressures to adopt sustainability, may produce heterogeneous responses. Institutional theory is not so adept at explaining internal circumstances within the firm that may explain heterogenous responses to external pressures. Several papers reviewed overcame the limitations of institutional theory by moderating it with concepts such as 'organisational culture' (Dubey *et al.* 2017) or combining it with theories such as the RBV (Fung *et al.*, 2020; Shibin *et al.*, 2018) or stakeholder theory (Govindan, 2018) that are better equipped for explaining interorganisational dynamics. Govindan (2018) highlights that the combination of institutional and stakeholder theory provides a solid theoretical underpinning for exploring both the external pressures of the organisational field and the internal pressures of the organisation. Some scholars have developed 'neo-institutional theory' to addresses some of the limitations by incorporating an 'institutional logic' perspective to explain the reasons for heterogeneous responses to institutional pressures (Greenwood *et al.*, 2010; Testa *et al.*, 2015). None of the papers included for final review adopted this perspective, so will not be discussed here but it could be a useful extension of the theory to adopt for future TBL research.

Table 7. Summary of papers adopting an institutional theory perspective

Author	Paper Type	Theory	Notes on method and data types	Keywords	Summary of theory usage
Silvestre *et al*. (2020)	Empirical	Institutional Theory	Case study (secondary data)	Sustainable supply chains, Sustainability standards, Supply chain corruption practices, Symbolic adoption, Social isomorphism for corruption, Institutional contexts	Examines the impact of different institutional contexts (weak or robust) on the corruption of supply chain sustainability standards using four case studies. The 'decoupling' aspect of Institutional theory is used to explain how companies may circumvent SSCM standards. The concept of "social isomorphism for corruption" is proposed as means to explain the various institutional pressures within weak institutional contexts that may encourage firms engage with corrupt practices.
Fung *et al*. (2020)	Empirical	Institutional Theory, RBV, and Decision-making Theory	Case study (secondary data)	Sustainable supply chain management, operations management theories, triple bottom line, sustainable planning strategy, case study, fashion company	Based on a combined theoretical perspective, a 'sustainable planning strategy framework' is proposed. Institutional theory is used to explain the external pressures on companies to adopt SSCM, whereas RBV is used to explain internal motivations (gaining competitive advantage). Normative and descriptive aspects of decision-making theory are used to explain how optimal decisions for adopting sustainable practices are reached given the available market data. The framework is tested using publicly available data on apparel brand, Nike.
Wu and Jia (2018)	Empirical	Institutional Theory	Case study (interviews were conducted and this was corroborated with secondary data eg. news articles, company reports)	Case study; Emerging markets; Institutional theory; Localization; Multinational enterprises; Supply chain; Supply chain field; Sustainability	Investigates the "supply chain localisation" as a 'institutional process' carried out by multinational enterprises (MNEs), whose supply chains exist within emerging economies. The research harnesses the "central construct" of institutional theory, the notion of the 'organisational field' to build the notion of the 'supply chain field'. The research presents the idea that MNEs encounter different institutional environments and that these differences can reveal institutional voids (deficiencies in the institutional structures) which much be reconciled if supply chain localisation is to be achieved.
Govidan (2018)	Conceptual	Institutional Theory, Stakeholder Theory, and Dynamic Capabilities Theory	Precursory literature review to guide study	Sustainable consumption and production, Theory development, Food supply chain, Conceptual framework	A combined theoretical perspective is used to identify challenges and barriers for sustainable consumption and production (SCP) in the food industry. A conceptual framework based on stakeholder theory is presented to identify drivers, barriers, and targets. Institutional theory is used to assessing the impact of external pressures on company decision-making related to SCP and complimentary stakeholder theory can assess both internal and external pressures. Dynamic Capabilities Theory is used to explain the rapidly changing nature of industry demands concerning SCP and how companies must adapt strategies and reconfigure resources to realise competitive advantage opportunities.
Shibin *et al*. (2018)	Empirical	Institutional Theory and RBV	Conceptual framework presented and empirically validated via a Delphi Study which was triangulated with secondary data (e.g., Corporate	Frugal innovation, sustainability, sustainable supply chain, TISM, MICMAC analysis, confirmatory factor analysis (CFA), structural equation modelling (SEM)	Addresses the gap between supply chain sustainability and 'frugal innovation' for SMEs in emerging markets. Institutional theory is combined with RBV because institutional theory links the firm with the 'macro environment' and helps to explain and understand institutional barriers and resource constraints. Also cites the 'knowledge-based view' (KBV) as an important extension of RBV which posits that knowledge is an important strategic resource that can be leveraged to achieve. Various aspects of institutional theory, such as mimetic pressures, are used to explain competition within organisational fields. Technology is cited as an

			Social Responsibility reports).		enabler of sustainable practice however, the unavailability of the 'latest technology' as a resource can be a potential barrier.
Dubey *et al* (2017)	Empirical	Institutional Theory	Survey	Benchmarking, Sustainability, Sustainable operations, Performance measurement systems (PMS), Sustainability measurements, Institutional theory, Organizational culture	Uses the limitations of institutional theory to explain why firms may react differently to the same external pressures is moderated by the concept of 'organisational culture'. Both elements are used as a foundation for a theoretical framework to help managers understand the effect of external pressures and the role of organizational structure on Performance Measurement Systems for sustainability benchmarking. The framework is empirically tested via a survey of Indian manufacturing firms.
Wilhelm *et al* (2016)	Empirical	Institutional Theory and Agency Theory	Case study (semi-structured interviews)	Sustainable supply chain management, multi-tier supply chains, Double-agency, Agency theory	Explores the context in which tier-1 suppliers fulfil the focal firm's sustainability requirements. Three different case studies in three different organisational fields are conducted. Both institutional theory and agency theory are used to examine the various dynamics at play. Aspects of the theories including decoupling and information asymmetry are provide useful explanations of certain firm behaviours. For example, the decoupling aspect of institutional theory helps explain mock compliance with sustainability audits.
Silvestre (2015)	Empirical	Institutional theory, Evolutionary theory, and Complexity Theory	Singular case study	Sustainable supply chains, Environmental turbulence, Institutional voids, Extreme ambiguity, Innovation, Supply chain learning loops, Supply chain sustainability trajectories, Emerging economies	Explores the how SSCM is implemented in emerging economies. A case study in the Brazilian oil and gas industry leads is used to develop propositions regarding how supply chains operate in these types of institutional environments. The research draws upon a combined theoretical perspective to generate a theoretical framework for guiding the study. The notion of 'institutional voids' is used to explain the ambiguity faced by managers when trying to make decisions on SSCM. Evolutionary theory is used to explain the how supply chain sustainability trajectories with the authors emphasising that SSCM is a journey and not a destination. Complexity theory is used as supply chains are typically inherently complex. This authors state that this is intensified in turbulent institutional environments, as is often the case in developing countries.

5.4 Theoretical perspectives for a new wave of triple bottom line innovation and deployment

The dominant theoretical perspectives have helped provide in-depth explanations of the current challenges. While there appears to be an increasing acceptance of these theories, but they do not offer a complete explanation and so further exploration may be needed before attempting consolidation. Technology is frequently discussed in the literature and there is a growing body of work on the relationship between Industry 4.0 technologies and the TBL of SSCM (Bai *et al*., 2020; Beltagui *et al*., 2020; Luthra *et al*., 2020). Several scholars have emphasised the need for the inclusion of technology as an essential element of the TBL and the broader sustainability concept (Eslami *et al*., 2019; Saberi *et al*., 2019). However, there is a lack of a consistent theoretical base to help support this type of inquiry (Kouhizadeh *et al*., 2021). The findings of the SLR suggest that there is a

general lack of theory to support the exploration of innovation and technological solutions in TBL-focused SSCM research. The following sections will discuss diffusion of innovations (DoI) theory and Information Processing Theory (IPT). Both have been highlighted as useful theories for SSCM research (Saberi *et al*., 2019; Sarkis *et al*., 2011). They both have potential to be combined with more established theories in the field to provide a strong theoretical foundation for the research seeking to contribute to the new wave of TBL innovation and deployment.

5.4.1 Diffusion of innovation theory

In a theoretic review of green supply chain management (GSCM), Sarkis (2011) provided a brief description of DoI theory and proposed it was as a promising theory for GSCM research. This theory was notably absent from the research reviewed for this SLR. An innovation can be described as an "idea, practice, or object that is perceived as new by an individual or another unit of analysis" (Rogers, 2003, p.12). The TBL can therefore be viewed as a form of innovation (Sarkis *et al*., 2011). Innovations often come in the form of technological development, to the point where the words "innovation" and "technology" are often used synonymously (Rogers, 2003). Diffusion of the innovation can be described as "the process in which the innovation is communicated through certain channels over time among the members of a social system" (Rogers, 2003, p. 5).

Innovations have different characteristics, perceived by individuals or groups that help explain their adoption rate (*Ibid*). For example, if an innovation is perceived to be better than the idea it supersedes then it provides a high level of 'relative advantage' to the would-be user. This advantage may be measured in the financial benefit that it brings the user (or organisation) but social prestige, convenience and satisfaction are also valid metrics. Although some studies have shown that GSCM can positively impact economic performance (Golicic & Smith, 2013) the question of whether it pays to be sustainable from a TBL perspective is still unsettled (Kirchoff *et al*., 2016; Kitsis & Chen, 2019). The perceived relative advantage of TBL adoption is seemingly not fully understood, as if it were, then more organisations would be doing it and the research problem would not exist.

Other attributes are considered as parts of the decision-making process are complexity, compatibility, trialability and observability. Innovations which are high in relative advantage, compatibility, trialability and observability but are low in complexity are likely to see faster adoption rates (Rogers, 2003). The 'compatibility' of the innovation

with existing values and norms of a society can also impact adoption rate. Sustainability involves changing attitudes, values and norms. DoI theory explains that innovations that are disruptive in this manner can typically see slower adoption rates. 'Complexity' of the innovation is another important consideration which can impact adoption rate (Ibid). Several scholars have commented on the extremely complex nature of sustainable development and the myriad of tensions relating to time horizons, overlapping dimensions of the TBL, and the often-conflicting demands of stakeholders (T. Hahn *et al.*, 2014).

The 'trialability', is the degree to which the innovation can be experimented with or implemented incrementally (Rogers, 2003). Trialability is likely to be particularly pertinent to technology adoption for SSCM. For example, it is not always possible to gradually phase in new information systems and there are inherent risks with technological change which may limit a firm's openness to a new technology innovation, particularly if the relative advantage is uncertain. TBL innovations may also be challenging in terms of observability. Investments are often made for longer-term benefits or to stop an unwanted future event from happening, something Rogers refers to as a 'preventative innovation' where the results or benefits are often not clearly visible. By applying this theoretical lens, we see that the relative advantage, compatibility, complexity, trialability and observability with TBL and supporting technologies is not straightforward. Even from the brief discussion above, DoI provides a useful lens for understanding why the TBL concept may not be seeing the rate of adoption that was expected and hoped for.

Another important aspect of DOI theory is its classification of members of a given social system into different 'adopter categories' based on their likelihood to embrace innovation over time. A 'social system' can be defined as "a set of interrelated units that are engaged in joint problem solving to accomplish a common goal" (Rogers, 2003, pg.23). Units refers to the members of the social system and may represent individuals, informal groups, and organisations. DoI posits that a social system will be made up of innovators, early adopters, early majority, late majority and laggards and these are organised based on the time in which it takes for them to adopt the innovation. The categories are typically plotted on a graph using an S shaped curve. This aspect of the theory can be particularly useful for explaining discrepancies in SSCM research. For example, studies have suggested that implementing GSCM can lead to positive economic firm performance (Golicic & Smith, 2013), following which the 'relative advantage' of

sustainability as an innovation is easily observable. However, why is that SSCM and TBL still face such barriers to progression? On one hand it can been explained by the broader scope of SSCM defined through the principles of TBL as it must integrate social sustainability unlike GSCM which typically focuses on waste reduction. However, as was identified by Kirchoff *et al.* (2016), studies which show positive correlation between GSCM and economic performance are typically conducted with exemplar firms. DoI theory would help us to caveat findings by categorising these firms as 'innovators' or 'early adopters', therefore would explain why we may see a faster adoption rates with those types of firms but not necessarily across a whole sector or industry.

In summary, DoI can be a useful lens for TBL-focused SSCM research as it can help to explain sustainability as a form of innovation per se. As Industry 4.0 technologies continues to develop at a rapid rate and the potential for SSCM focused technology solutions increases, this lens will likely be an increasingly important one.

5.4.2 Information processing theory

A lack of information transparency is a barrier to SSCM and causes numerous TBL-related supply chain issues (Guo *et al*., 2020). Saberi *et al*. (2019) proposed the use of information theories such as IPT to support research that investigates information technology sustainability solutions. IPT is concerned with understanding how firms cope with the need to process information when faced with uncertainty in their external environment (Galbraith, 1974). It suggests that "the greater the task uncertainty, the greater the amount of information that must be processed among decision-makers during the task execution in order to achieve a given level of performance" (p.4). When faced with a large volume of information, the company can either reduce the need for information processing or increase the capacity for processing information (*Ibid*). Busse (2017) highlights that a combination of both is also possible. A misfit between the volume of information and the capacity to process the information can compromise organisational performance (*Ibid*).

Genuinely adopting TBL principles in practice means that firms are faced with a greater volume of information that they must process to monitor and maintain adequate social and environmental performance levels (Wiengarten *et al*., 2017). Therefore, they must increase their capacity to process the information. Galbraith (1974) proposed investing in information systems as a potential strategy for addressing this challenge. However, as has been previously highlighted, technology accessibility can be an issue in

some institutional settings (Hannibal & Kauppi, 2019), so this strategy may not always be viable across an entire supply chain.

Only two papers reviewed in the SLR adopted Information Processing Theory (IPT), yet it is believed to be a promising theory for SSCM research (Busse *et al*., 2017; Hannibal & Kauppi, 2019; Saberi *et al*., 2019; Wiengarten *et al*., 2017). IPT was not utilsed in SSCM research until 2017 (Busse *et al*., 2017). The first paper from the SLR to use IPT was by Busse *et al*. (2017, p. 87). The authors aimed to "elevate IPT to the supply chain level". Based on the assumption that poor SSCM performance was caused by 'information deficits', they explored the information processing needs of buying firms in complex supply chain contexts. They proposed that organisations were typically exposed to three categories of SSCM-based uncertainty: 1) task uncertainty e.g. uncertainty about the sustainability credentials of a product; 2) source uncertainty e.g. uncertainty about supplier behaviour; 3) supply chain uncertainty e.g. uncertainty that arises from supply chain structures and complexities. The second paper from the SLR that employed IPT was by Wiengarten *et al*. (2017, p. 1142). They applied IPT to explore the impact of increased uncertainty of the external environment (in terms of the bill of materials, lead time, and product changes), caused by "rapid changes in customer preferences, shortened product life cycles and increased competition" (p.1142), on the TBL performance of organisations.

Neither of the papers that employed IPT in the SLR findings had technology as a focus. Saberi *et al*. (2019) suggested that IPT could play a more prominent role in examining the blockchain and supply chain nexus. However, they suggested that the theory needed further advancement for use in technology-focused SSCM research. IPT emerged long before BCT and so its propositions about technology are based on centralised information systems and centralised hierarchical decision making. Galbraith (1974, p.42) stated that "we cannot foresee the ramifications of information instantaneously available everywhere in the organisation. Information is a source of power, and so the present power structure is threatened [by the introduction of IS]".

Public (permissionless) blockchains allow all information to be available to the whole supply chain and external stakeholders (e.g. customers) (Wang *et al*. 2019). Advances in BCT, with its inherent characteristic of decentralisation, democratises information and potentially shifts the power from the central organisation to other stakeholders in the supply chain (e.g. customers). However, in private (permissioned) blockchains, access to information can still be controlled by a central organisation or by a consortium (*Ibid*).

With the latter, it may well be the case that although BCT may provide complete transparency in principle, the power may remain with the focal firm or consortium of firms, therefore information asymmetry could remain. Granados and Gupta (2013, p. 637) suggested that technology gives firms "unprecedented flexibility to conceal or disclose information to competitors, customers and suppliers" and develop 'transparency strategies'. BCT can enable firms to empower their customers, though may not always feel that it is in their best interests to do so. Further empirical studies employing IPT as a theoretical lens will be needed to assess its potential for BCT for SSCM research.

5.5 Evaluating the systematic literature review outputs

The SLR has confirmed that the TBL view of sustainability has become dominant in SSCM literature over the past decade with over 60% of papers choosing to define, understand or apply sustainability in supply chains on these terms in 2020. However, the majority of TBL-focused SSCM research lacks a clear theoretical underpinning. When present, theory is still typically used in isolation, despite increasing calls for the use of combined theoretical frameworks (Carter & Easton, 2011; Fernando & Lawrence, 2014; Zorzini *et al*., 2015). The topic has been approached from a diverse range of theoretical perspectives. However, stakeholder theory, RBV, and institutional theory, emerged from the study as the dominant theoretical perspectives (and the most likely to be used in combination with each other) suggesting the beginnings of consensus regarding a theoretical base for TBL-focused SSCM research that would help to address the fragmentation of the field (Cousins *et al*., 2006).

However, it is likely that the net may have to be cast wider still before attempting consolidation. The dominant theories have helped to explain the current state of play, but they may not be the best choice for exploring solutions. As highlighted by Pagell and Shevchenko (2014), to advance SSCM and the TBL we need research that is proactive and focused on matters like applying technology to practical settings (as is part of the aim of this thesis). Theories like DoI and IPT could be integrated alongside the more dominant and established theoretical perspectives in the field to help explain and predict organisational behaviour in relation to technology and information management. DoI is particularly well-suited, given it can be used to explain attitudes towards technological solutions as well as sustainability and the TBL as a form of innovations per se (Sarkis *et al*., 2011).

Finally, the findings of the SLR suggest researcher interpretations of even the most well-established theories in the field can differ significantly. Closer analysis of stakeholder usage theory revealed fundamental differences in researcher interpretation regarding how the TBL supply chain research should be understood and approached. On one hand, the instrumental view is ultimately one of 'self-interest', only considering environmental and social sustainability if it aligns with the economic success of the firm, albeit accommodating a longer-term, more indirect perspective where firms are willing to postpone being rewarded for their actions. On the other hand, the normative (ethical) view argues that the firm should prioritise environmental and social sustainability over and above profitability. The latter position argues that the question of "does sustainability pay?" is the wrong question to be asking (Pagell and Shevchenko, 2014). It states that when TBL trade-offs are required, profits should be bottom of the priority list. However, to what extent businesses should adhere to this is unclear. The altruistic or 'moral motives' of managers to engage in SSCM, even when it may not financially benefit their business to do so, has been discussed elsewhere in the literature (Paulraj *et al*., 2017; Presley & Meade, 2018). However, the proponents of the normative stakeholder view have themselves recognised that it carries important political and societal implications (Montabon *et al*., 2016). These will not be discussed here. However, more empirical research exploring this perspective will be essential to understanding if this theoretical position is tenable in practice in the long term.

Interestingly, the descriptive variant of the theory barely featured in the existing TBL focused SSCM literature. The pragmatists would probably be naturally inclined to lean towards the more accommodative descriptive view and avoid such dichotomies of instrumental vs normative. Drawing on the philosophical naturalism of the classic pragmatists like Peirce, we can look to the field of biology to inform our view. This may initially sound far-fetched, however, operations and supply chain management scholars have highlighted the importance of looking to the established theories of other fields to strengthen the theoretical toolkit for SSCM and offer new ways of viewing the problems at hand (Touboulic & Walker, 2015).

The pragmatists were greatly influenced by the Darwinian evolutionary world view (e.g. Peirce's notion that humans are 'social animals'). Incidentally, terms like 'survival' are commonly used in the business lexicon, particularly in conjunction with institutional theory. Like the Darwinian view, there are constant discussions about adapting to the pressures of the external environment (DiMaggio & Powell, 1983; Meyer & Rowan,

1977). Although drawn to a Darwinian world view, Dewey struggled with the self-interested nature of the 'survival of the fittest' concept (BBC, 2005). However, more recent developments in the field of evolutionary biology have given us sufficient evidence to believe natural selection is not just a simple case of survival of the fittest (Trivers, 1971).

Evolutionary biologist and sociobiologist, Robert Trivers, first introduced the concept of 'reciprocal altruism' in 1971. He posited that this was just the beginning of trying to outline the "complexities of the human altruistic system" (Trivers, 1971, p. 54). His work posited natural selection can work against those who do not reciprocate altruistic acts (what he describes as cheaters). Trivers proposed that all humans can be seen as "possessing altruistic and cheating tendencies, the expression of which is sensitive to developmental variables that were selected to set the tendencies at a balance appropriate to the local social and ecological environment". Abstract this to the organisational level and we can hypothesise that organisations will behave in a similar manner continually navigating situations whereby they may need to decide whether they choose to be altruistic or self-interested. Incidentally, Peirce had an inclination that human behaviour was not just a matter of straightforward self-interest as discussed in his 1887 paper 'Guess the Riddle' which has been described as his "greatest and most original contribution to speculative philosophy" (Houser & Kloesel, 1992, p. 245).

A brief search of related terms on Scopus suggests that researchers are only just beginning to explore reciprocal altruism in business and supply chain contexts. There is a limited amount of supply chain literature that posits that organisational decision-making is not purely driven by selfish motivations and that reciprocal altruism and goodwill can play a key role (Ma *et al*., 2021; Qin *et al*., 2020). However, it has mainly featured in Operations Research (OR) journals as opposed to OM journals and has not been used in relation to SSCM or the TBL. The OR research has indicated that supply chains will be made up of players that vary in terms of their tendencies to be selfish or altruistic and that the degree to which they may be likely to reciprocate acts may differ (Ma *et al*., 2021).

It is not the intention to delve into these types of discussions too deeply here, but to highlight that the present dichotomy of instrumental vs normative stakeholder theory prevalent in the literature may not be the most useful way of viewing SSCM decision making. The descriptive variant of stakeholder theory may be a more appropriate as it accommodates the perspective that organisations are made up of individuals that have both altruistic and selfish (cheating) tendencies (Trivers, 1971). Therefore, viewing

approaches to stakeholders as more of a spectrum, rather than a dichotomy, may be more appropriate for examining the altruistic complexities of an organisation and the broader organisational field in which it is embedded.

6. Summary

This introductory chapter has introduced the research problem connected to the limited rate of substantive TBL adoption in the context of the luxury fashion sector. A lack of supply chain transparency is at the core of the issue. Historically, technology has helped improve this, however, it is presently limited in its capacity to fully solve the problem. A new wave of technological innovation shows promise, but it is still early days and far more empirical research is needed. This chapter has provided an overview of the pragmatist philosophy and the action research strategy adopted for the research.

The literature suggested that the business case was a key underlying concept for organisational decision making and that some businesses were struggling to develop one in practice. Both the background literature and SLR highlight the importance of institutional context. The regulatory and consumer pressures, or formal and informal coercive pressures (DiMaggio & Powell, 1983), are not as significant in luxury fashion (and fashion more generally), as is the case in other industries such as food that are considered to have achieved a better standard of SSCM overall. This difference is likely to make it more difficult to develop a business case for substantive TBL adoption as the incentives are not as strong. Based on the review of the literature, the first paper presented in the following chapter is an examination of SSCM business case development challenges in the luxury fashion sector. Based on the findings of the SLR it employs a combined theoretical perspective of stakeholder theory and institutional theory. The justification for this is detailed in the first paper. The RBV, although the second most popular lens, was not employed as the first paper aims to establish a broad picture of SSCM business case development and does not focus on the exact configurations of resources as is typically the case with the RBV view of SSCM. Although the SLR suggested that theories supporting technology adoption and information processing (DoI and IPT) could be integrated as part of a combined theoretical approach, this was not done so ahead of the first paper. This is because technology was a topic of discussion rather than a key focus of the paper and at that stage further research into IPT and DoI is needed to better understand how they may compliment and strengthen the more established

theories in the field. The development of the theoretical framework becomes apparent in the second and third paper.

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Chapter 2 – Exploring the business case for sustainable supply chain management: lessons from the luxury fashion sector (paper 1)

Abstract
The 'business case' (BC) is a central concept within the sustainability discourse that is used to support and justify related managerial decision-making. This research explores the challenges managers face when developing a business case for sustainable supply chain management (SSCM). Guided by stakeholder and institutional theories, the research adopts a qualitative design, using semi-structured interviews with 21 participants representing a range of organisations operating within or interacting with the luxury fashion sector, including brand owners and managers, NGOs, suppliers, and a member of parliament sitting on the UK government Environmental Audit Committee. The research provides in-depth insights into key SSCM business case development challenges that deepens our understanding of the adoption barriers from a triple bottom line (TBL) perspective. Institutional complexity, poor regulatory environment, misaligned stakeholder priorities, slow technology adoption and uncertain market demand caused by what is termed in this research as 'fauxercive pressure' (coercive pressure based on disingenuous demand) were found to be impeding strong SSCM BCs. The findings suggest that developing value-driven BCs for SSCM are particularly challenging, and that presently there are ambivalent attitudes towards technology solutions that might help this agenda.

Keywords: sustainable supply chain management; triple bottom line; business case; institutional theory; stakeholder theory; fashion industry.

1.Introduction

Sustainable supply chain management (SSCM) and the Triple Bottom Line (TBL) framework (Elkington, 1999) have become increasingly important for researchers and practitioners (Seuring and Müller, 2008; Roy, Schoenherr and Charan, 2018). However, despite their prominence, both SSCM and the TBL are failing to progress as a quickly as expected (Kirchoff *et al.*, 2016; Elkington, 2018). The originator of the TBL, John Elkington, proposed a 'management concept recall' and suggested many firms were struggling to see beyond their economic bottom line (Elkington, 2018).

The business case (BC) concept has been central to understanding the managerial decision-making behind sustainability adoption. It posits that companies and industries

need a clear rationale to support and justify the adoption of sustainability initiatives (Carroll and Shabana, 2010; Kirchoff, Omar and Fugate, 2016; Presley and Meade, 2018). There have been varied views regarding what constitutes a BC. Generally, there has been a move away from the traditional narrow view of the business case for sustainability (concerned solely with profitability) to a broader view (Carrol and Shabana, 2010). The broader view justifies sustainability investments through the creation of business value that may not be as easily measured in traditional financial terms (e.g. employee retention, customer loyalty) (Carroll and Shabana, 2010; Hahn *et al.*, 2014; Presley and Meade, 2018). Some have criticised the dominance of profitability in SSCM decision making and have suggested the environment and society should be prioritised over profit (Montabon *et al.*, 2016). However, other authors have suggested this view is unrealistic and unsympathetic to the managerial realities (Nunes, 2020).

Despite the evidence suggesting a positive relationship between good SSCM firm performance and strong economic performance (Pagell and Wu, 2009; Golicic and Smith, 2013; Cousins *et al.*, 2019), some firms are struggling to formulate a clear business case for SSCM (Kirchoff, Omar and Fugate, 2016). This disparity in has largely been attributed to conflating greenness with sustainability. Most studies finding positive relationship have mainly focused on environmental dimension of the TBL only. However, SSCM decision-making must consider all three TBL dimensions (Wu and Pagell, 2011). Whether SSCM improves financial performance or not remains unsettled (Kitsis and Chen, 2019), particularly for non-exemplar firms (Kirchoff, Omar and Fugate, 2016).

This research paper explores the formulation of a business case for SSCM. Although there has been a stream of literature looking strategic CSR in supply chains and the business case for CSR (see Carrol and Shabanna, 2010), sesearch focusing on sustainability BCs from a supply chain (SC) perspective is still relatively rare (Presley and Meade, 2018). Using a combined theoretical view, comprising of institutional theory and stakeholder theory, an initial conceptual framework is developed to guide the qualitative research design. The research attends to various SSCM-wide tensions (e.g. conflicting TBL dimensions, time horizons, and stakeholder pressures) (Hahn *et al.*, 2014; Carter, Kaufmann and Ketchen, 2020) that influence, and largely impede, SSCM business case development.

From an empirical perspective, the research responds to calls for more industry-specific contributions to investigate practitioner understanding of SSCM (Rajeev *et al.*, 2017; He *et al.*, 2019) and address the "research-practice-gap" (Rynes, *et al.*, 2001).

Rajeev *et al*. (2017) stated that if SSCM solutions are to be achieved, then researchers should focus their efforts on conducting empirical studies in the most polluting industries. Furthermore, He *et al*. (2019) highlighted the lack of empirical research investigating practitioner views of SSCM and TBL implementation and found that not all managers were convinced of the feasibility of implementing TBL in supply chains. The luxury fashion sector has been selected for this research, as a relatively challenging context for reflecting upon the realities of SSCM business case development in practice. The fashion industry is recognised as a highly polluting industry (Yang, Han and Lee, 2017) with a poor social sustainability record (Huq, Chowdhury and Klassen, 2016). However, the SSCM performance of the luxury fashion sector has not been subjected to the same scrutiny as the fast fashion sector, despite being responsible for some serious SSCM issues, such as the burning of large quantities of excess stock (Guo, Sun and Lam, 2020), use of toxic chemicals in the supply chain, misleading consumers as to the provenance of items, and poor labour conditions (Karaosman *et al.*, 2020).

The remainder of the paper is organised as follows: Section 2 presents the theoretical background and discusses the current literature on the business case for sustainability. Section 3 provides an overview of the research methodology and the empirical setting. The findings are presented in Section 4. Section 5 provides a discussion of the findings and details the implications for theory and practice. Conclusions are drawn in section 6 with some suggestions for future research.

2. Research Background

The goal of for-profit organisations is to create economic value. The central tenet of the business case framing is that social and environmental TBL dimensions are considered only when they improve economic performance (Carroll and Shabana, 2010; Hahn *et al.*, 2014). Successful business case development is necessary to transition from the theoretical aspirations of corporate sustainability into real-world SSCM practice on a scale required to effect meaningful change.

The altruism or ‘moral motives’ of owners and managers to do the ‘right thing’ has been identified as a driver for SSCM, even when it does not benefit the business financially (Paulraj, Chen and Blome, 2017; Presley and Meade, 2018). This has been evidenced to an extent by the emergence of B Corps (benefit corporations) that strive to successfully balance TBL dimensions (Kim *et al.*, 2016). However, B Corps are still in a small minority (Elkington, 2018). The extent to which they would forgo profit to achieve

social and environmental objectives is unknown. It is unclear how 'moral motives' fit within the business case view of sustainability, and for this reason it is not a focus of this research.

There is a limited amount of research exploring what the business case means for the SC. Existing research advocating positive links between SSCM and firm financial performance typically focuses on the environmental aspect of the TBL (Golicic and Smith, 2013; Cousins *et al.,* 2019). These papers often focus on a narrow environmental waste and related cost reduction business case (Savitz and Weber, 2013). Furthermore, prior studies have mainly been conducted with exemplar firms, hence findings may not be representative of more typical firms (Pagell and Wu, 2009; Kirchoff, Omar and Fugate, 2016). Finally, industrial context is often unclear, making cross-industry comparisons difficult.

The question of "whether it pays to be sustainable?" is a far more complex matter. Firstly, the social dimension of the TBL, for example, stakeholder value and employee satisfaction, can be difficult to measure, helping to explain why some forms face difficulties when attempting to formulate a business case for SSCM (Carroll and Shabana, 2010; Kirchoff, Omar and Fugate, 2016). Secondly, SCs are complex with networks of stakeholders (the organisational field) Carrol and Shabana, 2010). Thirdly, institutional complexity concerns the contextual factors of the organisational field that determine the dynamics of a SC, encompassing potential tensions within the SC as well as supporting and enabling factors that may bring resolution to the tensions or assist in achieving integration and SC wide implementation (Bressanelli, Perona and Saccani, 2019; Carter, Kaufmann and Ketchen, 2020).

2.1 The theoretical underpinning of the research

Explaining the business case for SSCM requires a clear theoretical grounding, something that some scholars have acknowledged but noted is generally lacking in SSCM research (Rajeev *et al.,* 2017). Institutional theory is a commonly adopted theoretical lens in SCM and SSCM research (Shibin *et al.,* 2018). The theory suggests that firms strive to gain legitimacy in addition to economic success (DiMaggio and Powell, 1983). To gain legitimacy and increase their chances of survival, firms may adapt their organisational practices in response to various coercive, mimetic, and normative external pressures (Meyer and Rowan, 1977; DiMaggio and Powell, 1983). Conforming to such pressures causes them to develop homogenous characteristics over time (DiMaggio and Powell,

1983). It is a suitable lens for this research given the business case framing, the broader view of which is deeply connected to gaining corporate legitimacy.

Institutional theory has been used to examine external pressures that impact the organisational decision-making connected to SSCM in globally complex SCs, such as food (Glover *et al.*, 2014; Govindan, 2018) and fast fashion (Fung *et al*., 2020). Glover (2014) employed institutional theory to offer explanations as to why certain SSCM practices may be adopted without a direct financial return in supermarket SCs. The theory helps to identify differences in institutional environments making it suitable for researching SCs that span multiple geographic locations (Wu and Jia, 2018). It can help reveal deficiencies in institutional structures, known as 'institutional voids', such as weaknesses in government law and enforcement that can present challenges to SSCM implementation (Silvestre, 2015; Wu and Jia, 2018).

Another important aspect of institutional theory is the notion of 'decoupling' which occurs when conforming to external pressures to gain legitimacy conflicts with other organisational objectives, such as efficiency and profitability (Meyer and Rowan, 1977). It helps to explain 'greenwashing' where the sustainability image projected by firms to gain legitimacy is decoupled from the realities of their SSCM practice (Sarkis, Zhu and Lai, 2011; Mani, Gunasekaran and Delgado, 2018; Nath, Eweje and Sajjad, 2020) and can mislead customers about their sustainability credentials (Blome, *et al*., 2017). Silvestre *et al.* (2020) used decoupling logics to explain how companies may circumvent SSCM standards and engage in SC corruption. Similarly, Nath *et al.* (2020) and Wilhelm *et al.* (2016) used it to examine supplier mock compliance with the sustainability standards of buying firms.

Although institutional theory has provided a powerful explanatory lens in SSCM research, it has limitations. Both Sarkis (2011) and Dubey *et al*. (2017) have noted its inability to explain why firms operating in the same organisational field, exposed to the same external pressures, may exhibit heterogeneous responses with SSCM adoption. Neo-institutional theory addresses some of the shortcomings of traditional institutional theory by incorporating an 'institutional logics' perspective to explain the reasons for heterogeneous responses to institutional pressures (Greenwood *et al.*, 2010; Testa, Boiral and Iraldo, 2015). Conflicting institutional logics within an organisational field creates 'institutional complexity'. This complexity can lead to tensions and misalignment of SC partners that cause different organisational responses (*Ibid*). The idea that institutional environments can be pluralistic is not new. Meyers and Rowan (1977, p.356) highlighted

the potential for plurality and proposed that "societies promulgate sharply conflicting myths" (institutional rules) that create inconsistencies in the institutional environment. D'Aunno *et al.* (1991) suggested these inconsistencies may be heightened in certain sectors or organisational fields. In some organisational fields "there may be clearly defined hierarchies of institutional pressures based on the salience of particular beliefs" in which organisational responses are homogenous and easily understood. Whereas other sectors and organisational fields may can be described as 'fragmented institutional environments' with misaligned stakeholder values and demands that create a "free markets for beliefs, with several belief systems competing for attention and acceptance" (p.657). The latter creates more complex and heterogenous organisational responses. This is especially the case for sectors where there is no central authority e.g., government regulation to control the various beliefs (*Ibid*). Although discussions surrounding institutional complexity are well-established, it is often overlooked in the SSCM literature because of the dominant institutionally isomorphic view of sustainability adoption (Testa, Boiral and Iraldo, 2015). Testa *et al*. (2015) suggested qualitative interviews among managers and representatives of the main stakeholder groups would provide a deeper understanding of institutional complexity and better understand how conflicting stakeholder demands are managed in practice by organisations.

Some scholars have overcome the limitations of institutional theory by combining it with other theories, better suited to explaining interorganisational dynamics, such as the resource-based view (Shibin *et al.*, 2018; Fung, Choi and Liu, 2020) or stakeholder theory (Govindan, 2018). Stakeholder theory has been a popular theoretical lens for SSCM research (Touboulic and Walker, 2015). It is complementary to institutional theory, as stakeholders are closely aligned with institutions and both theories are concerned with organisational efforts to gain legitimacy (Sarkis, 2011). Govindan (2018) highlights that the combination of the two theories provides a solid theoretical underpinning for exploring both the external pressures of the organisational field, and the internal pressures of the organisation.

Stakeholder theory suggests that firms produce 'externalities' that impact stakeholders. Stakeholders are "any group or individual who can affect or is affected by the achievement of an organization's objectives" (Freeman, 1984). Stakeholders may be internal (e.g., employees) or external (e.g., NGOs) and apply pressure on firms to reduce negative impacts and increase positive ones (Sarkis, 2011), therefore stakeholder theory

aligns well with the sustainability agenda, where the goal is to reduce harm to people and planet.

Stakeholder theory is as an integrative theory (Modgill *et al*., 2020). Similar to institutional theory, it has been used to explain company decision making, therefore is a suitable lens for exploring and explaining the business case concept. For example, Modgil *et al*. (2020) used it to explain how value chains integrate societal demands. Instrumental stakeholder theory is a particular aspect of stakeholder theory that aligns well with the business case framing of SSCM, as it posits that it is in the best interests of the firm to respond to the needs of stakeholders, as they can either positively or negatively influence their economic performance (Paulraj, Chen and Blome, 2017). For example, Mani *et al*. (2018) found that self-interested firms can use socially responsible SC practices to forge good relationships with stakeholders to gain the legitimacy required to survive within the industry.

Montabon *et al.* (2016) argued that employing instrumental stakeholder theory can only explain how to reduce the harm caused by unsustainable SCs and cannot lead to the development of truly sustainable SCs. They stated that to achieve supply chain sustainability, the needs of stakeholders, including the environment and society, would need to be prioritised above customer demands and profit goals. However, achieving this would require a fundamental shift in logic (*Ibid*). Fracarolli *et al*. (2020) noted that that making such a shift is unrealistic and may explain the limited progression of SSCM in practice thus far.

Another area where stakeholder theory overlaps with institutional theory is its underlying assumption of 'information asymmetry', which similar to institutional decoupling, has been used to explain opportunistic behaviour such as greenwashing (Sarkis *et al.*, 2011). Information asymmetry occurs because information about sustainability performance is predominantly controlled by managers (firm insiders), who may distort and selectively release it to stakeholders, such as customers. This creates a power imbalance and makes it difficult to determine the extent to which the products and related process are 'green' *(Ibid)*.

A review of the existing literature has led to the adoption of a combined theoretical perspective of institutional theory and stakeholder theory for this research, given its aim is to explore how external institutional pressures and stakeholder pressure impacts SSCM business case development and related decision-making.

2.2 The business case for sustainable supply chain management

Examining the business case for sustainability from a SC perspective requires revealing the motivations not only for the organisation itself, but for the network of SC stakeholders (Schaltegger and Hörisch, 2017; Presley and Meade, 2018). There is a lack of clear understanding of what drives (or otherwise impedes) successful business case development for sustainability at the SC level (Presley and Meade, 2018). The literature points to two distinct motivations which explain sustainability adoption. These have been described as 'profit-seeking' and 'legitimacy-seeking' (Schaltegger and Hörisch, 2017). Although some scholars have found the legitimacy-seeking rationale to be the dominant logic, it is not clear to what extent it is driven by and intertwined with longer-term profitability ambitions (Schaltegger & Hörisch, 2017). Several scholars have suggested there is a business case for using sustainability to boost corporate legitimacy and reputation to make the firm more attractive to various stakeholder groups such as suppliers, customers, prospective employees and shareholders (Carter and Rogers, 2008; Carroll and Shabana, 2010; Roehrich, Grosvold and Hoejmose, 2014). This has been described as 'synergistic value creation' where firms 'focus on value creation by leveraging gains in reputation and legitimacy made through aligning stakeholder interests' (Kurucz *et al*. 2008, p. 90). This can help to create a competitive advantage and may help yield benefits that are not easily measured in simple financial terms e.g., employee satisfaction (Pivato, Misani and Tencati, 2008; Morioka *et al.*, 2017; Jia *et al.*, 2018). Similarly, Yang *et al.* (2017) devised a 'sustainable value co-creation model' for the luxury fashion industry which sought to create sustainable value for multiple stakeholders from a SC perspective.

The two rationales help to understand the business case for SSCM at a more abstract level of analysis and explain the logic behind organisational motivations to engage with SSCM. Categorising in terms of profit-seeking and legitimacy-seeking provides a useful distinction. However, in a departure from the existing literature, which views them in a dichotomic manner, we propose they should not be viewed as mutually exclusive dimensions. Viewing them as interrelated dimensions is supported by existing research that suggests that 'different modes' of value creation in a business case are not mutually exclusive (Kurucz, Colbert and Wheeler, 2008).

The literature has also focused on the specific reasons that firms engage with sustainability (cf. Bowen, 2006; Kitsis and Chen, 2019; Schaltegger *et al.*, 2012). For this research, we use the term 'SSCM business case drivers' to describe these. The literature

reveals a series of **business case** drivers that may independently, or collectively, drive SSCM business case development. We arrange these into eight main categories of SSCM business case drivers. Figure 1 presents these drivers in relation to the two underlying business case rationales, which correspond to three key categories of strategic drivers that create economic business value.

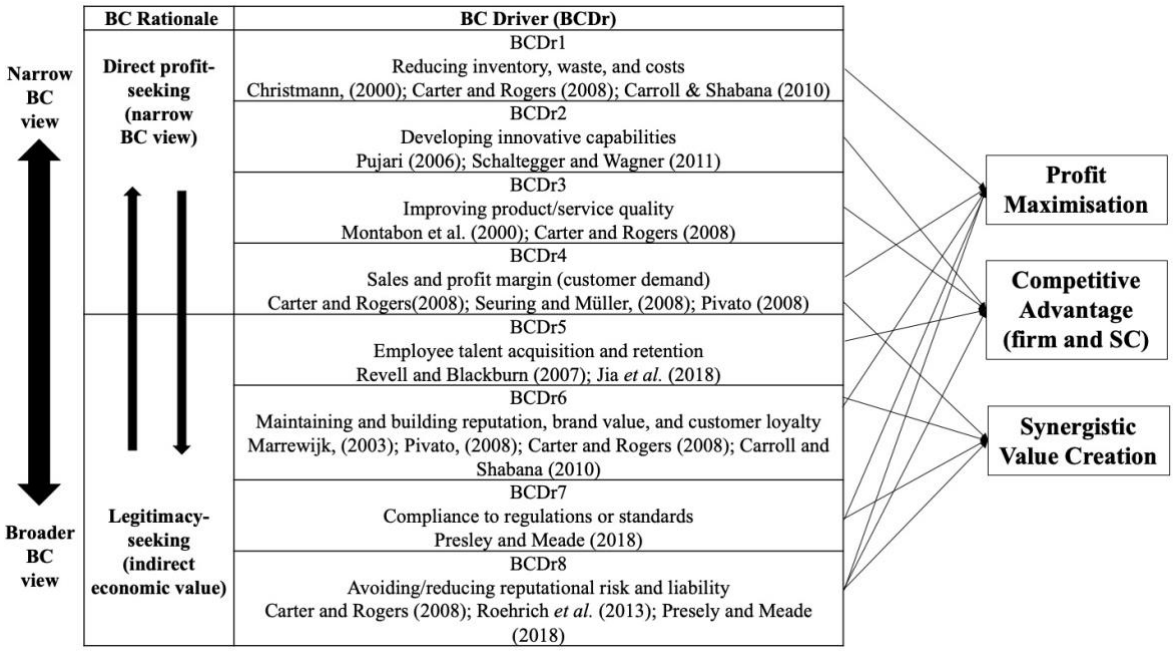

Figure 1. The relationship between SSCM business case rationale, business case drivers, and strategic drivers

2.3 The impact of contextual factors on sustainability supply chain management business case development

Successful SSCM implementation requires a degree of alignment of the objectives of multiple SC stakeholders (Montabon, Pagell and Wu, 2016). Although challenging, achieving SSCM means the SC collectively adhering to institutional pressures from the market, society at large, and legislative regulations (DiMaggio and Powell, 1983; Kouhizadeh *et al.* 2020), which are the key contextual factors within the organisational field (Walker, Di Sisto and McBain, 2008). The contextual factors can be divided into 'tensions' (Hahn, *et al.* 2014) and 'enablers' (Bressanelli, Perona and Saccani, 2019). Tensions arise at various levels of the SC (Hahn *et al.*, 2014; Carter, Kaufmann and Ketchen, 2020). They include the often conflicting goals of the sustainability agenda such as the TBL dimensions; conflicting time horizons such as sustainability investments which may only see returns in the long-term which conflicts with short-term financial

reporting (Carter and Rogers, 2008; Kirchoff, Omar and Fugate, 2016; Presley and Meade, 2018); multiple sources of potentially conflicting internal and external stakeholder pressure throughout the hierarchical nesting of the SC (Hahn *et al.*, 2014; Carter, Kaufmann and Ketchen, 2020).

Scholars researching the circular economy have suggested that the transition to circularity requires the consideration of 'enablers' and 'favourable conditions'. These include SC collaboration, digital technologies, and government regulation (Bressanelli, Perona and Saccani, 2019). As highlighted by Porter (2008), government is neither inherently good nor bad for firm profitability, however, it influences competition and barriers to entry. Institutional robustness (government regulations and appropriate enforcement) can enact important coercive pressure which can encourage firms to adopt SSCM initiatives (Jayaram and Avittathur, 2015; Silvestre, Viana and Sousa Monteiro, 2020). Legislative compliance enhances corporate legitimacy and enables firms to continue operating within an organisational field, thus, increasing their chance of survival (Meyer and Rowan, 1977). Institutional weakness, on the other hand, can allow poor sustainably performance or opportunistic behaviour to go unpunished (Silvestre, Viana and Sousa Monteiro, 2020).

In addressing SC alignment, the literature has emphasised the role of strong SC-wide infrastructure to enable SC transparency and SC collaboration, which have been largely sought through information technology solutions (New, 2010; Lyons *et al.*, 2012). However, their efficacy for addressing information asymmetry has been limited due to their centralised nature (Saberi *et al.*, 2019). Emerging digital technologies, such as Blockchain Technology (BCT), is promising for enabling levels of SC transparency and assurance that were not previously possible (Frederico *et al.*, 2019; Hawlitschek *et al.*, 2018). Therefore, it may provide the missing link required for widespread SSCM implementation and improvement (Bai *et al.*, 2020; Kouhizadeh *et al.*, 2020) and help with SSCM-orientated business model innovation based on assurance and value creation (Nowiński and Kozma, 2017) upon which clearer BCs for SSCM can be built.

The above reflections are summarised in a conceptual model to represent the interrelated dimensions (Figure 2).

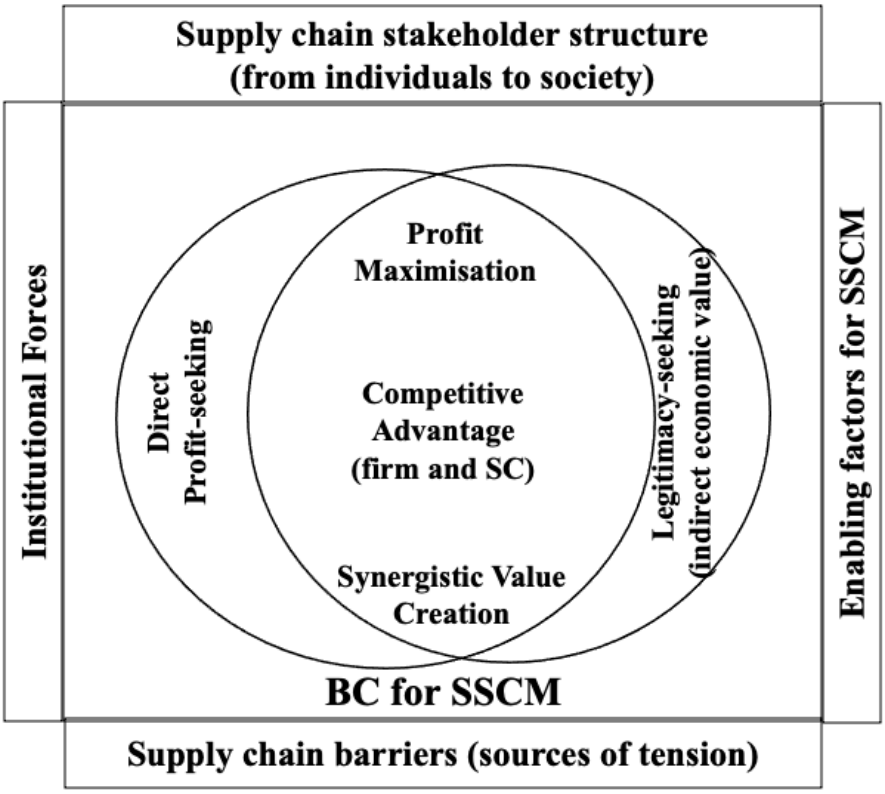

Figure 2. A conceptual model for visualising interrelating business case rationales for SSCM in the context of the organisational field

3. Methodology

3.1 Research approach and data collection

Building on the prior literature, we have taken the interplay between SC actors and their stakeholders to be the unit of analysis for this research (cf. Schaltegger and Hörisch, 2017). In-depth, face-to-face, semi-structured interviews were conducted with 21 stakeholders from 20 different organisations operating within or interacting with the luxury fashion SC. Table I details the profiles of the interview participants; the descriptors in Table 1, column 1, are used to ensure anonymity. According to Eisenhardt and Graebner (2007), selecting knowledgeable interview participants who view the focal phenomena from different institutional perspectives is key to mitigating against potential bias. As this research views the SC in the context of the organisational field in which it operates, interviews were also conducted with a broad range of institutional actors. These included senior managers of luxury brands, industry trade bodies, NGOs, SC technology providers, a third-party auditor, a public relations agency and also a senior member of parliament involved with the 2019 UK parliamentary 'Fixing Fashion' report (House of Commons: Environmental Audit Committee, 2019). In the large luxury brands single interviews were conducted because the personnel interviewed oversaw all of the supply

chain sustainability initiatives, therefore the majority of the knowledge was with them and interviewing more employees would not have led to further theoretical insights. Furthermore, as this study is about linking SSCM with business case related decision making it was critical that the participants had a holistic view of multiple functions of the business. Two interviews were conducted with a Large Technology Provider due to the size of the company and the very different job roles and expertise of the two participants.

Table 1. Profile of interview participants

Institutional Actor	Description	Interviewee Position
Industry Body 1	A UK trade body that serves a large number of international fashion brands.	Chief consultant
Industry Body 2	A UK trade body that serves a large number of international fashion brands and textile manufacturing firms.	International Business Director
Large Luxury Brand 1	Large British luxury fashion brand and retailer with a strong international presence.	Vice President Information Technology Supply Chain
Large Luxury Brand 2	Large British luxury fashion brand and retailer with a strong international presence.	Corporate Social Responsibility Coordinator
Large Technology Provider	Provider of SC technologies to large luxury fashion brands and retailers.	Executive Partner (EP)
	Same as above.	Retail Leader (RL)
Luxury Garment Manufacturer	London-based manufacturer of luxury fashion clothing for both large and small brands.	Director/Senior Manager
Luxury Retail Expert	Highly experienced fashion buyer who has worked in an internationally renowned luxury department store.	Buyer
MP	A senior UK politician and member of the Environmental Audit Committee responsible for the inquiry into the Fashion Industry which produced the 2019 'Fixing Fashion' report.	Member of Parliament
NGO1	A not-for-profit organisation promoting sustainability in the fashion industry.	Founder and Global Creative Director
Public Relations Agency	London-based strategic brand management, public relations and communications agency for international luxury fashion brands.	Owner/Senior Manager
Small Luxury Brand 1	International luxury brand.	Owner/Designer
Small Luxury Brand 2	International luxury brand.	Owner/Designer
Small Luxury Brand 3	International luxury brand.	Owner/Designer
Small Luxury Brand 4	International luxury brand.	Owner/Designer
Small Luxury Brand 5	International luxury brand.	Owner
Small Technology Provider	A technology start-up, specialising in emerging technologies for the luxury fashion SC.	Co-Founder
Supplier 1	UK-based cotton mill supplying luxury fashion brands and retailers.	General Manager
Supplier 2	UK-based woollen mill supplying luxury fashion brands.	Marketing Manager
Supplier 3	UK-based silk supplier supplying luxury fashion brands and couture ateliers.	Sales Manager
Third-Party Auditor	Auditor of Industry Body	Owner

The length of interviews ranged from 40 to 90 minutes. Most interviews were conducted in person. However, some took place via video-conferencing software because of the restrictions imposed due to the outbreak of the Covid-19 pandemic in spring 2020. The face-to-face approach was selected because it provides an opportunity for the researcher to build rapport and encourage open discussion. All interviews were recorded (audio only) with the consent of the participant, apart from one participant who requested that the interview not be recorded. The interview protocol (see Appendix 1) included a series of questions that guided the interviews. The semi-structured interview approach provided a necessary degree of flexibility for the exploratory nature of the study, allowing questions to be modified depending on the participant and their responses (Saunders *et al.*, 2019).

3.2 Data analysis

The interview recordings were transcribed verbatim and uploaded to the NVivo 12 software for coding and thematic analysis. The theoretical framework leading this inquiry integrates a series of a-priori codes taken from the SSCM business case drivers (Figure. 1). This was used as a "deductive analytic strategy" (Collins and Stockton, 2018, p. 7). This was not deductively tested (Merriam and Tisdell, 2015) but used to give focus to the research and enhance the efficacy of the inductive element of the research (Collins and Stockton, 2018).

The a-priori codes are presented in Table II and provided a foundation for the insights which emerged and evolved during the semi-structured interviews and throughout the thematic analysis (Saunders *et al.*, 2019). Based on the pre-existing ideas in the literature and the insights that have emerged from this research, we propose a new wider perspective on SSCM business case development, highlighting the impact that contextual factors have on the process, and consequently identifying some key challenges.

3.3 Empirical background: The luxury fashion sector

The literature identifies certain critical success factors (CSFs) in luxury fashion SCs: a high level of quality (both in the product and throughout the SC), a heritage of craftsmanship, emotional appeal, the creation of a lifestyle with which customers can engage, a global reputation for excellence, recognisable style and design, country of origin, uniqueness, and product innovation (Caniato *et. al.* (2009). The luxury fashion sector and broader fashion industry is important to the UK economy and society, supporting over 800,000 jobs (ONS, 2019). Its significance means it is well supported by

industry bodies which proactively address sustainability. Therefore, the limited amount of progress with the SSCM agenda is not caused by a lack of understanding.

One of the identified causes of poor SSCM performance in the luxury fashion sector relates to structural and market-related shifts. Since the 1990s, luxury brands have extended their product offering to follow a mass-market strategy, also known as the 'democratisation of luxury' (Karaosman *et al.*, 2020). This has given rise to an 'accessible luxury' phenomenon, creating confusion as to what now constitutes a luxury brand or product (Brun and Castelli, 2013). Luxury brands that pursue mass-market strategies and offer cheaper products face the same pressures on profit margins as the mid-market brands. Therefore, there is a temptation for luxury fashion brands to reduce quality and sustainability standards to hit profit targets (Karaosman *et al.*, 2020).

Luxury fashion consumers are reportedly starting to demand more in the way of SSCM and transparency (Mintel, 2019). Authors first highlighted the opportunity for luxury fashion brands to differentiate themselves through improved sustainability performance over a decade ago (Bendell and Kleanthous, 2007). Although some progress has been made, luxury brands are still not widely adopting sustainable value creation business models and supply chain transparency (Yang, Han and Lee, 2017).

4. Findings

The interview data shows luxury fashion to be a very institutionally complex sector. It suggests that firms face significant difficulties when trying to develop a clear business case for SSCM adoption and improvement. The challenges are caused by extensive misalignment at different SC levels due to multiple sources of tension caused by various contextual factors. Section 4.1 provides a summary of SSCM business case drivers found within the sector, their relationship to each other, the broader business case rationale, and how they translate to broader strategic drivers. These confirm the presence of the business case drivers found within the existing literature. However, section 4.2 presents a series of SSCM business case development challenges that emerged inductively from the interview data. The insights highlight several contextual factors which may be presently hindering SSCM business case development.

4.1 Sustainable supply chain management business case drivers and dominant logics

The data analysis process highlighted the notable SSCM business case drivers for the sector. All eight SSCM business case drivers outlined in Figure 1 were identified within the interview data. The findings expand the understanding of business case drivers by

highlighting their interconnectedness, which has not received much attention in the literature. Various clusters and configurations of business case drivers became apparent during the data analysis. The findings also support the conceptual framework presented by Fig. 2 that proposed a shift away from the strict dichotomic view of sustainability rationales. Viewing direct-profit-seeking and legitimacy-seeking logics as overlapping dimensions helps to better understand the broader business case view for the SC. A summary is presented in Table 2.

Table 2 – Relationships between SSCM business case drivers, business case rationale, and strategic drivers

BC Driver (BCDr)	Example sources in literature	Evidence from the data (interviewees that cited this driver)	Notable relationships with other business case Drivers	Dominant business case rationale	Translation to business case core strategic drivers
BCDr1 Reducing inventory, waste, and costs	Christmann, (2000); Carter and Rogers (2008); Carroll & Shabana (2010)	• Large Luxury Brand 1 • Small Luxury Brand 2 • Small Luxury Brand 3 • Small Luxury Brand 4 • Luxury Garment Manufacturer • Supplier 1 • Supplier 3	Some participants also noted reducing waste 'being green' helped improve reputation (BCDR6).	Direct profit-seeking was the dominant logic however, the legitimacy-seeking rationale comes into play because of links with BCDr6.	Profit Maximation (short and long term)
BCDr2 Developing innovative capabilities	Schaltegger and Wagner (2011)	• Large Luxury Brand 1 • Supplier 1	Innovative capabilities were presently only developed in order to achieve BCDr1	Direct profit-seeking was the dominant logic.	Profit Maximation (short and long term)
BCDr3 Improving products or service quality	Carter and Rogers (2008)	• Large Luxury Brand 1 • Supplier 1 • Supplier 2	Closely associated with BCDr6, BCDr6 and BCDr8 as most brands make SSCM improvements to preserve reputation and avoid risk.	Legitimacy-seeking logic is dominant	Profit Maximisation (long term) Synergistic Value Creation
BCDr4 Sales and profit margin (customer demand)	Carter and Rogers (2008); Seuring and Müller, (2008); Pivato (2008)	• Large Luxury Brand 1 • Large Luxury Brand 2	Closely associated with BCDr6. E.g., customer loyalty drives long-term sales	Direct profit seeking is dominant logic however legitimacy-seeking is closely connected to ensure longer term profit maximisation.	Profit Maximisation (short and long term)
BCDr5 Employee talent acquisition and retention	Revell and Blackburn (2007); Jia *et al.* (2018)	• Large Luxury Brand 1 • Industry Body 1 • NGO	Links to brand reputation and values (BCDr6)	Legitimacy-seeking logic is dominant.	Competitive Advantage Synergistic Value Creation
BCDr6 Maintaining and building reputation, brand value, and customer loyalty	Marrewijk, (2003); Pivato, (2008); Carter and Rogers (2008); Carroll and Shabana	• Large Luxury Brand 1 • Large Luxury Brand 2 • Luxury Garment Manufacturer • Supplier 1 • Supplier 2	Is closely connected and can influence BCDr4. Many of the other drivers influence this driver	Legitimacy-seeking logic is dominant but is closely linked with direct profit-	Profit Maximation (short and long term) Competitive

	(2010)		BCDr1,3,5,7 &8.	seeking rationale	Advantage Synergistic Value Creation
BCDr7 Compliance to regulations or standards	Presley and Meade (2018)	• Large Luxury Brand 1 • Large Luxury Brand 2 • Luxury Garment Manufacturer • Supplier 2 • NGO • Small Luxury Brand 4 NB: Although BCDr7 is an important business case driver in the sector, participants unanimously said that regulations and standards were currently either not present, not stringent enough or not well enforced.	Links to BCDr6 and BCDr8	Legitimacy-seeking	Profit Maximation (short and long term)
BCDr8 Avoiding and reducing reputational risk and possible liability	Carter and Rogers (2008); Roehrich *et al.* (2013); Presely and Meade (2018)	• Large Luxury Brand 1 • Small Technology Provider • Large Technology provider (EP)	Links to BCDr6, BCDr7 and also BCDR1, as compliance can reduce legal costs.	Legitimacy-seeking logic but closely linked with direct profit-seeking rationale	Profit Maximation (short and long term)

4.2 Sustainable supply chain management business case development challenges

Several insights emerged from the data that shed light on SSCM business case development challenges. These are summarised in Table 3. The insights reveal nuances related to perceptions of, and motivations for SSCM. They also reveal some stark areas of misalignment between corporate strategy and action, between various SC partners, and between the SC and the peripheral stakeholder groups. They also suggest potential incompatibilities between some of the sectoral CSFs and the transparency goals of SSCM.

SC misalignment results in various tensions and conflicting goals. The misalignment explains why certain SSCM business case drivers that should be strong in principle, are presently not translating into positive sustainability outcomes in practice. For example, with 'Insight 2', increasing sales (Table II, BCDr4) or reputation (BCDr6) are theoretically strong drivers for implementing or improving SSCM in the luxury fashion sector. However, market uncertainty regarding customer expectations or willingness to pay for sustainable products and practice causes a major distortion of messaging across the SC. Findings suggest brands feel that sustainability may not currently be influencing customer purchasing decisions as strongly as they are being led to believe.

Table 3 – Insights into SSCM business case development

Insight	Summary	Illustrative sample quotes
1.The 'low-hanging fruit' of SSCM can be difficult to pick	The nature and structure of the industry makes the sector institutionally complex. Furthermore, there is a lack of shared technological infrastructure to enable the necessary alignment. This makes supply chain coordination and collaboration difficult. Therefore, the 'easy wins' of SSCM (e.g., waste and cost reduction) can be difficult to achieve.	"There is no bigger vision for the future, mainly because I think in general, there is no loyalty with the brands […]. No one knows what's going to happen from season to season. […] there is no security, there is no reassurance." (Luxury Garment Manufacturer).
2. The customer demand for sustainable products is uncertain	Customers can provide a strong source of informal coercive pressure that encourages brands to adopt SSCM. Although the demand is reported to be positive and significant by a range of stakeholder groups such as industry bodies, the media, and NGOs, the findings suggest that consumer demand for sustainable products in the luxury fashion sector is presently uncertain. Brands are unsure if customers are willing to pay for sustainable goods and practices, which limits SSCM business case development based on the grounds of sales and profit margin (BCDr4).	• "For the luxury customers, I don't know if that's important to them […], I don't think it is to be quite frank with you, I mean I don't think it's important enough anyway, for it to make enough of a significant difference in terms of them changing their behaviours." (Luxury Retail Expert) • "If customers start asking these questions […] then the stockists will start to be engaged with it. But until then, it's going to be very slow, and a real uphill struggle." (Small Luxury Brand 1) • "At end of the day, the customer needs to change, and the big stores need to change how they buy." (Small Luxury Brand 2)
3. Weak institutional environment	There is a lack of legislation and therefore a major source of formal coercive pressure for SSCM adoption is missing. According to participant responses the laws that do exist (e.g., Modern Slavery Act) are not well enforced, not applicable to vast swathes of the industry, and have major loopholes. This is markedly different from other industries such as food which has much more stringent regulations. The MP offered the following explanation as to why this is: "Fashion is something that you do not put in the body but on the body. That is why it is not regulated so heavily." Institutional voids can emerge in institutionally weak contexts, enabling	• "In the UK, there is no legislation apart from the pioneering [Modern Slavery Act], which is really not binding enough nor […], strong enough in any way." (NGO) • "No one will outlaw incineration of excess stock. […]. How does that fit into the current times we live in? That's completely barbaric." (Small Luxury Brand 1) • "The only real UK recommendations around garments are to do with the flammability of nightclothes." (MP) • "All of this [sustainability] information is missing from our choices. […]. We need radical mandatory transparency.

	opportunistic behaviour (greenwashing).	But right now, this minute, we just do not have any regulation." (NGO)
4. Inefficacy of regulatory and accreditation systems	In principle, SSCM accreditation schemes can provide important sources of informal coercive, mimetic and normative pressure, and can encourage companies to comply and gain legitimacy. Presently, standards are all voluntary (not regulated by law) and do not have clear metrics. They lack meaning for both industry players and end customers because they are not well-understood. Affordability is an issue for suppliers; therefore, lack of accreditation is not necessarily indicative of poor SSCM performance and vice versa. Furthermore, standards are easy to circumvent because of their high level of ambiguity. This means they present opportunities for institutional decoupling (greenwashing) to occur through mock compliance and SC corruption. (Silvestre, 2020).	• Not every facility has the money to have ISO [certification] because maybe they are very small, artisanal (Large Luxury Brand 2) • "They started with the best intentions. They started because people believe that there's a better way forward. But, as of today, every single one of them is massively flawed […] "they're actually cheating and hoodwinking society because the customer doesn't know [what the accreditation means]. I call that greenwashing. People asking about sustainability are really wanting to understand where the products coming from, but they haven't got time to research it, so the next best thing is, "has it got this label?". Yeah, it has got a Better Cotton Initiative label on it. So, the consumer doesn't go any further than that. Well, the accreditation service there isn't 100% open and transparent." (Supplier 1) • "There are a plethora of initiatives which are poorly understood by the consumer." (MP)
5. Dominance of reputational risk in the sector	Maintaining an excellent reputation is a CSF for luxury fashion brands. They care deeply about customer perception. Therefore, there is a strong business case for SSCM integration on the grounds of avoiding reputational risk and maintaining legitimacy. However, as evidenced in insight 2, customer expectations regarding SSCM standards are presently uncertain. The risk to reputation will likely only increase if sustainability becomes a genuine concern for customers which impacts their willingness to pay for products. As highlighted by Luxury Brand 2, the change needs to come from the market.	"I remember one lecturer talking to me about, why do sometimes things happen that cause a brand to disappear? And he described them as the 'Death Star hit', if you pardon the Star Wars analogy, but it's that, and what he likened it to is, if this thing hits you, and it's right at the core of your values, and yet you are not living up to those values that you've professed to the world, then suddenly the very smallest of things happens, and suddenly it destroys the whole business. (Large Technology Provider – EP)
6. Extensive misalignment in the approach to SSCM and variance among stakeholders	Approaches to sustainability can differ at the individual firm level making it challenging to achieve SC collaboration and coordination. This aligns with Salzmann *et al*. (2005) who highlight that although viewing the business case in the	• "Young designers are trying to build a business based on the idea of sustainability. But if you're talking about big brands, no one cares. […] I had a meeting with the CEO of a very big Italian brand. He told me that, in the

(SC members and within organisations)	context of a whole industry can be useful, BCs are crafted by individual firms in accordance with their specific circumstances. Some participants felt that some larger brands only entertained sustainability because of the reputational risks. Findings suggest that smaller brands were either much more proactively engaged with SSCM, building brands around more sustainable values, or were considered more sustainable as a positive unintended consequence of working with financial constraints, therefore looked to reduce waste. Interestingly, participants commented that misalignment is also happening internally. Firms can find it difficult to develop a "joined-up" SSCM business case because of conflicting objectives of different business functions.	fashion industry, the companies [wouldn't] care about sustainability if there wasn't demand from society, from the customer." (Small Technology Provider) • "We just don't have budgets to waste […]. You know like fabrics from previous seasons that I'm not using, I'm toiling (garment design prototyping) out of necessity not because I'm going to do this really sustainable thing". (Small Luxury Brand 2) • "[We are] trying to look at business cases more holistically across the business rather than in a silo of the business" (Large Luxury Brand 1)
7. The luxury fashion sector is a slow adopter of SC technologies	Contrary to popular belief (House of Commons: Environmental Audit Committee, 2019), the response of several participants indicated that luxury fashion was a slow adopter of technology. This has important implications for SSCM business case development. For example, lack of SC technology integration may be preventing the level of SC transparency required to strengthen the necessary business case drivers for successful SSCM business case formulation. Technology adoption is markedly different in other industries, such as food. As evidenced by the MP, the issues in the luxury fashion sector stem from incentivisation. Other issues highlighted in the insights such as institutional weakness, lack of meaningful standards, uncertain customer demand all contribute to the lack of an incentive.	• "There is a public image that fashion is about innovation and that the industry adopts new technologies pretty fast. I can assure you, that it is one of the [toughest] industries to bring in new technologies. […] if you're thinking about innovations in a broader range, like in materials? Yeah. But in terms of technology – slow adopters." (Small Technology Provider) • "Clearly, luxury brands are very creative in their own right, but they may not necessarily be that creative with technology." (Large Technology Provider – EP) • "We've been trying to get RFID on our innovation agenda for a while. We tried for a bit, and it didn't work because it wasn't a strong enough business case for it." (Large Luxury Brand 1) • "There is no reason why, with Blockchain, the companies can't specify their supply chain provenance right the way through to the end. However, they are not incentivised to do this […]. The clothing industry incentivises turning a blind eye and enables the pursuit of the lowest price, even when that means that child labour and bonded labour are used to produce the clothes." (MP)

8. Some companies are reluctant to be transparent about their SC practices	Achieving sustainable value creation requires high levels of transparency and the disclosure of information regarding raw materials and production processes (Yang, Han and Lee, 2017). Some luxury fashion companies are reluctant to be transparent about their SSCM initiatives because they are unsure of the consumer reaction. luxury fashion customers expect products to be of an excellent standard. Publicly declaring product improvements may have an adverse effect on brand reputation. This highlights a possible incompatibility between the CSFs of luxury fashion and the goals of SSCM.	• "I think we're probably a bit too controlled about PR. […] when you actually compare what we do, to what some of the brands are doing that are telling everybody about it, we're so much more established in some of these things, but we just don't talk about it." (Large Luxury Brand 1) • "I think there is an inherent expectation of luxury brands that what you're getting is a better quality of product […]. Therefore, I think what luxury brands probably can't do is to come and say, 'and here is our sustainable range." (Large Technology Provider – EP).
9. Talent acquisition and retention is becoming a stronger SSCM business case driver	As internal stakeholders, employees are important sources of normative, coercive pressure and mimetic pressure (DiMaggio and Powell, 1983). Participants noted employee values were becoming increasingly aligned with the SSCM agenda. Consequently, this internal stakeholder group is applying pressure to improve SSCM.	"When I joined [Large Luxury brand 1], it was quite a hot brand. Everybody wanted to work there. […]. I think there was an undercurrent of, 'we don't really need to invest in our people, because if you don't want the job, 10 other people will do it'. But we've […] not [been] that hot recently, and we've had to really think again about how we motivate and give passion to that workforce in terms of what we stand for. […]. We all employ millennials, Gen-Xs, Gen-Zs, and they have a very different work ethic, [their loyalty] is based on a very different set of criteria. My team's brand loyalty is, it's not killing the planet, it's actually doing a lot about recycling, it's creating circular economy." (Large Luxury Brand 1)

5. Discussion

The values, priorities and demands of various stakeholder groups in the luxury fashion sector are often misaligned or conflicting which creates institutional complexity and increases the probability of heterogenous organisational responses to the institutional pressures to adopt SSCM (D'Aunno, Sutton and Price, 1991). Furthermore, the institutional pressures at play within the organisational field are generally not conducive to successful SSCM business case development. However, this is not universally the case, for example findings indicate that corporate sustainability was becoming increasingly important for employee acquisition and loyalty and that they were an important source of normative institutional pressure. The need for constant design innovation in the sector requires new design talent to ensure sustained competitive advantage. Hence, attending to sustainability concerns of the workforce is a key factor in determining and defining the business case for the firm. The key areas of misalignment revealed in the findings are discussed in sections 5.1-5.5.

Most of the insights reveal numerous challenges that need to be overcome for successful SSCM business case development to occur. The sector is highly sensitive to reputational risks, therefore is strongly motivated by legitimacy-seeking drivers. However, the findings suggest that the legitimacy-seeking rationale is often closely intertwined with profit-seeking motives, making it difficult to determine the dominant rationale in the sector. Furthermore, gaining legitimacy and maintaining reputation is currently a relatively comfortable endeavour in the sector. There is little in the way of accountability for poor SSCM practice or greenwashing. Firms may deem the risk to reputation sufficiently low enough to only engage with SSCM on a superficial level. Hence, SSCM business case drivers closely aligned with legitimacy may only lead to symbolic adoption and do not necessarily effectively translate into substantive social and environmental outcomes in practice.

Successful SSCM business case development in the luxury fashion sector, that is BCs which are built upon drivers that result in strong economic outcomes for the company and positive social and environmental outcomes, are mainly limited to profit-seeking drivers associated with the narrow business case view. SSCM business case development seems largely based on the 'easy wins' of SSCM such as reducing inventory, waste, and costs (see Table II, BCDr1). However, even SSCM BCs built on the theoretically easy wins can be difficult to achieve in practice. The following sections will discuss the institutional

complexity of the sector and highlight the key challenges relating to misaligned stakeholder priorities and institutional pressures.

5.1 Institutional complexity and supply chain coordination challenges

There are two factors relating to institutional complexity which inhibit the necessary alignment required for effective SSCM business case development. Firstly, the nature of the sector and second, the structure of the SC networks. In keeping with the characteristics of the wider fashion industry, the luxury fashion sector is fast-paced, with short product life cycles, high volatility, low predictability with high levels of impulse purchasing (Christopher, Lowson and Peck, 2004). Luxury fashion typically diverges from fast fashion in the sense that cost reduction, although desirable, is not traditionally a primary concern, as the sector typically benefits from large profit margins (Kapferer and Laurent, 2016). However, cost efficiency is gaining more importance in the sector. This is particularly the case for brands providing 'accessible luxury' whose profit margins may be under pressure due to cheaper price points (Karaosman *et al*., 2020). Hence, investing in SSCM needs clear justification in terms of financial returns.

Insight 1 (Table 3) suggests that the industrial conditions and misaligned company and stakeholder objectives can make it difficult to achieve the necessary level of SC coordination to reduce waste and subsequent costs. Theoretically, these should be comfortable sustainability victories (Savitz and Weber, 2013). However, luxury fashion SCs are not particularly conducive to creating efficiencies with materials and costs. Luxury fashion brands still typically follow differentiation or focus strategies that depend on the product uniqueness and value, as perceived by the customer (Porter, 1980). Therefore, the creation of 'innovative products' that contribute to preserving the reputation of the brand is paramount. However, the findings suggest that the luxury fashion SC has not yet fully figured out how to differentiate or create value based on SSCM practice. Furthermore, the customer demand is not yet strong enough to establish a clear need for SSCM implementation (Savitz and Weber, 2013).

Innovative products typically require agile SCs to support them (Fisher, 2011). However, it could be said that agile SCs do not align with the objectives of SSCM as easily as those of lean SCs, where emphasis is placed on achieving efficiency (Das, 2018). The fast-paced nature of the 'fashion cycle' makes it difficult to build long-term SC partnerships, causing inefficiencies with waste and cost reduction (see Insight 1). The Luxury Garment Manufacturer even commented upon the misalignment of intra-

organisational business functions. They felt brands were unable to coordinate their different business functions effectively which caused waste and negative environmental impacts. Small Luxury Brand 3 also felt the nature of the sector was to blame for a lot of the sustainability problems:

> *"I feel like the trends and having to do a show and new collection every six months, that needs to change."*

Another challenge stems from the fact that luxury fashion SCs consist of many SME manufacturers and suppliers. Both Large Luxury Brand 1 and 2 commented that this made it difficult to achieve SC transparency and assess the SSCM practice of some suppliers. Large Luxury Brand 1 stated that it also made it difficult to integrate SC wide technology infrastructure to improve SC transparency and SSCM. Hence, there may be barriers to SC collaboration, creating value, and developing SC-wide BCs.

5.2 Market uncertainty and misalignment of stakeholder perceptions

Recent reports indicate that customer demand for sustainable products is strong and increasing (BoF and McKinsey, 2021). However, several interviewees were not convinced. The findings of this study reveal that certain stakeholder groups, capable of enacting informal coercive intuitional pressure, such as customers and peripheral stakeholder groups such as industry bodies, NGOs, the media (Dimaggio and Powell, 1983; Huq, 2016), are signalling a strong demand for sustainable products and practices which is not there. This is problematic as sustainable SCs are only validated if the customer desires and accepts the end product (Seuring and Müller, 2008).

Just as firms may engage in greenwashing, customers may engage in 'conspicuous virtue signalling'. This relates to the projection of virtuous moral values to boost personal reputation, particularly on social media platforms, whilst shopping habits may differ in reality (Wallace, Buil and de Chernatony, 2020). We propose that customers and peripheral stakeholder groups may all partake in conspicuous virtue signalling as they may enact coercive institutional pressure that does not represent true demand. We describe this as 'fauxercive pressure' – coercive pressure based on disingenuous demand. The following quote is illustrative of this sentiment:

> *"I have a feeling that the trend in the fashion industry, with the insiders, is bigger than outside the actual customers. […] that's probably, why the buyers are not as crazy about sustainability yet, as the fashion press is. I don't see the general, luxury fashion customer is [as] focused on sustainability yet as we get told in the fashion trade." (Small luxury brand 4)*

Other participants, such as Supplier 2, commented that consumers could be "very vocal online" but that this "didn't necessarily translate into sustainable purchases".

Fauxercive pressure may encourage firms to believe they can build SSCM BCs by using good SSCM performance to enhance their legitimacy and reputation which they can leverage to increase sales, customer loyalty, and ultimately improve profitability for the business. However, it is unclear at present whether customers are willing to pay for these efforts and whether SSCM investments will yield a return. This does not suggest that the reports on shifting customer attitudes towards more sustainable consumption habits are false. Rather, they are still in an emergent state where the customer expectation is not yet sufficiently clear on which to build a BC. The challenge for firms is the increased dissonance between the cost-free vocalised preference of the consumer and the integrity of that preference as seen enacted via consumer purchasing. Customers, the media, industry bodies, and NGOs have an asymmetry of cost in vocalising the SSCM agenda – they have nothing to lose from signalling concern over sustainability. Small Luxury Brand 1 commented that media had been very engaged with their sustainability journey but that it could merely be *"because it's a zeitgeist".* The risks to firms, trying to navigate SSCM, are far more significant, both financially and reputationally. As highlighted by He *et al.* (2019), it is easy for some stakeholder groups to 'talk the talk' with sustainability when they are unaware of the reality managers face when implementing SSCM in practice.

The market ambiguity caused by fauxercive pressure also increases mimetic isomorphic pressure, resulting in behaviour where "organisations tend to model themselves after similar organisations in their field that they perceive to be more legitimate or successful" (DiMaggio and Powell, 1983, p. 152). This may create a hotbed for greenwashing if firms see competitors publicly declaring SSCM initiatives and receiving a good response. Present information asymmetry, caused by a lack of appropriate technical infrastructure to aid SC transparency, only adds to the problem. In

summary, on the customer side, there is a risk of insincere demand for SSCM which may, in turn, be met by superficial responses from firms.

5.3 Institutional weakness and the inadequacy of sustainability standards

The institutional complexity of the sector is also exacerbated by the existence of 'institutional voids'. Present legislation is not comprehensive enough. That which exists is not well enforced or does not apply to most of the industry. For example, only companies with a turnover of more than £36 million need to publish a modern slavery statement to comply with the modern slavery act 2015 (UK Government, 2021). 99% of UK fashion companies are SMEs with an average turnover of much less than £36 million (ONS, 2019). Therefore, regulation is not applicable to vast swathes of the sector.

The lack of sustainability legislation also means that focal firms do not have the agency to effectively govern SSCM standards. Furthermore, it means they are not incentivised to integrate transparency-enabling technological solutions. This is markedly different from the food industry, where traceability is a mandatory requirement in many countries (Gandino *et al.*, 2009). As highlighted by the MP (see Table III, Insight 3), the disparity is easily explained by the difference in health and safety concerns. The repercussions of food safety breaches are more instantaneous and there have been high-profile scandals, such as the Horsemeat scandal, which received widespread media attention, boosting societal awareness (Tian, 2016). However, fashion is far from risk-free. Greenpeace (2012; 2014) have previously reported the presence of chemicals with carcinogenic or hormone-disrupting properties in clothing, highlighting a pressing need for tougher restrictions.

Weak institutional contexts result in a low level of normative and formal coercive pressure to comply with sustainability standards and norms. It also results in high levels of mimetic pressure, where companies may be more likely to mimic competitors who are greenwashing without being held accountable (Silvestre, Viana and Sousa Monteiro, 2020). Overall, weak institutional contexts drive the industry towards greenwashing and pretence.

Several stakeholders expressed dismay at the UK government for rejecting every single recommendation made to it after a recent parliamentary enquiry into fashion sustainability. The industry will likely remain unregulated for the foreseeable future and will depend on voluntary standards. However, as highlighted in Insight 4, SSCM accreditation standards are inadequate for evaluating SSCM performance and are not

understood by customers. The existing literature has also highlighted their susceptibility to SC corruption (cf. Silvestre *et al*., 2020). Overall, it is difficult to make a business case for such standards as their value is not clearly defined.

5.4 Variance in corporate sustainability strategies

Corporate sustainability strategies vary from company to company (Salzman *et al*. 2005). The existing literature has already highlighted possible differences in sustainability approaches in the luxury fashion sector based on company size (Macchion *et al.,* 2018). Larger brands have the financial capital to be able to pursue SSCM *(Ibid).* This was supported by Large Luxury Brand 1 who felt larger brands were obliged to 'lead the way' with SSCM. However, many participants felt that larger players were only motivated to implement SSCM to avoid reputational risk and felt they adopted more 'defensive' sustainability strategies. Although larger firms may have the means to invest in SSCM, it does not mean they will.

In agreement with Macchion *et al.* (2018), the findings suggest that some SMEs adopt SSCM as part of a differentiation strategy. However, this is not universally so. Smaller brands are better aligned with the objectives of SSCM due to financial constraints. Many sought ways to reduce material waste and associated costs. In summary, motivations, perceptions, and responses vary. This individualistic approach to corporate sustainability strategies prevents sustainable value co-creation, therefore, impedes the development of the SC-wide business case for sustainability.

5.5 Transparency and technology adoption issues

The issues with SSCM business case development outlined in this research mainly stem from a lack of transparency (as a proxy for alignment). The findings provide strong evidence to suggest that the luxury fashion sector is a reluctant and slow adopter of SC technology infrastructures that improve information transparency. As highlighted by Yang *et al*. (2017), information transparency is essential for 'sustainable value co-creation' which involves multiple stakeholders and the collaboration of the entire SC. Yet, our findings suggest that luxury fashion brands are struggling to develop a business case for even the well-established SC technologies, such as RFID, which has been utilised in food and healthcare since the early to mid-2000s (Chen *et al*., 2008).

The sector does not presently seem interested in integrated technologies, such as BCT, which shows promise for addressing information asymmetry challenges. Participants described BCT as a *"solution without a need"* and *"tech without a cause"*, aligning with

the findings of Verhoeven (2018) who described it as 'solution looking for a problem'. As highlighted by the MP's comments (see Table III, Insight 7), the required institutional pressures and various stakeholder pressures to incentivise integrating transparency-enabling technologies are not present in the luxury fashion sector in the same way that has been evidenced in the food industry, where they are adopted to ensure regulatory compliance (Astill *et al.*, 2019). However, BCT may provide the supporting mechanisms to reduce information asymmetry and allow customers to determine product provenance and therefore, may genuinely enable sustainable value creation.

The Small Technology Provider suggested that technological innovation in the luxury fashion SC was more likely to occur at the textile manufacturing stage. In the luxury fashion sector, UK suppliers typically take a proactive approach to SSCM and transparency as a source of quality assurance, value creation and competitive advantage. This contrasts with prior fashion sustainability studies where the focal firm predominantly drives suppliers to improve SSCM and transparency (Benstead *et al.*, 2020).

The findings suggest that luxury fashion brands are struggling with information transparency with their customers. The luxury fashion sector was slow to adopt e-commerce strategies (Okonkwo, 2009) and some participants indicated that brands were not adept at communicating product sustainability credentials on digital platforms. The Large Technology Provider (RL) commented:

> *"A lot of companies will be doing some great things a customer would love to hear about […], but they probably don't have a channel to say that"*

The hesitant attitude towards transparency, outlined in Insight 8, also highlights a potential incompatibility between the CSFs of luxury fashion and SSCM. Luxury fashion is like theatre - if the back-of-house is revealed then it ruins the mystique of what is presented on stage (Kapferer, 2010). This is at odds with SSCM, which requires SC transparency to create sustainability-based assurance and value for customers (Nowiński and Kozma, 2017). Many participants commented on a need for more transparency in the luxury fashion sector, as evidenced by the following quote:

> *"All of this [sustainability] information is missing from our choices. […]. We need radical mandatory transparency. But right now, this minute, we just do not have any regulation." (NGO)*

Large Luxury Brand 2 also felt that the inability to communicate sustainability information transparency also related to concerns about exposing too much information to competitors:

> *"I would say the problem is that many brands are competing and are trying to not tell the other competitors about their suppliers.*

5.6 Theoretical implications

This research contributes in-depth insights into how SSCM BCs are formulated in practice in a SC embedded within an institutionally complex organisational field. In doing so it contributes to the reduction of the "research-practice gap" (Rynes *et al*, 2001) and offers a deeper understanding of how institutional complexity caused by different stakeholder demands are managed in practice. The SC perspective broadens the view of the business case for sustainability and highlights how influential the contextual factors within the organisational field can be on the SSCM business case development process. Contextual factors have not been thoroughly explored from a SSCM business case perspective in the existing literature.

The findings of this research show that the underlying dynamics of the SC, institutional complexity, market uncertainty, laws and governance, corporate sustainability strategies, and SC infrastructure (e.g., information technology systems) are key contextual factors that determine how SSCM BCs are developed. They create the environment in which SSCM BCs are formulated have the power to constrain or enable SSCM business case drivers and configurations of drivers. In the case of the luxury fashion sector, the environment of the organisational field can be described as fragmented "characterised by disparate values and conflicting beliefs about appropriate structure and behaviour" (D'Aunno, Sutton and Price, 1991). The ambiguity about appropriate organisational responses to sustainbablity concerns presents challenges to firms trying to develop SSCM BCs in this sector, this is partcilualry heighted due to its weak regulatory environment (*Ibid*). The uncertain and conflicting demands of the sector cause heterogenous organisational responses. The business case concept is at the epicentre of the decisions regarding SSCM adoption are reached. At present the situation leads to either superficial SSCM business case development where TBL principles are symblically adopted for markteing purposes to gain legitimacy but not put into practice,

substantive SSCM business case development that lead to genuine organisational improvements in SSCM performance, or a mixture of both.

The decoupling aspect of institutional theory has been useful for explaining disengenous organisational responses to institutional pressures to improve SSCM (greenwashing). To our knowledge, decoupling has not previoulsy been used to examine the integrity of inputs (institutional pressures) to the organisational decision-making process. The findings of this research suggest that customers and other peripheral supply chain stakeholders can engage in conspicious virtue signalling where they decouple the reality of their consumption habits from the virtuous image of themselves they project thus creating fauxercive pressure. This adds to the ambiguity and leaves organisations questioning stakeholder expectations for sustainability.

Figure 3 presents a graphical summary of the findings and discussions of this research and highlights the contextual factors that influence SSCM business case development. This is not intended to be an exhaustive representation of contextual factors but a visual aid to help researchers and practitioners consider the various causal relationships and their impact on SSCM business case development.

Despite the importance of reputational risks to the sector and its key SC stakeholders, neither of the business case rationales appear to be particularly dominant among the firms. This research takes steps towards unifying the terminology on the business case for sustainability and extends the exitsing research by presenting the profit-seeking rationale and legitimacy-seeking rationale as interrelated dimensions with shared objectives. Furthermore, the study highlights the interconnectedness of SSCM business case drivers.

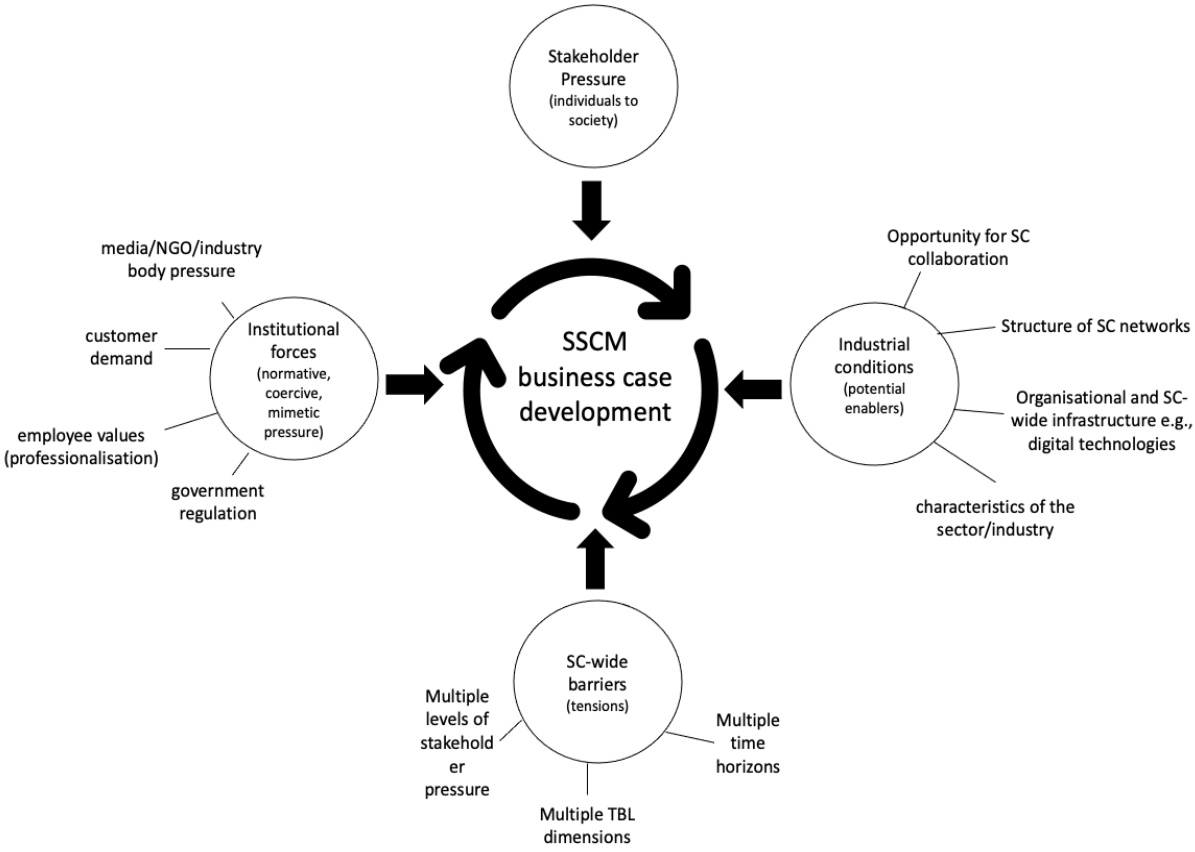

Figure 3. Contextual factors creating institutionally complex environments for SSCM business case development

BC drivers at the SC level can be hindered by numerous misalignments within the SC and broader organisational field. These misalignments come in the form of challenges regarding the interactions of various stakeholders. Subsequently, this causes institutional complexity and tensions between SC members to arise. Table 4 summarises some of the contextual factors which presently hinder SSCM business case development that could enable successful SSCM business case development if the desired state can be achieved.

Table 4 - Contextual factors that influence SSCM business case development

Current state (impedes SSCM business case development)	**Desired state (enables SSCM business case development)**
Institutional weakness	Institutional robustness
Weak, uncertain customer demand for sustainable products and services	Strong, genuine customer demand for sustainable products
Inadequate voluntary industry SSCM standards that are not useful for managers and customers	Appropriate voluntary industry SSCM standards that are useful for managers and customers
Supply chain collaboration difficult to achieve	Effective supply chain collaboration is easier to achieve
Existing technologies (limited level of transparency)	Ideal technologies (unprecedented levels of transparency and connectivity)

5.7 Managerial and policy implications

This research provides important insights for both practitioners and policymakers. Managers should be wary of false demand signals coming from customers but also periphery stakeholder groups (e.g., industry bodies, media, NGOs). Brands are misled into investing in SSCM to meet the vocalised values and expectations of customers that do not result in a positive financial outcome. Some companies may choose to pursue SSCM improvements, irrespective of economic benefit. However, from a business case perspective, managers looking to justify SSCM investments in terms of economic value should endeavour to gain a clear picture of the demand for sustainable products and practices.

The message for policymakers is clear. More stringent regulations are not only required to create a more fertile ground for SSCM business case development but are also desired by most stakeholder groups. As, previously highlighted, fashion may look to the food industry as a blueprint in this regard. There are, however, instances where policy can negatively impact SSCM and may cause institutional decoupling (e.g. greenwashing and mock compliance) (Tan *et al.*, 2017; Nath, Eweje and Sajjad, 2020). SSCM regulations should be realistic in their attainability to avoid negative unintended consequences (Carter *et al.* 2020). If the sector remains unregulated then there will be a continued dependence on voluntary SSCM initiatives - managers should be wary of those that lack clear metrics or meaning for the SC and the end customer.

Despite the present barriers, business case development is an adaptive process that must "reflect the changing conditions for business at a global level" (Kurucz *et al.*, 2008, p.2). Bain and Company (2021) predict that by 2030 the luxury sector will have been transformed both conceptually and structurally, as wider societal trends, such as climate change and technological breakthroughs continue to develop. Luxury fashion brands may be able to leverage their SSCM credentials in a way that create competitive advantage based on these terms, enabling them to differentiate themselves from 'accessible luxury' brands. However, this will require a proactive approach to achieving SC transparency.

Currently, it is challenging for luxury fashion companies to enhance legitimacy and reputation through improved SSCM performance in a way which translates sustainable value co-creation. This may help to explain why opportunities for differentiation strategies based on sustainable business model innovation, first highlighted by Bendell and Kleanthous (2007) over a decade ago, have not yet been fully realised in the luxury fashion sector (Yang, Han and Lee, 2017). The current inability and unwillingness to be

transparent with information which proves SSCM credentials undermines efforts to create synergistic value. To achieve this, the sector needs to invest in the technologies which support transparency. This could finally enable brands leverage their SSCM credentials into meaningful value propositions.

6. Conclusions

This research contributes to developing a deeper understanding of why SSCM is not progressing as expected and responds to calls for a deeper knowledge of how practitioners understand SSCM (Rajeev *et al.*, 2017; He *et al.*, 2019). Viewing the business case for sustainability from a SC perspective has received only limited attention in the literature. This research provides a realistic picture of how SSCM BCs are developed in practice. It highlights some important contextual factors that presently impede SSCM business case development along with some opportunities to overcome the barriers.

Although truly sustainable SCs may only be achieved when environmental and social aspects of the TBL are prioritised over profit and demand (Montabon *et al*, 2016), this present research suggests such aspirations are currently difficult to achieve in practice. In line with the existing literature, the findings suggest that improving social and environmental performance will typically only be considered when it generates economic value, either directly or indirectly (Carroll and Shabana, 2010; Hahn *et al*., 2014). Therefore, helping firms to create a clear business case for SSCM initiatives may be one of the only means of guaranteeing its progression. Improving supply chain sustainability transparency can support business case goals as it can help to increase customer willingness to pay for sustainable products and processes (Bai and Sarkis, 2020), especially when the data is recorded on an advanced technology system like blockchain (Guo et al. 2020).

The findings suggest responsive, agile SCs may have a different set of considerations when it comes to developing a business case for SSCM. Luxury fashion brands compete on differentiation by creating value for customers. However, findings reveal that luxury fashion brands are still struggling with sustainable value co-creation. This is partly because of the lack the necessary SC information transparency or verification to drive this but also because of the uncertainty regarding customer willingness to pay for sustainable products and practices. The findings help to expand the applicability of institutional theory by highlighting disingenuous coercive pressure, or ‘fauxercive pressure’ from customers and other peripheral stakeholder groups who may send false

signals regarding their willingness to pay for sustainable products. Determining true demand for sustainable products may become increasing difficult over the coming years as societal pressure to lead a sustainable life intensifies and stakeholders may engage in conspicuous virtue signalling (Wallace, Buil and de Chernatony, 2020).

To conclude, this research sheds light on how institutional logics and institutional complexity impact SSCM business case development. Sustainability has caused a shift in institutional logics which have impacted the competitive conditions in which SCs operate and in which BCs are developed (Thornton, 2002). Although sustainability has become a central debate within SCM and wider society, it is a relatively new concept in the history of economic markets. Stakeholder values and beliefs about sustainability are still developing, thus expectations and demands are still uncertain and so SSCM business case development will need to adapt accordingly as belief systems around sustainability gain more clarity.

6.1 Limitations and future research

Although all the companies involved in this research operate in an international setting, the majority have their headquarters in the UK. This was justified, given the focus on territory-specific concepts, such as legislation, though it limits generalisability. Future research opportunities include conducting similar studies in different geographical settings or different sectors to explore the respective impact of contextual factors on SSCM business case development. The findings suggest that certain organisational fields are more conducive to successful SSCM business case development than others e.g., the food industry. Inquiries into the contextual factors of organisational fields where SSCM has been more successfully adopted may help to create a roadmap for lagging sectors.

Finally, the luxury fashion sector has been identified as a suitable industry for exploratory studies into emerging technologies, such as BCT (Nowiński and Kozma, 2017). Interestingly, this research finds that the luxury fashion sector is a slow SC technology adopter. This is not to say it is an inappropriate context for researching emerging technology. However, technology integration for SSCM presents its own set of challenges that require investigation. Issues related to ‘technology readiness’ may need more consideration before researchers proceed with these types of investigations.

The combination of institutional theory and stakeholder theory provide a strong theoretical framework for examining the business case for SSCM. However, future research may wish to explore other theories for examining SSCM business case

development. The RBV perspective could provide a particularly useful lens for examining SSCM business case development given its concern with how firms can achieve competitive advantage and commercial success (Barney, 1991). Furthermore, as technology is becoming an increasingly key element of TBL and SSCM debates (Eslami *et al.*, 2019; Saberi *et al.*, 2019), future research may wish to integrate theoretical lenses, such as Information Processing Theory or Innovation Diffusion Theory with more established SSCM theories to support explorations into the nexus of technology and SSCM (Hwang *et al.*, 2016; Saberi *et al.*, 2019).

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Appendix 1- Interview protocol

- What is your current opinion on sustainable development in the luxury fashion industry?
  - What do you think the main sustainability issues are in the luxury fashion supply chain?
  - Does the organisation you own/work for (or with) have sustainability initiatives in place?
    - Do these relate to supply chain practice? If so, how?
    - Are there metrics in place to measure the success of these initiatives?
    - What were/are the main motivations for implementation?
    - Was there a clear business case for implementation?
  - Do you think improved sustainability practice can help the luxury fashion industry innovate new business models and create stronger business cases?
  - What are your thoughts on current legislation relating to garment labelling/sustainability in the UK?
  - How far do you think achieving sustainability in in the luxury fashion supply chain is dependent on information transparency? Please explain.
  - Does the organisation you own/work for or with currently use any form of technology solution to improve SC transparency and improve/measure SSCM performance?
    - If yes, please detail what types of technology are used
    - If no, are they considering it for the future?
  - Are you aware of emerging technologies, such as Blockchain Technology?
    - If yes, what are your thoughts on their suitability for improving supply chain transparency and SSCM in the luxury fashion?

Chapter 3 – Non-fungible tokens: a missing ingredient for sustainable supply chains? (paper 2)

Abstract
We explore the potential of non-fungible tokens (NFTs), a recent innovation in blockchain technology (BCT), to incentivise sustainable supply chain practices while simultaneously helping to overcome the barriers to BCT adoption. The potential application of NFTs to drive supply chain sustainability and overcome present barriers is critically examined using the Technology Organisation Environment (TOE) framework whilst drawing upon theoretical threads from the behavioural psychology and gamification literature to explain the value proposition of NFTs. We find that NFTs have the potential to engage a range of supply chain stakeholders in a sustainability agenda in a way that BCT has been unable to achieve to date. NFTs a) have the potential to increase customer willingness to pay for sustainable products; b) show promise as an anti-counterfeit measure; c) support circular business models; d) help reduce the negative impacts of overproduction and overconsumption by proving a digital alternative to physical items. This paper is one of the first to conceptually explore the potential of NFT applications to supply chains. It provides an important foundation for future empirical research that seeks to understand of how NFTs can be utilised to advance BCT adoption in sustainable supply chains.

Keywords: non-fungible tokens, NFTs, blockchain, sustainable supply chains, gamification

1. Introduction

The emergence of blockchain technology (BCT) has provided a means to address chronic issues associated with managing the complexities of supply chains, including addressing sustainability concerns (Cole *et al.*, 2019; Kouhizadeh *et al.*, 2021; Saberi *et al.*, 2019). The decentralised nature of BCT sets it apart from other supply chain technologies and provides new grounds for improving supply chain transparency (Wang, Singgih, *et al.*, 2019). It can be a key factor in the realisation of the goals of sustainable supply chain management (SSCM) and the concepts through which it is operationalised such as the triple bottom line (TBL) (Guo *et al.*, 2020).

BCT has the potential to translate SSCM initiatives into meaningful value propositions for customers (Kshetri, 2018; Saberi *et al.*, 2019; Wang, Han, *et al.*, 2019), increasing

their willingness to pay for sustainable products (Guo *et al.*, 2020). This can be a determining factor in SSCM adoption (Gouda & Saranga, 2020). It has the potential to provide novel sources of value creation that drive new and sustainable business model innovation based upon complete product assurance and verification (Maull *et al.*, 2017; Nowiński & Kozma, 2017; Schneider *et al.*, 2020). Bai *et al.* (2020) found that BCT was considered the most promising technology associated with the fourth industrial revolution (I4.0) from an economic sustainability perspective. However, present research suggests the current value proposition of BCT and SSCM is still unclear to end consumers (Davies, 2021; Kouhizadeh *et al.*, 2021; Saberi *et al.*, 2019) which may limit its potential in that regard.

Despite the potential of BCT for effecting SSCM, its adoption is still limited and there are many barriers to integration that have been explained in the literature (Kouhizadeh *et al.*, 2021; Saberi *et al.*, 2019; Wang, Singgih, *et al.*, 2019). Kouhizadeh *et al* (2021) extensively explored adoption barriers via the Technology-Organization-Environment (TOE) framework. Bai and Sarkis (2020) also referenced the TOE framework when discussing the performance and decision-making criteria for the adoption of blockchain technologies. Addressing these barriers is a pressing matter for academic researchers and provides the motivation for this paper. Key technological barriers relating to the immaturity of BCT, are well identified in the literature (cf. Kouhizadeh *et al.*, 2021; Saberi *et al.*, 2019; Zhou *et al.*, 2019). However, it is the external environmental such as lack of customer motivation to engage with BCT and SSCM that scholars believe presents the most significant barrier as this impacts the ability to develop a business case for adoption (Davies, 2021; Saberi, 2019; Kouhizadeh, *et al.* 2021). Van Hoek (2019) found that although a business case was not a necessity for companies to engage in BCT supply chain pilots, it would likely be a necessity for larger scale roll outs.

Solutions may also be found in the emerging evolutions and advances of BCT that have the potential to create the right context for successful adoption. In particular, the continued development of ‘smart contracts’ provides an additional layer to BCT that has led to some promising innovations in recent years. In 2018, a new form of digital asset known as ‘non-fungible tokens’ (NFT) were created (Entriken *et al.*, 2018). NFTs are crypto tokens that can be attached to unique items that need ‘provable ownership’ and can represent both physical and digital goods (Ethereum, 2021). NFTs have predominantly represented digital goods to date and exist within blockchain ‘metaverses’ (virtual worlds). The gaming and digital art industries have been early adopters (Dowling,

2021; Wang *et al*., 2021). Several NFT marketplaces have emerged such as OpenSea, Rarible, SuperRare, and Nifty Gateway (Wang *et al*., 2021), and the market value tripled in 2020, exceeding the $250 million mark (Nonfungible.com, 2020) and surpassed $2 billion in 2021 (Frank, 2021).

The rapid development of the BCT platforms invites further examination into the state of progress and may help shed light on solutions for progressing the BCT for SSCM agenda. While it is envisaged that NFTs, signified by the idea of the 'tokenisation' of physical items, can enable a variety of new BCT applications (Regner *et al*. 2019), studies exploring their potential are rare (Ethereum, 2021). This paper aims to extend the growing literature on BCT for supply chains by conceptually exploring NFTs in a supply chain context. It focuses specifically on the potential of NFTs to extend the effectiveness of BCT for driving SSCM. Understanding the potential of NFTs requires different types of explanatory theories. This paper adopts a behavioural psychology and gamification perspective to explore the potential of NFTs and explain how their secret 'scarcity' ingredient can offer new valuable knowledge to our understanding of the potential of BCT for SSCM. The TOE framework is also used to discuss how NFTs may address the barriers to BCT for SSCM, as its suitability has already been established in the field (cf. Kouhizadeh, *et al*. 2021). The following research question has been devised in support of the research aims:

RQ. Are NFTs the missing ingredient for BCT-enabled sustainable supply chains?

In examining and answering the question, we explore new opportunities that the technology can offer for the future of the SSCM agenda and achievement of TBL ambitions.

The remainder of the paper is organised as follows: Section 2 provides an overview of BCT for SSCM. Section 3 highlights some of the present barriers to BCT for SSCM adoption. Section 4 provides an overview of smart contracts and crypto tokens. Section 5 explores the potential of NFTs for improving SSCM and puts forward propositions that provide avenues for future research. Section 6 highlights some NFT-specific barriers. A theoretical framework for BCT research is discussed in Section 7.

2. Blockchain technology for sustainable supply chain management

The mechanics of BCT systems are well-documented in the literature (cf. Wang, Han *et al.*, 2019 and Treiblmaier, 2018). Simply put, every block represents data detailing a specific transaction (Hald & Kinra, 2019) which is validated by a peer-to-peer network before it is added to the blockchain (van Hijfte, 2018). The decentralised nature of BCT means that no single entity controls the data (Wang, Han, *et al.*, 2019). The emergence of the Ethereum blockchain platform and its creation of 'smart contracts' extended the scope of BCT beyond the cryptocurrency domain, making it suitable for application in a wider range of business contexts (Buterin, 2013). Contracts between various parties can be executed autonomously using a pre-agreed computerised transaction protocol, which eliminates the need for third-party intermediaries (van Hijfte, 2018). These innovations have led to BCT being the focus of increasing supply chain attention (Wang *et al.*, 2019).

The transparency of BCT has the potential for addressing numerous social, environmental and economic problems (Guo *et al.*, 2020; Saberi *et al.*, 2019). BCT can be used to build trust rapidly (Dubey *et al.*, 2020), provide product provenance assurances (Choi *et al.*, 2020; Helo & Hao, 2019; Nowiński & Kozma, 2017). Subsequently, it can help support more sustainable business models such as product rental services (e.g. luxury handbags) (Choi *et al.*, 2020). It can help to reduce supply corruption and product counterfeiting (Cole *et al.*, 2019; Helo & Hao, 2019; Koh *et al.*, 2020; Kshetri, 2018; Saberi *et al.*, 2019; Vu *et al.*, 2021). The magnitude of counterfeiting is significant. It threatens the supply chains of many industries, including luxury goods, pharmaceuticals, electronics, food and wine, and even business-to-business products such as spare parts and pesticides.

Counterfeiting has an extremely negative impact upon all dimensions of the TBL (Caniato *et al.*, 2009; Danese *et al.*, 2021; Ellis *et al.*, 2017; Ghadge *et al.*, 2021; Koh *et al.*, 2020; OECD, 2021; Vu *et al.*, 2021; Wang, Singgih, *et al.*, 2019). For example, counterfeit supply chains cause major social sustainability issues relating to the poor treatment of workers (Kouhizadeh *et al.*, 2021; Saberi *et al.*, 2019). Counterfeit food products also threaten public health (Helo & Hao, 2019). Counterfeit goods can also be extremely environmentally damaging as often use cheaper chemicals during production processes and seizures of goods leads to large volumes of material waste (OECD, 2021). Counterfeiting threatens the livelihood of those who work in authentic product supply chains and negatively impacts the economic bottom line of companies either through to lost sales or damaged reputation (Ellis et al. 2017; OECD, 2021) . As such, they pose big

problems to business managers and owners who trade on reputation and compete on quality (e.g. luxury brands).

BCT can make it easier to measure and manage key environmental data, such as water usage and greenhouse gas emissions (Saberi *et al.*, 2019). It can increase the level of supply chain accountability, enabling businesses to verify sustainability claims (Kshetri, 2018). SSCM certification and other data relating to traceability and provenance can also be securely stored on the blockchain (Liu *et al.*, 2020), helping to address the concerns of environmental activists and create value for consumers (Manupati *et al.*, 2020; Nowiński & Kozma, 2017; Wang, Han, *et al.*, 2019).

There have been several successful BCT supply chain pilot studies (cf. Wang, Han *et al.* 2019; van Hoek, 2019). Examples of where it has been employed to drive ethical supply chain practice are limited. However, it has been piloted in the coffee industry to make fairer and faster payments to small suppliers (Wang, Han, *et al.*, 2019), highlighting its potential to support UN Sustainable Development Goals related to reducing inequality and poverty (United Nations General Assembly, 2015).

3. Barriers to blockchain technology for sustainable supply chain management adoption

The potential of BCT has been well explored in the literature. However, the business benefits of BCT are not yet fully understood and there are several barriers limiting its adoption as a SSCM solution (Kouhizadeh *et al.*, 2021; Saberi *et al.*, 2019). The TOE framework (Tornatzky *et al.*, 1990) was adopted by Kouhizadeh *et al.* (2021) as the theoretical lens for explaining BCT for SSCM adoption barriers. The framework posits that technology adoption is influenced by three key aspects. Firstly, the technological (T) aspect which refers to technological capability, complexity, and availability. Secondly, the organisational (O) aspect which concerns intra-organisational priorities and considerations. Thirdly, the environmental (E) aspect which refers to the characteristics of a given industry including regulatory conditions, inter-organisational relationships, and market competition (Tornatzky *et al.*, 1990). The following sections will discuss some of the key barriers to BCT for SSCM, in accordance with the typology proposed by Kouhizadeh *et al.* (2021), to provide context for later discussions on how NFTs may help to address them.

3.1 Technological barriers

From a technological perspective, the immaturity of BCT presents several adoption barriers (Kouhizadeh *et al*., 2021; Saberi *et al*., 2019; Wang, Singgih, *et al*., 2019). There are technical issues related to the architecture of BCT platforms, namely scalability, decentralisation, and security. This is known as the 'blockchain scalability trilemma' (see Figure 1). Choosing to improve one aspect will negatively impact at least one of the other two (Zhou *et al*., 2020). Scalability challenges largely relate to transaction speed (the time it takes for a block of data to be added to the blockchain) (*Ibid*). However, another scalability concern which is often overlooked in the SSCM literature is the negative environmental impact of certain BCT networks. Bitcoin and Ethereum use a consensus mechanism to verify transactions, known as 'proof-of-work'. This protocol is very energy intensive (*Ibid*), severely undermining the use of BCT for SSCM and needs addressing if the technology is to scale without negatively impacting the environmental. Energy efficiency can be improved by using a different consensus mechanism called 'proof-of-stake' (van Hijfte, 2018). The Ethereum blockchain is currently in the process of migrating to a proof-of-stake protocol (Ethereum, 2021). Some newer blockchains have been built using this protocol but have sacrificed decentralisation and security (the key features of BCT) in favour of achieving better transaction speeds (Zhou *et al*., 2020). Overcoming BCT scalability issues without compromising decentralisation and security remains a major challenge (*Ibid*).

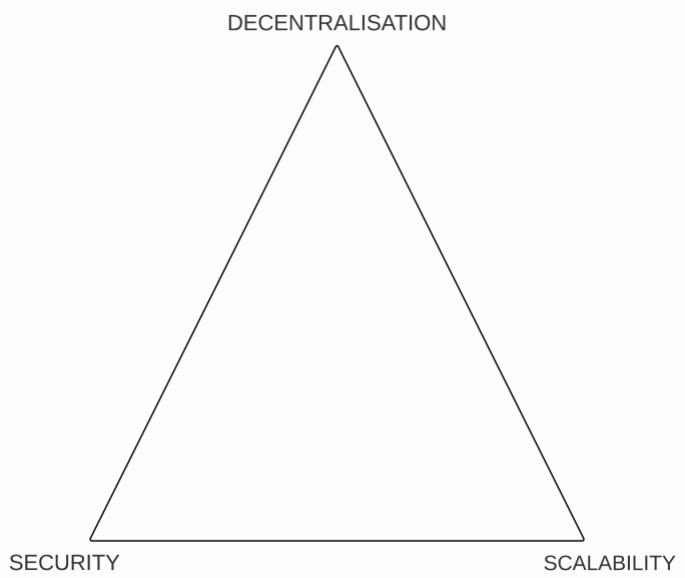

Figure 1. The blockchain scalability trilemma

Kouhizadeh *et al*. (2021) suggest that the immaturity of the technology can also lead to a negative public perception. For example, the association of BCT with cryptocurrencies can damage their image as they can be associated with illegal 'dark web' activities such as money-laundering. Additionally, recent media attention about the energy consumption of Bitcoin may also contribute to a negative perception of BCT. A summary of technological barriers is presented in Table 1.

Table 1. Technological BCT barriers in sustainable SCs

(Kouhizadeh et al., 2021; Saberi et al., 2019)

Barrier	Description
T1 - Security	BCT helps to improve data security but there are still concerns related to hacking and data breaches.
T2 - Access	Strong internet and information technology infrastructures are required to be able to utilise the technology and its integration may not always be practical or compatible with existing processes.
T3 - Negative perceptions	The public perception of BCT may be negative due to its association with crypto and the dark web. Bitcoin's reputation for being extremely energy intensive and damaging to the environment may also contribute to a negative perception of BCT.
T4 - Immutability	Whilst immutability can be seen as an advantage of BCT it also means that incorrect records will always be stored on the blockchain even if they are updated with corrections.
T5 - Immaturity	The scalability trilemma stems from the immaturity of BCT. Presently, scalability challenges are difficult to overcome without compromising key characteristics of BCT such as decentralisation and security.

3.2 Organisational barriers

There are numerous organisational barriers to BCT for SSCM adoption that have been highlighted in the literature. Some of these are common to the integration of any new supply chain practices such as financial constraints, lack of managerial commitment, and reluctance to integrate new systems (Kouhizadeh *et al*., 2021; Saberi *et al*., 2019; Wang, Singgih, *et al*., 2019). However, BCT-specific organisational barriers include a lack of BCT knowledge and expertise, a lack of understanding about how it can be used in sustainable supply chains and how it fits with organisational culture and procedures (Kouhizadeh *et al*., 2021; Saberi *et al*., 2019).

As highlighted in the introduction of this paper, the lack of a sustainable business model for BCT is a key organisational barrier to integration (Saberi *et al*. 2019). Businesses are unsure whether integrating BCT for SSCM will translate into competitive advantage (Davies, 2021; Kouhizadeh *et al*., 2021) and are uncertain that investment in SSCM and supporting technologies will be "compensated by their customers" (Saberi *et al*., 2019, p. 2126). The immaturity of the technology also means there is a lack of

industry benchmarks and understanding about what constitutes 'best practice' when it comes to BCT for SSCM. According to Saberi (2019), "supply chains that successfully implemented this technology to track their sustainable practices are difficult to find" (p.2125). A summary of the key organisational barriers is highlighted in Table 2.

Table 2. Organisational BCT barriers in sustainable supply chains (Kouhizadeh et al., 2021; Saberi et al., 2019)

Barrier	Description
O1 - Financial constraints	Integrating new systems is costly. BCT requires the whole supply chain to adopt the technology for it to be effective. Focal companies (and their supply chain partners) may not have the financial resources available to commit to the technology.
O2 - Lack of managerial commitment	Some managers fail to have long-term commitment to SSCM and therefore do not see the benefit of adopting technologies which support it. The value proposition of BCT and SSCM for customers is not clear and therefore managers are uncertain how it can help to innovate sustainable business models.
O3 - Lack of organizational policies	Organisations need to decide upon how BCT fits with existing processes and whether new policies need to be put in place to support its integration.
O4 - Lack of knowledge and expertise	Lack of technical expertise and detailed knowledge about BCT and SSCM.
O5 - Organizational culture	Challenges relating to the blockchain trilemma all stem from the immaturity of the technology.
O6 - Inertia	Hesitancy and reluctance from organisations and industries to switch to BCT and replace traditional centralised systems.
O7 - Lack of benchmarks	Lack of industry standards and metrics for SSCM performance and therefore a lack of understanding about how BCT can be integrated to measure it.

3.3 Environmental barriers

In terms of the environmental context, there are several external and supply-chain wide barriers to adoption. One of the most significant barriers is the lack of customer motivation to engage with BCT and an uncertainty about customer expectations and demands for sustainable products and practices (Davies, 2021, Kouhizadeh, 2021; Saberi, 2019). The value proposition of both BCT and SSCM for customers is still not clear (*Ibid*). This barrier is one of the most important to overcome as it influences other environmental and organisational barriers. For example, it limits BCT-supported sustainable business model development where BCT can be integrated (Davies, 2021, Kouhizadeh, 2020). Understanding the value proposition for customers is an essential part of business model development (Osterwalder & Pigneur, 2010) and there seems to be uncertainty and a lack of understanding regarding what this is at present.

Other environmental barriers include the lack of rewards or incentivisation for adopting BCT for SSCM (Davies, 2021, Kouhizadeh, 2020). There is little in the way of

promotion from external stakeholders such as NGOs, trade bodies, and governments about how BCT can be harnessed to create sustainability-based value (Saberi *et al*. 2019). A central barrier to this is a lack of government incentivisation or industry standards for both SSCM and BCT adoption. Government regulations about cryptocurrencies are unclear, creating uncertainty about policies for BCT as the underlying technology (Saberi *et al*. 2019). For example, the Chinese government banned Bitcoin mining in May 2021 and in September 2021 banned all cryptocurrency transactions (BBC, 2021), whereas El Salvador recently became the first country to adopt Bitcoin as legal tender (Frankel, 2021). US officials have referred to the crypto space as "the Wild West" but so far have done little to regulate it (The Financial Times, 2021). Geographic and cultural differences of supply chain partners have already been identified as a barrier to BCT for SSCM (Kouhizadeh *et al*., 2021; Saberi *et al*., 2019). This barrier may be heightened if BCT regulations continue to vary significantly between countries.

BCT can help to limit opportunistic behaviour in transactional supply chain relationships (Schmidt & Wagner, 2019) and can encourage supply chain collaboration, communication, and coordination (Kouhizadeh *et al*., 2021; Saberi *et al*., 2019). However, a lack of collaboration, communication, and coordination can also prevent its adoption (*Ibid*). Integrating BCT with existing supply-chain-wide practices and technologies is also a challenge (*Ibid*). A summary of the key organisational barriers is highlighted in Table 3.

Table 3. Environmental BCT barriers in sustainable supply chains
(adapted from Kouhizadeh et al., 2021; Saberi et al, 2019)

Barrier	Description
E1 - Lack of customer motivation to adopt BCT and make sustainable purchases	It is uncertain whether businesses will increase sales by investing in BCT for SSCM. Customer demand for sustainable products is still uncertain and they have a lack of understanding about both BCT and SSCM.
E2 - Lack of supply chain alignment	Lack of collaboration, communication, and coordination among supply chain partners due to potentially conflicting priorities makes it difficult to integrate BCT throughout the whole supply chain.
E3 - Information disclosure between supply chain partners	Supply chain partners can have different privacy needs and may be reluctant to share confidential information with each other.
E4 - Integrating BCT and SSCM	Integrating BCT with current business processes and sustainability practices can be challenging.
E5 - Cultural differences of supply chain partners	The different geographical or organisational culture of supply chain actors and partners that can impede BCT.
E6 - Lack of governmental policies	There is a lack of regulation for BCT usage and uncertainty regarding how different governments may approach BCT regulation in the future.
E7 - Market competition and uncertainty	Businesses are unsure whether integrating BCT for SSCM will lead to competitive advantage. This largely stems from ambiguity regarding

	customer demand for sustainable products and processes.
E8 - Lack of external stakeholder involvement	External stakeholders such as NGOs, trade bodies, and governments do not promote harnessing BCT to drive sustainability-based value and governments do not incentivise BCT for SSCM adoption.
E9 - Lack of industry BCT standards	There is a lack of industry standards for how to adopt BCT in an ethical and safe manner.
E10 - Lack of rewards and incentives	There is a lack of incentivisation or reward systems that may otherwise encourage customers, organisations and their suppliers to engage with BCT for SSCM.

This section provides an overview of the technological, organisational and environmental (interorganisational and external) barriers to BCT for SSCM adoption. The uncertainty regarding customer demand for BCT-authenticated sustainable products and services appears to be the root cause of many of the present issues. If this can be overcome, then issues with business model development can also be solved. This can help to incentivise organisations and their supply chain partners to engage with BCT and SSCM. The following section is an overview of recent developments in the field of BCT and provides context for subsequent discussions regarding how these developments can help to address some of the adoption barriers.

4. Advances in blockchain technology: tokenisation and non-fungible tokens

BCT is advancing rapidly, and new developments are emerging that can help overcome the barriers to harnessing BCT for SSCM. 'Tokenisation' is one rapidly developing area of BCT, enabling the conversion of ownership rights into a digital crypto token (Di Angelo & Salzer, 2020). Tokens, managed by smart contracts built on the blockchain (Chittoda, 2019; Di Angelo & Salzer, 2020), mark a significant departure for BCT from its origins (crypto coins) (Chittoda, 2019). Crypto tokens can vary in terms of fungibility or non-fungibility (Bal & Ner, 2019). In economic terms, 'fungible' means the asset is interchangeable and can be divided into smaller units without impacting their value. Both traditional fiat (government issued) currency and crypto coins can be described as fungible assets (Bal & Ner, 2019; Ethereum, 2021). A 'non-fungible' asset has unique properties (e.g. an original painting) is indivisible and non-interchangeable. NFTs were created in 2018 using the ERC-721 token standard (Entriken *et al*., 2018) as a means for proving the ownership of unique digital and physical goods (Watanabe *et al*., 2019). NFTs also allow for 'fractional ownership' of an asset. This enables the creator of an NFT to issue shares, whereby fractional owners can profit from the NFT beyond its original sale (Ethereum, 2021). Semi-fungible tokens such as ERC-1155 emerged shortly after NFTs and are a multi-token standard that can support both fungible and non-fungible tokens

(*Ibid*). They can enable categories of tokens that can be "1 of n with a serial number or slightly different metadata" (EOSIO, 2021). This latest development shows potential for small product ranges that share the same unique characteristics (e.g. a limited-edition clothing collection or a particular year of vintage wine).

Tokenisation can address the issue of incentivising sustainable behaviour in support for promoting SSCM. Tokenisation can be used to financially reward sustainable behaviour by issuing crypto tokens (Esmaeilian *et al*., 2020; Saberi *et al*., 2019). For example, Esmaeilian *et al*. (2020) highlighted some notable start-up companies that reward customers with tokens for purchasing carbon-neutral products or recycling plastics.

Tokens need to be clearly defined in terms of what they represent (e.g. an investment or means of exchange), as the value of a token is dependent on supply and demand and on the level of belief that the participating community has in it (di Angelo and Salzer, 2020). Previous supply chain studies on tokenisation have mainly focused on fungible token standards such as ERC-20. Peer-reviewed articles on NFT usage in business contexts are scarce (Regner *et al*., 2019). NFTs offer a different value proposition. How they may influence BCT for SSCM adoption is still largely unknown and requires further exploration.

Not all blockchains support smart contracts. Ethereum is still the most popular blockchain for building smart contracts (Chittoda, 2019; Di Angelo & Salzer, 2020). However, there are some notable blockchains that have emerged in addition to Ethereum which support both smart contracts and tokens. At the time of writing, these include EOSIO, Flow, Solana, and Tezos. The Hyperledger blockchain also supports smart contracts and has been used successfully in pilot studies in both shipping and food supply chains by IBM (Wang, Han, *et al*., 2019). However, Hyperledger tokens are still under development (Androulaki *et al*., 2021). An overview of these blockchains is provided in Table 4. The tokenisation of assets requires complementary and enabling decentralised applications (DApps), that provide a user-friendly interface for issuing and exchanging tokens for specific purposes (van Hijfte, 2018).

Table 4. Notable blockchains which support NFTs

	Ethereum	**Tezos**	**EOSIO**	**Flow**	**Solana**
Cryptocurrency coin	Ether (ETH)	TEZ (XZT)	EOS (EOS)	FLOW (FLOW)	SOL (SOL)
Fungible token standard	ERC-20	FA1.2 (TZIP-7)	N/A	flow-ft	N/A
Non-fungible standard	ERC-721	N/A	N/A	flow-nft	N/A
Multi token standard	ERC-1155	FA2 (TZIP-12)	dGoods	N/A	SPL token
Consensus protocol	Proof-of-work	Proof-of-stake	Delegated proof-of-stake	Proof-of-stake	Proof-of-history/stake.

The characteristics of NFTs that make them unique and of interest in the discourse of BCT for SSCM are explored further in the following sections.

4.1 Scarcity: the secret ingredient of non-fungible tokens

NFTs are a particularly exciting prospect because of their association with scarcity. Given that the value of an item is usually governed by key properties such as its ownability, authenticity and scarcity, BCT has made significant advances in terms of verifying the authenticity of products. However, BCT in isolation does not offer a form of provable ownership of (scarce) items. It was not until NFTs (the ERC-721 token standard) that smart contracts could be used to create unique, rare and distinguishable tokens with different properties that can be transferred between owners (Ethereum, 2021). Prior to ERC-721, crypto tokens were strictly fungible.

NFTs are rare, scarce, and unique tokens that can only be owned by a limited number of individuals. This inherent shortage of supply normally translates to increased desire (i.e. boost in customer demand). Research has already shown that 'scarcity' is a powerful psychological driver that influences human perception by placing higher perceived value on rare items as opposed to abundant ones (Chou, 2021; Worchel *et al*., 1975). This phenomenon is called the 'scarcity heuristic' (Mittone & Savadori, 2009). It explains how value is assigned to an item based on how easy (or difficult) it is to acquire the item or lose it to a competitor. Theoretically, this is based on the neurobiological nature of the human brain, usually wired to quickly estimate the quality or utility of an item based on its availability, exclusivity and scarcity that leads to irregular and irrational consumer behaviour (Mittone & Savadori, 2009). Facebook and Clubhouse are two prominent examples of how scarcity and exclusivity were used to influence perceived value. Facebook was initially available to Harvard students and Clubhouse was a 'by invitation

only' platform for Apple users (Chou, 2021). By tapping into one of the main core human drives i.e. scarcity through exclusivity, both systems were able to attract millions of users.

NFTs make great use of the power of scarcity and have already become increasingly popular in the creative and entertainment industries, namely art, music, and gaming (Wang *et al.*, 2021, p. 12). Digital artist Mike Winkelmann (known as Beeple) is a prominent example of how NFTs have been capable of transforming the digital landscape when it comes to value creation. Prior to 2020, his digital artwork sold for $100 per piece. He began selling exclusive NFTs of his work, which started at $66,000 (Tarmy & Kharif, 2021). By March 2021, Christie's auction house sold an NFT piece of his digital artwork for $69.3 million, making it one of the most expensive artworks of all time (Dowling, 2021). This fundamental economic difference highlights the significance of NFTs to increase the inherit economic value of an item through its rarity, authenticity and exclusive ownership.

4.2 Non-fungible tokens can represent physical products

Real-world examples where NFTs have been linked with physical items are limited (Ethereum, 2021). However, there are some early examples in practice which highlight their potential. A design studio called RTFKT (pronounced artefact) launched a collection of digital sneakers in collaboration with a digital artist named Fewocious. Customers purchased NFTs, with the promise of physical product being delivered at a later date. Nike have recently announced the acquisition of RTFKT (Nike, 2021). Nike had already filed patents for blockchain-enabled 'cryptokicks' sneakers in 2019 (Katje, 2021) indicating an interest to capitalise on the strong collectability culture in the world of sneakers. Similarly, a fashion brand called 'Overpriced' which considers itself an 'NFT-first and physical-goods-second brand' launched a collection of high-end hooded sweatshirts (Tong, 2021). Outside of fashion, L'Eau de distance by Danilo Lauria and Gunu Kapoor is a fragrance first to be issued as 10 exclusive NFTs on the Tezoz blockchain with the physical fragrance dispatched later (Salonga, 2021).

5. Non-fungible tokens for sustainable supply chain management: a future research agenda and propositions

The previous sections have outlined the existing barriers to BCT for SSCM using the TOE framework and have outlined the concepts of tokenisation, specifically detailing the unique characteristics of NFTs. The existing literature has highlighted some considerable commercial success stories of NFTs in the digital realm. Similarly, the practitioner

literature has reported the success of early initiatives that have used NFTs to represent physical items. They appear to represent a clear value proposition for customers. Therefore, we believe further conceptual exploration is needed to examine whether they can be utilised to advance BCT for SSCM. The barriers to BCT explained using the TOE framework in Section 3 have led to the development of the propositions put forward in the following sub-sections. They specifically propose ways in which NFTs can help to overcome the TOE-related barriers and ultimately help develop business cases for BCT for SSCM adoption. As highlighted in the introduction, this presently remains one of BCTs most significant barriers to progression.

5.2 Non-fungible tokens as accessible receipts of sustainable purchases

Although the existing literature suggests BCT can address transparency issues in supply chains, organisations are still unsure that BCT-enabled SSCM metrics and certification translates into a clear value proposition for customers. Customers ultimately justify the existence of a supply chain and the business model it supports by either accepting the product or service (Seuring & Müller, 2008). A successful business model must fulfil a customer need or desire with a clear value proposition (Osterwalder & Pigneur, 2010). There is a customer need for clearer SSCM metrics, so they are equipped to make decisions about making more sustainable purchases. We posit that NFTs enable traceability and SSCM data to be communicated in an accessible format for end users that represents a clear value proposition. This empowers them to make informed sustainable consumption decisions and provides them with proof of ownership, functioning as reward mechanism for making sustainable purchases.

A recent study proposed a directed acyclic graph (DAG) token design for traceability within supply chains whereby the transaction history of ERC-721 tokens on Ethereum could be retrieved within a matter of seconds without having to explore the whole blockchain. This was previously a time-consuming activity (Watanabe *et al.*, 2019). These developments have the potential to enable customers to immediately access and verify SSCM credentials stored on the blockchain in-store enabling them to make informed purchasing decisions and incentivising the customer to purchase the item.

P1. NFTs provide ownership of a digital receipt which can support and establish blockchain-verified SSCM certification and credentials.

5.3 Incentivising and rewarding sustainable behaviour and consumption

Borrowing from the gamification literature can help articulate an incentivising structure that drives and rewards sustainable purchases (and hence consumption) through NFTs. Gamification is the use of game mechanics (such as badges, avatars and leaderboards) in a non-gaming context to derive certain behaviours (Kark, 2011; Werbach, 2014). Such mechanics can be used in this context to incentivise and reward sustainable behaviour by devising a gamified engagement loop (Zichermann & Linder, 2013) around the pursuit and consumption of sustainable items through the collection of rare NFTs. More precisely, this can be achieved through two main game mechanics: exclusive badges and avatars.

First, scarcity can be achieved by attaching NFTs to sustainable purchases. This formulation guarantees that the exclusivity aspect is added to what used to be a regular (physical) product. By definition, NFTs are one of a kind and owning an exclusive/verifiable NFT in addition to the purchased product, transcending the value of the purchased item to that of a rare collectible. As such, the same intrinsic motivations and core drives attached to the appeal of owning rare items (Mittone & Savadori, 2009) and the reflected self-image (Bakker, 2011) (associated with purchases) can be achieved. Rare NFTs, therefore, can act as exclusive (sharable) badges, which is a potentially-important motivational factor that can provide a sense of accomplishment that incentivises users through social recognition (Chou, 2021; Gazzaniga, 2010) by associating the desired behaviour (sustainable consumption) to different rewards (i.e. publicly-granted badges). This again adds to the value of the purchase, as consumers not only get to contribute to the environment and collect rare tokens in return, but also get to show off this contribution. Hence, social proof (Ryan *et al*., 2006; Ryan & Deci, 2000) can also be developed in return, putting more pressure on other consumers to follow a similar sustainable pattern to achieve the same social recognition. This can be of substantial economic benefits to the whole SSCM ecosystem.

Second, once the adoption of such mechanisms spreads through different suppliers and manufacturers within the supply chain, a centralised system, aggregating and visualising consumer NFTs and their contribution towards SSCM, can be a useful addition. This system can help consumers showcase all of their purchases from different suppliers and even provide a quantifiable representation of their contributions towards a sustainable ecosystem in the form of a visually appealing and customisable avatar

(Hamari *et al*., 2014). This would provide an opportunity for consumers to share and compare their contributions with others on different social media platforms. Again, this can help develop a positive competitive environment to that of a virtual leaderboard in terms of who owns which limited collectible and who is contributing towards sustainability, and how. For example, those who are purchasing sustainable clothing lines can easily see that reflected on their avatar's unique costumes, compared to those who invest in organic food products seeing this reflected on their avatar's healthy physique. This in return can develop a positive engagement loop of sustainable purchasing patterns from different and diverse supply chains.

P2. NFTs can improve customer willingness to pay for SSCM products by gamifying sustainable consumption and by increasing the value of their possessions.

5.4 Incentivising and rewarding sustainable supply

A major barrier to BCT integration is convincing all supply chain partners to participate (Kshetri, 2018; Saberi *et al*., 2019). Fractional NFT ownership presents an interesting opportunity in this regard. Focal brands could issue shares of the NFT to all supply chain partners who comply with sustainability standards, so that they can receive a payment for the initial NFT sale and any future sales in secondary markets. This would incentivise the whole supply chain to compete together as a value chain. A visual example of this is presented in Figure 2. This shows how various certificates and transaction data can be uploaded to the BCT and packaged up in the form of an NFT by the focal brand. Figure 2 presents just one of many possible ways in which NFTs could be integrated in supply chains. An alternate solution would be for the tokens to be minted (created) upstream in the supply chain and then 'written' by supply chain partners as various transformations take place throughout the supply chain process (cf. dos Santos *et al*. 2021). Alternatively, each supply chain partner could mint an NFT that can be 'collected' by the customer.

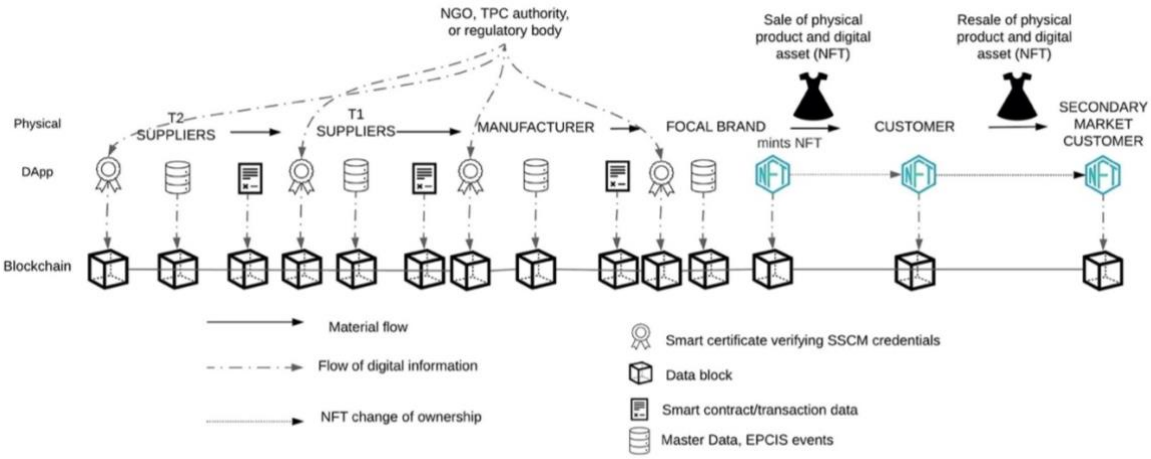

Figure 2. Using NFTs on blockchain for SSCM verification and incentivisation

P3. Tokenising SSCM with non-fungible and semi-fungible tokens could help incentivise the sustainable behaviour of all supply chain members.

5.5 Proof of ownership for anticounterfeit and circularity

As explained in Section 2, BCT has already been highlighted as a potential solution for addressing counterfeiting. BCT can help reduce information asymmetries that allow such practices to exist (Kouhizadeh *et al*., 2021). Although there have been successful BCT pilots in luxury sectors, such as with DeBeers diamonds (Hargaden *et al*., 2019), research exploring BCT as a counterfeiting solution is still scarce (Danese *et al*., 2021; Toyoda *et al*., 2017). Danese *et al*. (2021) highlighted that the characteristics of BCT are not guaranteed to offer protection against counterfeiting and adulteration if it is not complemented by a suitable platform (DApp). Furthermore, there are challenges related to associating physical items with their digital records on the blockchain (discussed in Section 5.5).

NFTs help provide the missing piece of the puzzle for BCT as an anti-counterfeit solution. They can prove product custody for physical items as they move through the supply chain, providing complete assurance. Therefore, they also have significant potential for usage in secondary or rental markets where product authenticity is a major concern (Choi *et al*., 2020; Kansara, 2020). For example, if NFTs had existed in 2006, then it would be highly unlikely that Rudy Kurniawan would have been able to con auction house Acker Merrall & Condit into selling $24.7m of counterfeit vintage wine (Hellman, 2012). NFTs may be of interest for policymakers involved with quality

assurance, such as those involved with Protected Designation of Origin goods (European Commission, 2021). This leads to the following proposition:

P4. NFTs can help reduce the negative social, environmental, and economic impacts caused by counterfeit supply chains.

The positive impact that NFTs could have on secondary or rental markets means they have the potential to accelerate the shift to circular economy (CE) principles. The CE concept has emerged in parallel with the SSCM discourse (Genovese *et al*., 2017) and embodies a transition from the traditional linear economy to a more restorative system (Bressanelli *et al*. 2019). Bressanelli *et al*. (2019) proposed that digital technologies will aid the transition to circularity in supply chains. The development of internet and mobile phone applications has already enabled platforms which support circular business models. For example, luxury fashion has seen a big growth in rental and resale markets; luxury resale actually grew during the Covid-19 pandemic when the rest of the sector saw a 40% decline in revenue (BoF and McKinsey, 2021). However, the counterfeiting risks presently threaten the entire value proposition of circular business models. NFTs would help to provide the level of assurance required by both businesses and companies to fuel luxury circular business model growth. The above discussion leads to the following propositions:

P5. NFTs can help to support circular supply business models and supply chains.

5.6 Reducing overproduction and overconsumption

Overconsumption and overproduction is an intractable problem in many sectors (e.g. fashion and food) where vast quantities of excess stock negatively impacts environmental sustainability issues such as carbon emissions and water consumption (Audet & Brisebois, 2019; Guo *et al*., 2020). As discussed in Section 4, NFTs can be linked with physical products ahead of their production. In other words, they enable an 'NFT first, physical product second' approach, offering the opportunity for companies to produce the exact quantity of products, therefore, help eliminate waste and reduce operating costs. In intrinsically innovation-led sectors such as luxury fashion, product flow to market typically requires agile supply chains (Fisher, 1997), where eliminating waste is not a prerequisite but still desirable. NFTs may help companies to implement agile supply

chain strategies, achieve better cost efficiencies and reduce their negative environmental impact.

Issuing NFTs in advance of the physical delivery of goods may also influence supply chain management strategies that have traditionally been broadly characterised in terms of make-to-order (MTO) or make-to-stock (MTS) (Naylor *et al*., 1999; Soman *et al*., 2004). As NFTs provide a digital representation of physical products, the products themselves do not have to be MTS. In other words, there is no need to hold inventory prior to the sale of the NFT. NFTs may help innovate new supply chain strategies whereby digital products are 'pushed' but the physical product is 'pulled' (with an MTO style execution) once the NFT sale has been made. Therefore, the decoupling point, the "point at which strategic stock is often held" (Naylor *et al*., 1999, p. 108), can be situated upstream, ensuring raw materials do not need to be committed until the NFT sale is complete. NFTs effectively present a risk-free way of trialling new products. If the NFT does not get minted or sold, then the product will not be manufactured. There will of course be limits with regards to how long customers are willing to wait for physical items, which means supply chain responsiveness will be essential for NFT-based business models. The ongoing developments with the 'hardware-driven technologies' associated with the fourth industrial revolution (I4.0) such as additive manufacturing (3D printing), are however promising in driving agility and responsiveness within supply chains and can enable rapid customised production (Hahn, 2020).

> **P6.** An 'NFT first, physical product second' (digital MTS x physical MTO) approach can help reduce the environmental waste and associated costs caused by overproduction.

It is important to highlight that NFTs are more than just a digital receipt or IOU. The next generation of consumers will likely be looking for NFTs that represent a digital twin to the real-world physical item that is an equally interesting value proposition within the metaverse space. For example, popular metaverses like Decentraland already allow participants to buy NFTs of a 'virtual tunic' for their virtual characters to wear in the virtual world (Dowling, 2021). It is therefore perceivable to project future states where customers buying a physical luxury item may also wish to enjoy their purchase in the virtual realm. For context, virtual citizens of Decentraland can buy a coded piece of the metaverse known as 'LAND' as an NFT which currently trades at $6,000 per lot

indicating its economic potential. Therefore, companies exploring NFT integration should consider what the NFT represents in the metaverse and how their digital operations support and complement physical supply chain strategies.

P7. NFTs that represent physical items need to represent an equally desirable value proposition in the metaverse.

With regards to overconsumption, there is the potential for NFTs to replace physical products entirely. This has important implications for mass market sectors, such as fast fashion. For example, Dress X, a digital only fashion company founded to help address overproduction in the fashion industry, offers digital-only designs for a fraction of the cost of a physical item (DressX, 2021). Customers upload a photo of themselves to the application which then utilises augmented reality technology to fit the garment to the customer which they can use to post on social media.

Some early predictions have suggested that digital fashion could minimise the negative impact of fast fashion supply chains (Roberts-Islam, 2021). NFTs are a natural extension of the digital product offering (Tong, 2021). In August 2021, Dress X launched its first ever NFT collection with Crypto.com, offering limited edition designs. This highlights how fast fashion brands may be able to offer semi-fungible digital alternatives instead of having to purely sell physical items. Therefore, they can reduce overproduction and material waste without having to compromise on revenue. If augmented and virtual reality continues to progress, then digital garments could replace some of the demand for physical items. However, there may be negative unintended consequences (Carter *et al.*, 2020) for social sustainability e.g. unemployment.

P8. NFTs can reduce the negative impacts of mass production by presenting a digital alternative to physical items.

6. Limitations of non-fungible tokens

Whilst NFTs can address some key BCT for SSCM adoption barriers, there are also some NFT-specific adoption barriers. These will be discussed in the following sections.

6.1 Linking non-fungible tokens with physical items

Linking the blockchain data with physical goods throughout the whole supply chain is a challenge that BCT needs to overcome (Watanabe *et al*., 2019). This can be seen as a general BCT challenge. However, it is a particularly salient issue for NFTs. So far, this has largely been achieved with RFID barcodes and QR codes that can be scanned to link to the blockchain data. However, barcodes are easily replicated (*Ibid*). Near Field Communication (NFC) chips encrypted with unique data is a potential solution to this (Danese *et al*., 2021) but anything physically attached to the product could easily be removed and attached to counterfeit goods. NFTs do not solve this issue. For example, an NFT could easily be resold with a counterfeit good in place of the original physical item.

There are developments in the field of chemistry that can enable the link between physical items with the NFTs and the related blockchain data. Kennedy *et al*. (2017) created a chemical signature by embedding engineered nanomaterials into features of a 3D part that could be scanned via a smartphone camera; scans were uploaded as a blockchain entry on Ethereum. In the textile industry, FibreTrace has created a patented system which blends indestructible bio-luminescent pigment with fibres, creating a unique signature that can be scanned via a small portable device throughout the supply chain and the data uploaded to the Hyperledger blockchain (FibreTrace, 2021). Ellis *et al*. (2017) successfully developed a handheld Spatially Offset Raman Spectroscopy (SORS) device for detecting chemical components within whisky supply chains, enabling counterfeit alcohol to be analysed in situ. The ‘Raman’ data was not added to the blockchain in this study, but it could be if the handheld SORS device had networking capabilities. Figure 3 presents a model for understanding how different layers of assurance can be achieved based on how the product is linked with the blockchain data.

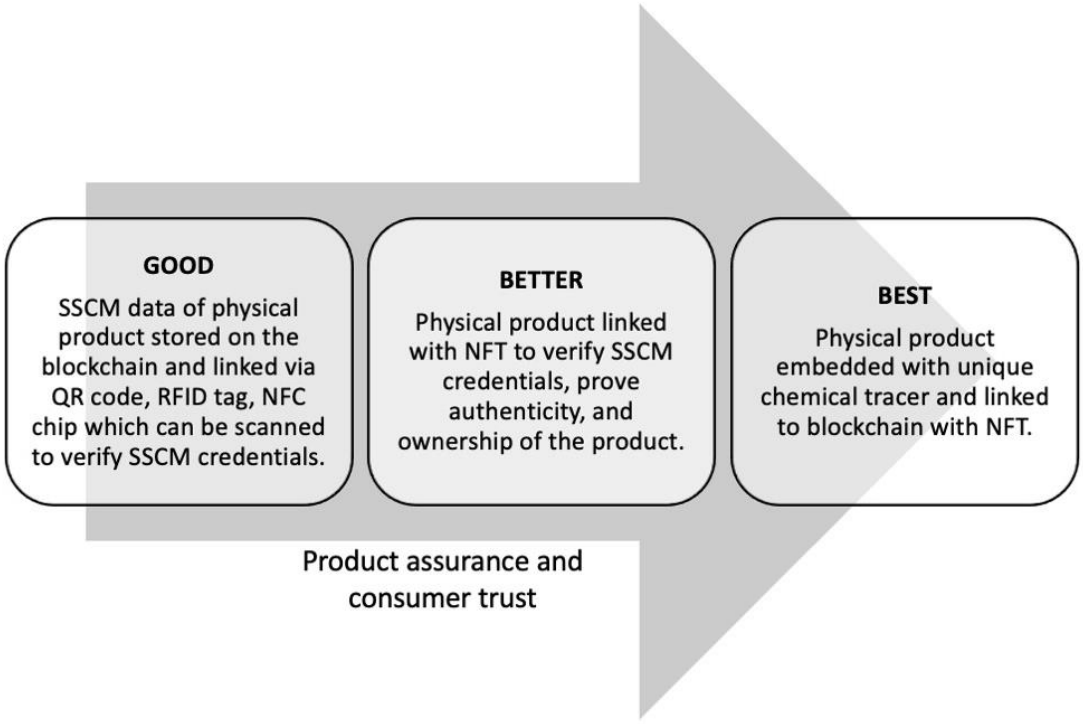

Figure 3. Options for blockchain-enabled product assurance

6.2 Interoperability

There are some interoperability issues with NFTs. NFT marketplaces are isolated from each other and are restricted to the BCT platforms upon which they are built. Customers can only sell, buy and trade NFTs within the same marketplace or platform, potentially limiting their widespread adoption (Wang *et al*., 2021). Selecting a blockchain platform that fits the strategic needs of a given organisation is an extremely important exercise, as once selected it could be difficult or costly to change platforms and can lead to feelings of managerial regret (Bai & Sarkis, 2020). Managers and company owners need to consider the blockchain scalability trilemma. For example, the EOSIO blockchain (see Table 2) has achieved impressive transaction speeds that far exceed those of Ethereum. However, its decentralisation has been called into question (Zhou *et al*., 2020). Managers will need to decide which characteristics of BCT are most desirable and consider the possible trade-offs involved with the different BCT platforms.

6.3 Minting costs

There are efficiency and cost issues with the NFT minting process (Di Angelo & Salzer, 2020). Minting costs can vary significantly depending on the blockchain platform used. Costs can fluctuate and could be prohibitively expensive for certain product categories. For example, on the Ethereum network, users minting an NFT need to pay a ‘gas fee’

which refers to the "unit that measures the amount of computational effort required to execute specific operations on the Ethereum network" (Ethereum, 2021). Unlike fungible tokens, NFTs must be minted individually which is time consuming, requires lots of computational power and thus can incur high gas fees (Regner *et al*., 2019). Gas fees can fluctuate daily and can be prohibitively costly (Jabbar & Dani, 2020). However, luxury supply chains characterised by 'innovative products' typically have larger profit margins (Fisher, 1997) that could accommodate fluctuating minting gas fee costs. Additionally, purchasing NFTs requires the user to first purchase the native coin of the blockchain, which presents further challenges as cryptocurrencies are extremely volatile (Regner *et al*., 2019).

6.4 Market risks

Crypto markets, such as NFT marketplaces, are extremely vulnerable to speculative bubbles (Cheah & Fry, 2015). However, bubbles occur in many traditional asset classes and so this should not necessarily deter interested parties from investigating NFTs further. However, to reiterate DiAngelo and Salzer (2020), token value is dependent on the level of trust that the participating community has in it. Therefore, businesses should consider the potential risks to corporate reputation when partnering with NFT marketplaces. NFT marketplaces are not immune from corruption. Like the rest of the crypto space, they are highly unregulated. In September 2021, OpenSea reported instances of insider trading – the NFT marketplace has since banned the practice (Hern, 2021). Although NFTs can help protect intellectual property, they can also be a target for counterfeiting. Recently there have been instances of fake NFT art sales, highlighting the importance of guaranteeing NFT authenticity (Bakare, 2021).

7. Discussion

This paper has highlighted several ways in which NFTs can help improve SSCM practice and overcome existing barriers to BCT for SSCM. The ability of NFTs to provide ownership and create value helps to provide the missing link that BCT needs to enable businesses to present a clearer business case for BCT for SSCM. They are likely to increase customer willingness to pay more for sustainable products which is an essential barrier for BCT for SSCM to overcome. Figure 4 presents a visual summary of the propositions that have been put forward, outlining the ways in which NFTs may positively impact SSCM and strengthen the business case for BCT for SSCM.

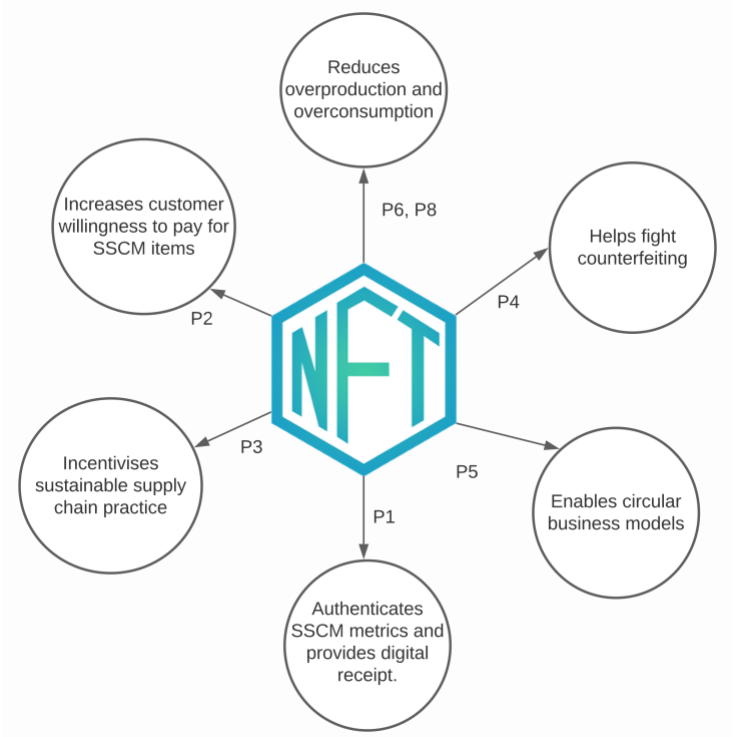

Figure 4. Ways in which NFTs may drive SSCM

Table 5 is based on the TOE framework that was used to introduce the barriers to BCT for SSCM (Section 3). It summarises how NFTs may (or may not) impact each barrier. NFTs are bound by many of the same technological constraints as BCT and so do not help to address technological barriers (although may help to improve the perception of BCT). However, they show significant potential for addressing some of the key organisational and external environmental barriers to BCT for SSCM adoption. NFTs provide an opportunity for blockchain-based SSCM product data to be presented in a way which represents a clear and meaningful value proposition for customers. As has been explained, BCT has struggled to deliver this previously, thus has struggled to provide the foundational element of a successful business model (Osterwalder & Pigneur, 2010).

Table 5. How NFTs address BCT for SSCM adoption barriers (Kouhizadeh et al., 2021; Saberi et al., 2019)

	Barriers to BCT for SSCM	**Can NFTs help?**	**Comments**
Technological context (T)	**T1** - Security	No	NFTs are a layer on the BCT and are only as secure on the blockchains they exist on.
	T2 - Access	No	NFTs are unlikely to overcome the barriers relating to the compatibility of BCT with existing supply chain information technology systems.
	T3 - Negative perceptions	Potentially	Only if they represent a trusted value proposition to stakeholders (e.g. customers) but NFTs are still open to

			corruption and therefore may not shake potentially negative connotations of BCT and cryptocurrencies.
	T4 - Immutability	No	Once you mint an NFT you cannot change its contents. Therefore, NFTs do not solve the immutability challenge of BCT.
	T5 - Immaturity	No	NFTs do not solve the blockchain scalability trilemma.
Organisational context (O)	**O1** - Financial constraints	Yes	Helps to justify investing in supply chain sustainability because it helps support business case.
	O2 - Lack of managerial commitment	Yes	Helps managers to develop clear business case for BCT for SSCM.
	O3 - Lack of organisational policies	Yes	Helps companies understand applicability of BCT for SSCM.
	O4 - Lack of knowledge and expertise	No	Could add further complexity. However, it could help engage managers/employees to gain knowledge about the technology.
	O5 - Organisational culture	Potentially	Could be the catalyst to engage employees with BCT for SSCM.
	O6 - Inertia	Potentially	There are many blockchains emerging which support NFTs. This may present managers with an overwhelming array of potential platforms and may lead to a reluctance to commit.
	O7 - Lack of benchmarks	Yes	Could facilitate the development of appropriate standards (e.g. for counterfeiting).
Environmental context (E)	**E1** - Lack of customer motivation to adopt BTC and make sustainable purchases	Yes	Activates customer core drivers for purchase, therefore, increases customer willingness to pay for authenticated SSCM products and services.
	E2 - lack of supply chain alignment	Yes	NFTs encourage the whole value chain to collaborate and compete as one. NFTs also help prove the chain of custody throughout the supply chain.
	E3 - Information disclosure between supply chain partners	No	Not directly. However, supply chain partners may be more incentivised to disclose information due to the benefits that can be gained from collaborating with supply chain partners.
	E4 - Integrating BCT and SSCM	No	Not directly. However, they could help extend the effectiveness of existing supply chain technologies such as RFID.
	E5 - Cultural differences of supply chain partners	No	Not directly. Although they may help unify international supply chain partners with a common goal.
	E6 - Lack of governmental policies	Yes	NFTs can incentivise government to introduce NFT policies that address counterfeit supply chains.
	E7 - Market competition and uncertainty	Yes	NFTs represent a clear value proposition to customers. Also, the 'NFT first, physical product second approach' can minimise risks related to market uncertainty.
	E8 - Lack of external stakeholder involvement	Yes	Could engage NGOs, third-party authentication bodies to encourage adoption. SSCM certification can be issued as NFT.
	E9 - Lack of industry BCT standards	No	NFTs do not solve this and may add further complexity that prevents the development of industry standards.

	E10 - Lack of rewards and incentives	Yes	NFTs can help to incentivise and reward consumers for sustainable consumption and incentivise supply chain partners to engage in SSCM practices.

This paper supports the recent calls of Eslami *et al*. (2019) and Saberi *et al*. (2019) to include technology in TBL and sustainability debates. However, integrating technology into TBL and SSCM adds further complexity to the situation. Integrating theories which help to explain and evaluate how technology intersects with SSCM may be a useful addition to the theoretical toolkit for SSCM and may help to better explain adoption barriers (Hwang *et al*., 2016; Saberi *et al*., 2019). However, studies which explore supply chain innovation and technology adoption usually lack a strong theoretical framework for barrier evaluation and analysis (Kouhizadeh *et al*., 2021).

This paper has discussed how NFTs may address the barriers to BCT for SSCM using gamification and the TOE framework. There are related underpinning theories of the TOE framework (cf. Hwang *et al*., 2016) that can strengthen its explanatory power and help guide future BCT-based supply chain research. We build upon Hwang *et. al*.'s work and propose some additional theoretical perspectives that could help strengthen the TOE framework for the purpose of BCT and NFT research (see Figure 5). For example, Resource-Based View and Natural Resource-Based View can be useful for exploring organisational contexts and both are well established in the field of SSCM (Sarkis *et al*., 2011). Furthermore, Resource-Based View has already been used to examine the impact of BCT (Treiblmaier, 2018) highlighting its suitability for examining how firms harness the technology to gain competitive advantage. Additionally, Information Processing Theory (IPT) has been highlighted as another suitable theoretical perspective for understanding BCT-enabled supply chains (Saberi *et al*. 2019). Finally, we propose that the development of areas such as tokenisation and NFTs require new theoretical angles from the world of gamification and behavioural theory to help explain the motivations for the adoption of such technologies.

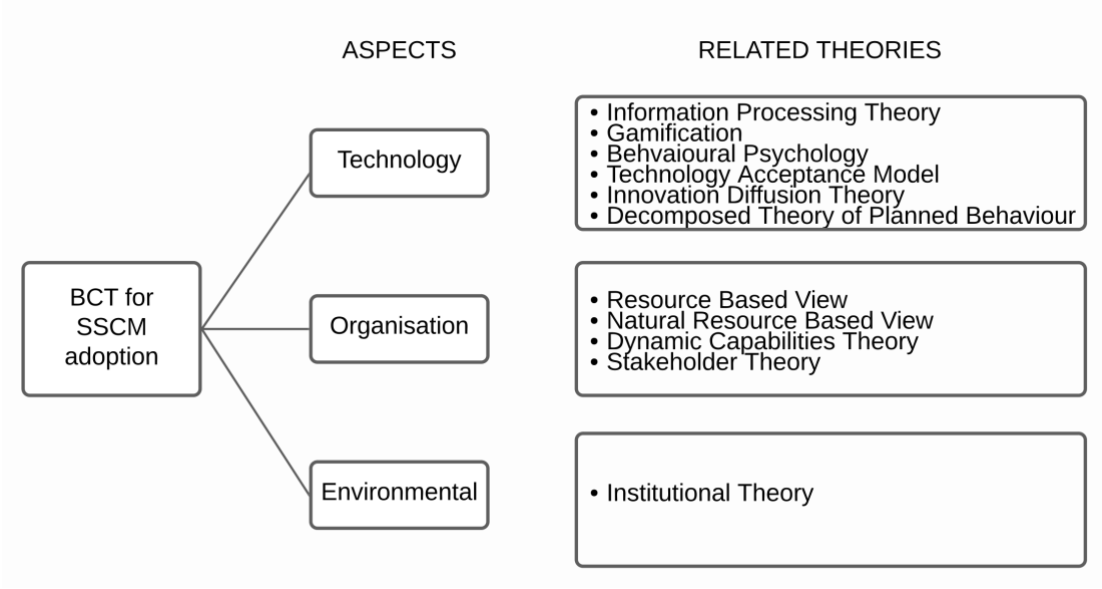

Figure 5. TOE framework and underpinning theories (adapted from Hwang et al., 2016)

Although NFTs have the potential to see widespread adoption across multiple industries and market sectors in the longer-term, this research suggests that, initially, their application may be better suited to sectors and industries where scarcity, rarity, exclusivity and uniqueness (the characteristics of NFTs) are desirable qualities and where companies are not competing on cost. The luxury sector is an example of this. Luxury is a macroeconomic sector which encompasses many different industries, including automotive, apparel, leather goods, jewellery, watches, beauty and fragrance, yachts, and fine foods (Nowiński & Kozma, 2017; Saberi *et al.*, 2019). Some scholars have already highlighted that BCT application is particularly suitable for usage in luxury supply chains (Danese *et al.*, 2021; Nowiński & Kozma, 2017; Saberi *et al.*, 2019; Schmidt *et al.*, 2021; Wang, Singgih, *et al.*, 2019).

One of the only pieces of academic research exploring the potential application of NFTs in supply chains to date, has been in high-end wine production. Different harvests of the same crop can have unique properties e.g. some wine producing regions or certain vintages can be more valuable than others (dos Santos *et al.*, 2021). Product provenance and assurance is particularly important for luxury markets as they are especially vulnerable to supply chain corruption and counterfeiting (dos Santos *et al.*, 2021; Nowiński & Kozma, 2017). Furthermore, customers in sectors such as luxury fashion are beginning to demand much more in terms of supply chain transparency and sustainability (BoF and McKinsey, 2021).

8. Conclusion

This paper extends the existing BCT for SSCM literature by conceptually exploring NFTs, a recent technological development in BCT. It concludes that NFTs have the potential to be the missing ingredient that BCT needs to drive sustainable supply chains. The ability of NFTs to prove ownership of unique digital and physical assets adds valuable capabilities to BCT that were previously missing. We believe NFTs can help a wide range of stakeholders to understand the value and benefits of BCT and can help strengthen the business case for BCT for SSCM adoption in several ways. NFTs show significant potential for advancing BCT solutions aimed at addressing product counterfeiting which negatively impacts all three dimensions of the TBL and causes major issues for international businesses, governments, and society in general. NFTs also show significant promise for supporting circular business models related to secondary markets and the sharing economy. This paper has also discussed the potential implications of NFTs for future supply chain manufacturing strategies and has proposed combining a digital MTS with a physical MTO strategy which can help reduce waste and associated costs.

NFTs are bound by many of the same technical challenges as BCT. However, if the blockchain scalability trilemma can be overcome then NFTs will become extremely scalable (Entriken *et al*., 2018; Regner *et al*., 2019) and could see widespread adoption. This paper has also highlighted some NFT-specific adoption barriers. Nevertheless, the early commercial success of NFTs indicate that they can be a valuable feature for BCT for SSCM solutions.

This paper has proposed that NFTs may be more suited to luxury markets initially. However, if BCT and NFTs become more scalable and affordable then application will likely extend to mass market products. For example, semi-fungible tokenisation could have important implications for pharmaceutical supply chains that are vulnerable to corruption and counterfeiting. This paper has conceptually explored the potential of NFTs for improving the potential of BCT for SSCM and has proposed several avenues for future research. Further empirical research is needed to understand how they may be utilised effectively for SSCM.

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Chapter 4 – Blockchain technology clusters as enablers for achieving sustainability: action research in a luxury textile supply chain (paper 3)

Abstract
This paper examines how emerging technologies (i.e., blockchain technology (BCT) clusters) can help to support TBL adoption in supply chains from a value creation perspective. An action research project is conducted with a luxury woollen textile manufacturer to explore two different BCT clusters. The first cycle investigates the potential pairing of BCT with Spatially Offset Raman Spectroscopy (SORS). The second cycle explores the pairing of BCT with bioluminescent nano-particle photon markers (marketed as FibreTrace®). The technology-organization-environment (TOE) framework, underpinned by a combined theoretical perspective of institutional theory, stakeholder theory and diffusion of innovations theory (DoI), are utilised to explain the adoption decision-making process. The findings suggest that BCT clusters, as part of the broader concept of 'sustainable innovation clusters', introduced in the research, can help support the business case for the adoption of TBL principles in practice. DoI theory aids in explaining how BCT clusters may help overcome present barriers and enable the more widespread diffusion of TBL practice in supply chains.

Keywords: blockchain, spatially offset raman spectroscopy, bioluminescent nano-particle photon markers, sustainable supply chain management, business case, business model innovation, triple bottom line

1. Introduction

Businesses are facing increasing pressure to address sustainable supply chain management (SSCM) concerns (Matos *et al.*, 2020). Failure to do so can risk damaging firm reputation and profitability (Roehrich *et al.*, 2014; Tuni *et al.*, 2020). Overall, the literature suggests that concepts such as the triple bottom line (TBL) are not diffusing as rapidly in business contexts as theoretically hoped and expected (Elkington, 2018). Despite the apparent motivations for sustainability, businesses often struggle to create a clear SSCM business case (BC) (Kirchoff *et al.*, 2016; Presley & Meade, 2018).

A range of factors have been shown to constrain or enable SSCM business case development (e.g. government regulation, customer demand, technology systems). These

can differ depending on the context of the organisational field being studied (Davies, 2021). Taking a broader, value-driven view of the business case for sustainability (Carroll & Shabana, 2010a) (as opposed to one that narrowly focuses on cost reduction) is a considerable challenge to overcome (Davies, 2021). SSCM business case development is generally hindered by a lack of supply chain transparency and accountability. Although it is largely acknowledged in the literature that integrating technology solutions built on ICT platforms can help to address such matters, existing centralised technology solutions have been identified as having considerable limitations that inhibit the success and progression of TBL sustainability goals in supply chains (Azzi *et al.*, 2019; Saberi *et al.*, 2019).

Emerging waves of technology, associated with the fourth industrial revolution (Industry 4.0) such as Blockchain Technology (BCT), have the potential to provide the required transparency levels for the widespread diffusion of TBL in SSCM and related business case development (Birkel & Müller, 2021; Kouhizadeh *et al.*, 2021; Luthra *et al.*, 2020; Nowiński & Kozma, 2017; Saberi *et al.*, 2019; Wang *et al.*, 2019). Some have suggested BCT can enable the creation of sustainability-based value and sustainable business model innovation (Kshetri, 2018; Saberi *et al.*, 2019; Wang *et al.*, 2019).

However, many practitioners and the industry at large are still unfamiliar with BCT or struggle to see a clear business case for adoption. Firms are exercising caution as they deliberate whether the potential benefits of BCT outweigh the current adoption challenges (Bai & Sarkis, 2020). A critical issue in this regard is the integration of BCT with complementary 'feeding and reading' technology solutions (e.g. RFID, QR codes, and Near-Field-Communication) (Danese *et al.*, 2021). Whilst additional technologies may help firms to realise the benefits of BCT for SSCM, they can also further complicate the adoption process. Furthermore, although feeding and reading technologies can aid the effectiveness of BCT they are not the optimal solutions for addressing issues related to supply chain corruption and counterfeiting (Azzi *et al.*, 2019). There are a range of emerging 'tracer technologies' that could be paired with BCT but even less is known about these combinations of technologies as most are not currently established in supply chains. The diffusion of innovations (DoI) theory (Rogers, 2003) helps in understanding technology combinations through the concept of 'technology clusters'. The literature is yet to address this in relation to BCT or its potential to tackle TBL issues. Examining this will assist in addressing the business case development related to the adoption of BCT clusters for TBL-based value creation.

Conversely, there have been propositions in the emergent literature suggesting that both value-driven SSCM business case development and technology adoption can be supported by business model innovation. Innovative BMs may be required to support a systematic, ongoing creation of business cases for sustainability technologies (Bendell & Kleanthous, 2007; Chesbrough & Rosenbloom, 2002; Nowiński & Kozma, 2017). The BCT literature has suggested the important role that business model innovation can play in widespread adoption (see Nowinski *et al*. 2017). However, little is known about how business model innovation may play a role in achieving the right business case for TBL and SSCM by using advanced technology clusters.

The main agenda of this paper is to explore how emerging technology clusters can aid and assist in the progression of the TBL agenda from a value creation perspective. It specifically seeks to address the barriers to SSCM business case development by examining the potential of BCT clusters to support sustainable business model innovations that can enable the more rapid and widespread diffusion of the TBL concept in supply chains. An action research project is undertaken in the luxury fashion sector. The study is supported by the managerial team from a luxury textile supplier in collaboration with researchers from the fields of operations management, chemistry, and an external supplier of a BCT linked tracer technology solution.

Luxury supply chains have been highlighted as a suitable context for BCT as they can be vulnerable to counterfeiting and product adulteration and are highly sensitive to reputational risks (Caniato *et al*., 2009; Nowiński & Kozma, 2017; Saberi *et al*., 2019). The sector has also been exposed to some high profile SSCM scandals (Guo *et al*., 2020). Some have suggested that some luxury fashion companies are lagging behind with sustainable development (Carrigan *et al*., 2013; Fernie & Perry, 2019; Karaosman *et al*., 2020; Moore, 2011). Continued technological developments may allow luxury fashion businesses to differentiate themselves based on good TBL performance (Blendell and Kleathouse, 2007) and begin to capitalise on this in earnest by providing proof of SSCM credentials (Nowinski & Kozma, 2017).

The study employs the Technology-Organisational-Environmental (TOE) framework (Tornatzky *et al*., 1990) to examine the adoption decision-making processes in a real supply chain context. The TOE framework is supported by the integration of a combined theoretical perspective of stakeholder theory, institutional theory (both well established in SSCM) and DoI theory. The action research supported by the theoretical scaffold seeks answers to the following research question:

RQ. Can a BCT-based technology cluster help to create a stronger business case for substantive TBL adoption in SCs?

2. Research Background

2.1 Blockchain technology for sustainable supply chain management

A key barrier to the progression of SSCM is its reliance on centralised information systems and the need for trust between supply chain partners (Saberi *et al*., 2019). However, dependencies on trust come with a risk of deceptive behaviour. Hence, centralised systems can leave the supply chain vulnerable to corruption and counterfeiting (Azzi *et al*., 2019). As a decentralised ledger technology, BCT presents an opportunity for 'trust-free' supply chains due to its ability to create immutable, consensually agreed, fully auditable records of all prior transactions, approved by the whole network (Hawlitschek *et al.*, 2018). The characteristics of BCT make it possible to deliver unprecedented levels of supply chain transparency, verifiability, accountability which may reduce or even completely eradicate information asymmetry (Frederico *et al*., 2019; Saberi *et al*., 2019). Its potential for advancing the SSCM agenda has been highlighted by several scholars (Bai *et al*., 2020; Bai & Sarkis, 2020; Garcia-Torres *et al*., 2019; Kouhizadeh *et al*., 2021; Saberi *et al*., 2019).

Some have predicted that BCT is more effective at managing the environmental pillar of TBL (Saberi *et al*., 2019). Others have highlighted its potential for minimising socially damaging supply chain practices (e.g. the production and distribution of counterfeit goods) (Bai & Sarkis, 2020; Kouhizadeh *et al*., 2021). Despite the recognised potential for improving TBL performance in supply chains, several barriers to BCT adoption have been identified (Kouhizadeh *et al*., 2021). These range from technical barriers owing the immaturity of BCT, through to lack of organisational and customer understanding (*Ibid*). Like SSCM, the lack of a clear business case is a major barrier to BCT adoption (van Hoek, 2019). It has been labelled as a 'solution looking for a problem' (van Hoek, 2019; Verhoeven *et al*., 2018).

From a supply chain perspective, BCT is fundamentally a platform for information and process transparency. Therefore, understanding its viability for creating value requires considering BCT as part of a bundle of solutions. Watanabe *et al*. (2019) state that linking BCT data with the physical product as it moves through the supply chain is a challenge that needs addressing. The literature refers to this approach as a 'technology cluster', described as "distinguishable elements of technology that are perceived as being

closely interrelated (Rogers, 2003, p.14). Rogers (2003) states that perceiving innovations in this way can increase the likelihood and rate of adoption.

Wang *et al*. (2019) suggested that further diffusion of BCT in supply chains would require interactions with other technologies such as IoT and Artificial Intelligence. Danese *et al*. (2021) posited that BCT application in supply chains requires the integration of compatible and complementary information 'feeding and reading' technologies such as RFID tags, labels with QR codes, or Near Field Communication (NFC) chips. However, Azzi *et al*. (2020) suggests that RFID, QR codes and NFC technologies must all be attached (not embedded in the products) subsequently limiting the potential of BCT to deal with counterfeit or adulterated products. Tracer technologies have received scant attention in the existing supply chain literature. However, chemistry scholars such as Ellis *et al*. (2015;2017) have proposed they have important implications for supply chain practice. Taking a chemical reading of a product in its raw state or adding a unique tracer element for detection enhances the utility of BCT (Azzi *et al*., 2019). It offers the best protection against counterfeiting and deceptive supply chain practice e.g. greenwashing the term used to describe "the creation or propagation of an unfounded or misleading environmentalist image" (Oxford English Dictionary, 2022).

2.2 Sustainable supply chain management business cases and sustainable business models

The literature established that achieving the goals of TBL and SSCM is mainly predicated on the existence of a clear and justified business case (Carroll & Shabana, 2010a; Kirchoff *et al*., 2016; Presley & Meade, 2018), supported by and in alignment with the business model of the organisation (or supply chain) (Schaltegger *et al*., 2012). The business case and the business model concepts have received substantial attention in the existing SSCM and sustainability literature. There is no consensus regarding an exact definition of either concept and only a limited amount of literature has addressed their relationship (see Schaltegger *et al*., 2012). The literature suggests that both the business model and business case concepts have been addressed in a siloed and isolated manner (Zott, 2011). For example, they have been examined in the context of corporate social responsibility (Carroll & Shabana, 2010), SSCM (Kirchoff *et al*., 2016) Circular Economy (Geissdoerfer *et al*., 2018; Mendoza *et al*., 2019) and sustainability more generally (Hahn *et al*., 2014). For this study, the business case concept is viewed as being central to explaining the reasons why companies may adopt or improve their sustainable practice

and why this may be of benefit and value to the company (Carroll & Shabana, 2010a). BM, on the other hand, is considered as a means of describing the required organisational architecture for creating, delivering, and capturing this value (Osterwalder & Pigneur, 2010; Teece, 2010; Zott *et al*., 2011).

2.3 Business model innovation

The business model concept has become an accepted unit of analysis used to explore how companies 'do business' (Zott *et al*. 2011). It accommodates perspectives beyond the organisational boundaries of the central organisation (*Ibid*), leading some to highlight the supply chain as a key business model facet (Boons & Lüdeke-Freund, 2013). A key characteristic of both business case and business model is the need for continuous review over time to reflect and adapt to changing business conditions, including changing market trends, legislation, and ongoing technological developments (Kurucz *et al*., 2008; Teece, 2010). An important concept that has emerged is the notion that the business model concept may help businesses to innovate but can also itself 'be innovated' (Mitchell & Coles, 2003; Zott *et al*., 2011). Business model innovation is aimed at ensuring firms can achieve sustained competitive advantage (Mitchell & Coles, 2003). Business model innovation encompasses minor modifications to existing BMs to radical transformations, redesigns and even the creation of entirely new business models (Foss & Saebi, 2017; Geissdoerfer *et al*., 2018). Schaltegger *et al.* (2012) posited that the business case or business cases (plural) for sustainability should be supported by business model innovation. Sustainable business model innovation has since emerged as a subcategory of business model innovation (Geissdoerfer *et al*., 2018).

Technology is perceived to have no intrinsic value, and it is the business case and business model concepts that offer validation and justification for its existence through the realisation of practical application (Chae *et al*., 2014; Teece, 2010; Zott *et al*., 2011). An innovative business model is essential for unlocking the latent potential of technology (Chesbrough & Rosenbloom, 2002). As previously discussed, technologies such as BCT have the potential to transform BMs across industries and their supply chains (Nowiński & Kozma, 2017; Wang *et al*., 2019). However, according to the business model innovation concept, discovering the latent potential of BCT will only occur if coupled with a viable business model that gives it a 'raison d'etre' (Chesbrough & Rosenbloom, 2002).

2.4 A preliminary conceptual model

Viewing the business model in conjunction with the business case provides an important perspective. business case logics indicate that commercial enterprises, unless driven by the altruism of owners, will typically only engage in activities that improve their TBL performance the economic business benefit is not compromised (Busse, 2016; Paulraj *et al.*, 2017). Determining the environmental and social value propositions of business practice, irrespective of whether they translate to economic benefit for firms, raises bigger questions with regards to how business value is perceived (Birkel & Müller, 2021). If businesses are reportedly still struggling to move beyond the economic bottom line (Elkington, 2018; Kirchoff *et al.*, 2016), then focusing on translating environmental and social value outputs into traditional economic-based value (Kurucz *et al.*, 2008), through the process of business model innovation, may be key for ensuring the rapid and widespread adoption of SSCM and the TBL. Birkell and Müller (2021) proposed that BMs that span supply chains and commercialise SSCM credentials are required to fully unlock the potential of Industry 4.0 technologies.

A visualisation of the relationships between the TBL concept, emerging BCT clusters, and the concept of business model innovation is presented in Figure 1 and is used to shape and guide the action research methodology.

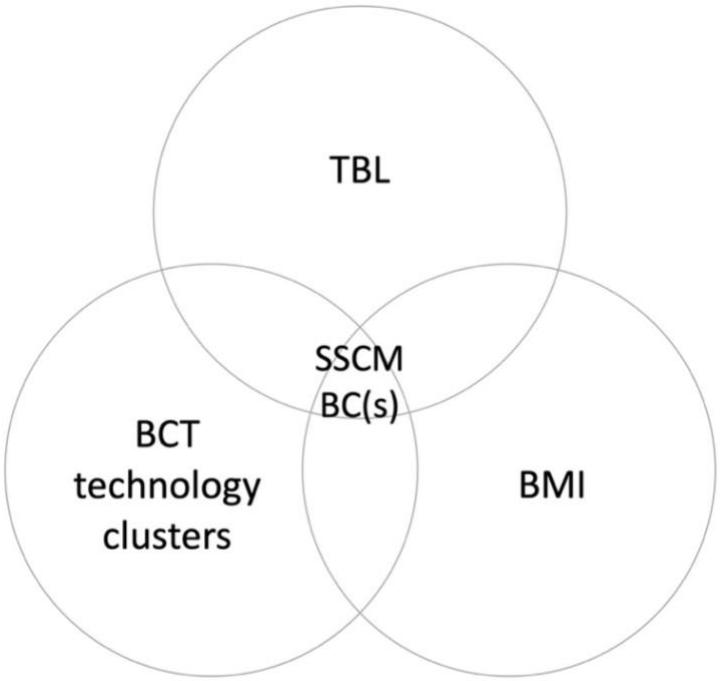


Figure 1. Conceptual framework to visualise how SSCM BCs may be achieved through the synthesis of the TBL adoption, emerging technology clusters and business model innovation

2.5 Theoretical underpinning of the research

The TOE framework (Tornatzky *et al*., 1990) is a theoretical framework used to explore the organisational decision-making related to innovation adoption (Hwang *et al*., 2016; Tornatzky *et al*., 1990). It posits that the decision to adopt technology is based on a range of factors that can be broadly categorised in three different context groups. The technology (T) aspect refers to technological capability, complexity, and availability. The organisational (O) aspect concerns intra-organisational priorities and considerations. The environmental (E) aspect describes the external conditions of a given industry including regulatory conditions, inter-organisational relationships, and market competition (Tornatzky *et al*., 1990). TOE has been established as a suitable theoretical framework for exploring BCT in sustainable supply contexts (Kouhizadeh *et al*. 2020). However, Hwang *et al*. (2016) have proposed integrating organisational theories to strengthen its explanatory power.

Figure 2 shows the TOE framework employed for this study underpinned by institutional theory, stakeholder theory and DoI theory. Institutional theory and stakeholder theory are complementary, as both are employed to explain organisational efforts to gain legitimacy (Sarkis *et al*., 2011). The combination of these two theories provides a foundation for exploring both the external pressures to adopt sustainable practice within the organisational field (institutional theory), and the internal response to both external and internal stakeholder pressures of the organisation (stakeholder theory) (Govindan, 2018).

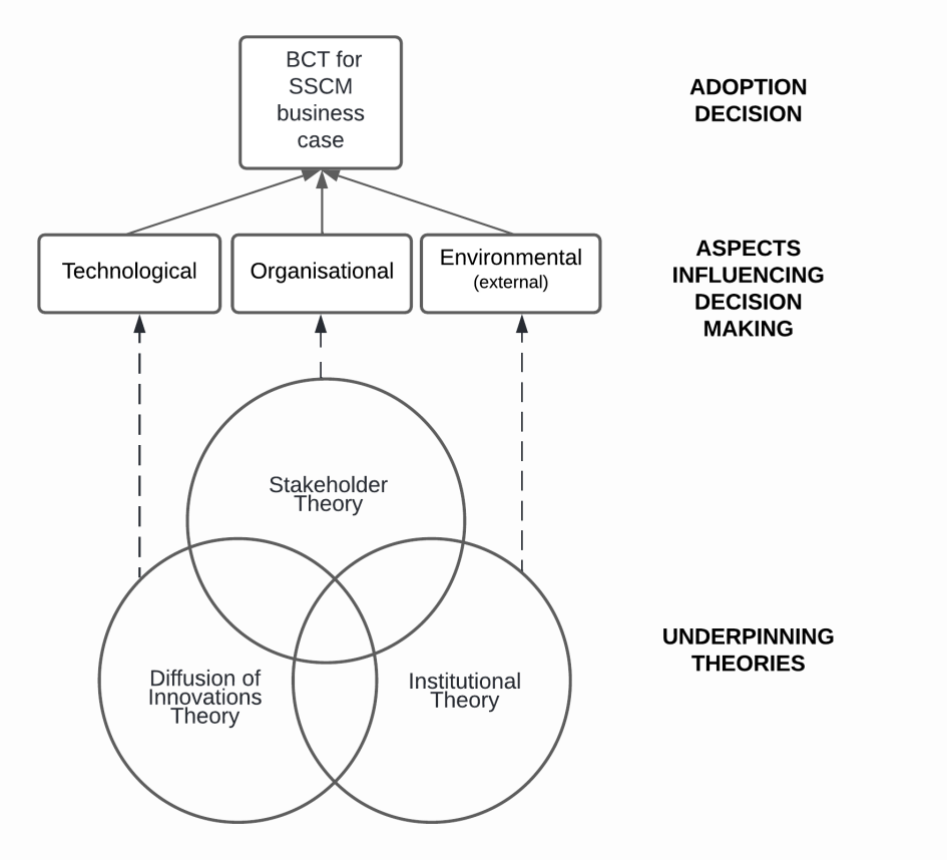


Figure 2. TOE framework and middle-range theories used in the study (adapted from Hwang et al. 2016)

Technology is increasingly seen as an essential component of the achievement of the TBL and the broader sustainability concept (Eslami *et al*., 2019; Saberi *et al*., 2019), yet SSCM research which focuses on technology is typically atheoretical (Kouhizadeh *et al*., 2021). Saberi *et al*. (2019) called for the integration of theories that can help support these types of inquiries. DoI theory has been identified as a promising theory for SSCM research (Sarkis, 2011).

Institutional theory has gained popularity in SCM research (Shibin *et al*., 2018). It suggests that firms are motivated to gain legitimacy (in addition to economic success) to increase their chance of survival within their 'organisational field' which refers to "recognised areas of institutional life" taking the "totality of relevant actors" to be the unit of analysis (DiMaggio & Powell, 1983, p. 148). This makes it well-suited to supply chain research. Firms gain legitimacy by conforming to normative, coercive, and mimetic isomorphic pressures (Ibid). Subsequently, firms develop homogenous characteristics over time yet the need to conform can conflict with organisational goals such as profitability. This leads to 'institutional decoupling' where organisation practice

disconnected from the projected image (Meyer and Rowan, 1977). This aspect of theory has been useful for explaining greenwashing and sustainability corruption (Blome *et al.*, 2017; Silvestre *et al.*, 2020).

Institutional theory's capacity for explaining the organisational need for legitimacy connects well with the business case for sustainability discourse. Several scholars have highlighted that there is a business case for adopting sustainable practices to gain legitimacy in the eyes of stakeholder groups (e.g. customers, prospective employees and shareholders) to ensure long-term economic viability (Carroll & Shabana, 2010b; Carter & Rogers, 2008; Roehrich *et al.*, 2014).

Whilst institutional theory accurately explains why firms develop homogenous characteristics, it does not sufficiently explain why they may produce heterogeneous responses. Stakeholder theory can be used to moderate the limitations of institutional theory as it considers the pressures enacted on firms from an individual to societal level (Govindan, 2018). Stakeholder Theory is one of the most popular theories in SSCM research (Touboulic and Walker, 2015; Davies 2021). Stakeholders can be defined as "groups or individuals who can affect or are affected by the achievement of an organization's mission" and can be either external or internal to the company" (Freeman *et al.*, 1984, p. 52). Stakeholders have the power to influence the success of a company, therefore failing to respond to their demands can be seen as a major organisational risk (Katiyar *et al.*, 2018). The instrumental stakeholder theory is the most popular variant in SSCM research (Davies, 2020), which connects well with business case and business model objectives as it assumes that organisational willingness to engage in SSCM is ultimately motivated by self-interest. In essence, it suggests that firms can do well (financially and reputationally) by doing good (Busse, 2016). Furthermore, failing to do so can threaten company reputation (Katiyar *et al.*, 2018).

Despite their explanatory power, institutional theory and stakeholder theory are not adept at revealing the specifics of innovation or technology adoption hence the value in utilising the DoI theory. Diffusion refers to the "process in which an innovation is communicated through certain channels over time" (Rogers, 2003, p.5). An innovation can be defined as an "idea, practice, or object that is perceived as new by an individual or another unit of analysis" (e.g. an organisation) (p.12). The terms "technology" and "innovation" have become somewhat synonymous. Technology has been the dominant focus of DoI research (Rogers, 2003). However, DoI theory is sufficiently broad to

accommodate technology, sustainability (viewed through the TBL paradigm) and business model innovation as forms of innovation.

DoI postulates that the decision-making process for innovation adoption typically follows five stages: 1) knowledge about the innovation; 2) persuasion to adopt the innovation; 3) decision to adopt or reject the innovation; 4) implementation of the innovation; 5) confirmation of innovation adoption; (continued adoption). Rogers (2003, p.2) defines adoption as "a decision to make full use of an innovation as the best course of action". The decision to adopt the innovation is influenced by the attributes of the innovation(s) as perceived by the organisation (Rogers, 2003). Rogers (2003) classified these attributes into five main categories: 1) relative advantage – answers the question "is it better than what I do now?" and is usually discussed in terms of a ratio of the expected benefits to costs of adoption; 2) compatibility – the degree to which the innovation meets the existing values, practices and the needs of the organisation; 3) complexity – concerns how difficult the innovation is to use or understand; 4) trialability – the degree to which the innovation can be tested before full commitment; 5) observability – the visibility of the effect of the innovation adoption to others. Other important aspects of the theory include the notion of 'innovativeness and adopter categories' which can be used to describe the extent to which an organisation may be relatively earlier in adopting innovations than other members of a social system.

3. Methodology

The following section provides an overview of the action research approach, the collaborating organisation (section 3.2) and the project team (section 3.3). Finally, an overview of the action research cycles and data collection is provided (section 3.4).

3.1 Action Research

AR has become a popular approach for operations management and supply chain management research (Benstead *et al.*, 2018, 2021; Coughlan & Coghlan, 2002, 2016; Müller, 2005). There have been calls for more participatory SSCM research which adopts an action research design (Pagell & Shevchenko, 2014; Touboulic & Walker, 2016). Researcher participation is an essential feature of action research. It is "research in action, rather than research about action" (Coughlan & Coghlan, 2002, p. 222). Action research aims to solve practical problems and bring about organisational change whilst simultaneously contributing to scientific knowledge (Coughlan & Coghlan, 2016; Näslund *et al.*, 2010). It seeks to take the findings and reflections of the specific action

research project and extrapolate them to a "theory-based context beyond [the] local situation" (Coghlan and Shani, 2018).

The synergy amongst AR, pragmatism, and sustainability, combined with the ability of action research to provide a deeper connection between research and praxis, makes it a particularly well-suited approach for the type of inquiry undertaken in this study (Touboulic and Walker, 2016). Action research has been selected due to the transformational nature of SSCM and technology innovation and because this research focuses on bringing about organisational and societal change. The study follows a traditional action research approach where collaboration occurs between the practitioners (firm insiders) and outside researchers in a democratic manner in the pursuit of 'workability', that is, desirable practical outcomes that solve the identified problem or need (Greenwood & Levin, 2007).

3.2 The collaborating organisation

The research team have collaborated with a multi-million-pound, heritage woollen mill (referred to henceforth as 'The Milling Company'), operating in the luxury textiles sector. The mill and company headquarters are situated in West Yorkshire. It is one of only two vertically integrated mills in England. The company is still family-owned, led by the 7th generation of the family to run the business. The Milling Company is a royal warrant holder and is Woolmark certified (Woolmark, 2021). They predominantly use wool from Merino sheep to make their fabrics. Their customer segments include luxury fashion houses, the British military, and Saville Row tailors. More information regarding the company business model can be found in Appendix 1.

The company displays all of the 'critical success factors' (CSFs) required for operating in the luxury sector (Caniato *et al.*, 2011), including a global reputation for excellence and premium product quality from end-to-end of the supply chain; a heritage of craftsmanship; a reputation for continuous innovation to sustain the product positioning as being technically superior; a strong association with the company country of origin.

The compatibility of the concepts of luxury and sustainability have been debated in the academic literature. The association of luxury with ostentation and personal excess seemingly conflicts with the notions of selflessness and moderation associated with sustainability (Kapferer, 2010; Widloecher, 2010; Hennigs *et al.*, 2013; De Angelis *et al.*, 2017). However a desire to preserve rare natural resources, skilled craftsmanship and superior product quality and longevity suggest luxury and sustainability have many areas

of common interest (Sheth *et al.*, 1991; Wiedmann *et al.*, 2007, 2009; Kapferer, 2010; Cervellon & Shammas, 2013; Hennigs *et al.*, 2013; Cervellon, 2014). It is the latter position with which The Milling Company aligns itself. The company aligns itself with the 'slow fashion' movement (seen as the antithesis of fast fashion) which embodies many of the same CSFs as luxury (Presley and Meade, 2018). Incidentally, The Milling Company has conducted in-depth market research on slow fashion and is deeply involved in related educational drives on the subject.

The Milling Company takes a holistic TBL approach to SSCM. It has played a key role in the 'Campaign For Wool' initiative which aims to promote wool as a 100% natural renewable and fully biodegradable resource that is a natural alternative to environmentally damaging practices (The Milling Company, 2020). The Milling Company publishes annual sustainability reports in which it states that the business would "continue to design [their] future business with a long-term outlook engaging future family generations" (p.6). The report states that the company "recognise that a sustainable business must be built around an operating model that renews rather than depletes resources, that balances the will for growth with the need to conserve and that provides stability whilst adjusting rapidly to changing market conditions" (p.6)

From an environmental perspective, The Milling Company has made a concerted effort with reducing material waste, and energy and water consumption. It has invested in cutting edge machinery and redesigned production processes reducing their electricity consumption by 28%, gas consumption by 39% and water consumption by 37.5% (per metre of fabric produced) since 2015. Social sustainability principles align with many of the existing practices of the company. It works closely with several local businesses with whom it has longstanding partnerships. The company own several residential properties and provide affordable housing for its employees (*Ibid*). It states "we find that our approach of treating employees as family encourages a greater level of loyalty. Our average length of service is 9.2 years against the UK average of 3.2 years, our current longest serving employee has been with us 42 years, with our all-time record being 65 years" (The Milling Company, 2020, p.35).

3.3 The project team

The action research collaboration consisted of a 'research team' from the University of Liverpool Management School and the chemistry department's Surface Science Centre and a 'management team' from The Milling Company. The research team consisted of a

PhD researcher in SSCM and BCT with a practitioner background in the luxury fashion sector; a reader in operations and supply chain management; a professor in operations and supply chain management; a professor in chemistry; a research associate in chemistry. The management team consisted of a director of sales; a director of quality management; a marketing manager; an assistant marketing manager; a senior process engineer; an assistant process engineer. The lead researcher, experienced in the luxury fashion sector, worked part-time with The Milling Company for the duration of the project. Regular meetings were held with the whole research team to evaluate action and diagnose the issues for the next cycle (Saunders *et al*. 2019; Coghlan & Brannick, 2014). To prevent bias and increase rigour, all other members of the research team maintained distance from the collaborating company.

3.4 Action research cycles; data collection and analysis

The 'spiral of action research cycles' framework, proposed by Coghlan & Brannick (2014), has been adopted to provide rigour to the research. First, there is a 'pre-step' to comprehend the project context and rationale for action (Coghlan, 2019; Coughlan & Coghlan, 2002). Next is a series of iterative cycles, each following four main steps: constructing, planning action, taking action and evaluating action (*Ibid*). It is the continual exploration and evaluation of solutions to issues at multiple stages of the research, with the distinct aim of evoking change, that distinguishes action research from other research strategies (Saunders *et al*., 2019). Constructing the issue involves establishing the theoretical and practical foundations for action (D.Coghlan, 2019).

The numerical order of the cycles in this action research research misleadingly suggest they were conducted in a chronological fashion. In practice, research cycles often occur concurrently (Benstead *et al*., 2018). Cycles 1 and 2 are focused specifically on reflection upon the attributes of the technology clusters. There was a degree of overlap between evaluating the technology cluster cycles (Cycles 1 & 2) and discussions about how this connects and supports the company business model and the business case for technology adoption and SSCM procedures more generally (Cycle 3). The data sources for this research included: researcher journal entries noting observations made during researcher participation in the day-to-day activities of the firm; meeting minutes; employee and research partner interviews; spectra scans (laboratory data); and company documentation (e.g. company sustainability and market research reports).

Qualitative data was analysed using Nvivo software. During the pre-step (Section 4.1), themes relating to the business case drivers for exploring BCT clusters emerged inductively from the interview data and meeting minutes analysis. These were triangulated with company reports. During cycle 1 and 2 the attributes of innovation typology (Rogers, 2003) was used to deductively code the interview data and meeting minutes relating to the responses to the exploration of the two BCT clusters. These were triangulated with the lead researcher's journal entries to provide a more comprehensive and robust explanation of the phenomena and omit the likely possibility of bias that is inherent to a single data source. Laboratory scans were analysed by the chemistry team an explained to the rest of the project team.

4. Action research: cycles and findings

4.1 The 'pre-step' – establishing prior conditions and context for action

The pre-step is a core action research activity (Coghlan & Shani, 2018) and helps understand why the project is necessary or desirable by establishing the context and mutual interest of the collaborators (Coghlan, 2019). As explained by DoI theory, decision-making units rarely expose themselves to innovations before first establishing a problem or need (Rogers, 2003). In the case of this action research project, the problem was observed by both the lead researcher and the collaborating organisation independently of each other in the luxury fashion sector. The problem, as explained by the decoupling aspect of institutional theory, was that many luxury fashion organisations were symbolically adopt sustainability and TBL (that can be seen as a form of innovation) without substantively adopting it in practice, something Meyer and Rowan referred to as a 'ceremonial façade' (Meyer & Rowan, 1977).

Several sources of academic literature have either implicitly or explicitly explained the decoupling between TBL theory and practice. Bowen *et al* (2006, p. 151) described it as the "apparent paradox between the desirability of green supply in theory, and the slow implementation of green supply in practice". Brockhaus *et al* (2019, p. 1166) postulated there was a "gap between often elusive sustainability aspirations and tangible product improvements". Some have blamed this on a gap between academia and practice (Rashidi *et al*., 2020). However, others have suggested the gap between theory and practice also occurs within the industry itself i.e. between captains of industry and practising managers (He *et al*., 2019).

Rogers (2003) uses the term ‘preventative innovations’ to describe innovations that are “adopted now to lower the probability of some unwanted future event”. The adoption benefits may only be realised at a later or unknown date and so the “relative advantage of a preventative innovation is delayed reward” (2003, p.234). This contrasts with what he terms ‘incremental innovations’ where the beneficial consequences are felt in the short term. This aspect of DoI corresponds with the notion of narrow and broad views of SSCM BCs and offers an explanation as to why some scholars have found there to be the need for a clear business case for SSCM adoption (Golicic & Smith, 2013) and why others feel the matter is unsettled (Kirchoff *et al.*, 2016; Kitsis & Chen, 2019). Scholars such as Hahn (2014) have highlighted that sustainability outcomes have different time horizons which create a source of tension.

Expanding upon DoI theory can help explain that organisations may perceive the relative advantage of superficially adopting the TBL (e.g. making reputational or profit gains) without having to consider how the other perceived attributes of the innovation will play out in practice. Figure 3 provides a visual representation of the problem observed by the project team. Figure 4 adapts the five-stage innovation-decision process model by Rogers (2003) to reflect the observed problem adding in a third option of ‘superficial adoption’ during stage 3 to account for greenwashing firms. This raises the question of why all organisations would not then symbolically adopt sustainability. It is likely answered by the reputational risk that such subterfuge may be revealed (Katiyar *et al.*, 2018; Roehrich *et al.*, 2014; Tuni *et al.*, 2020). Some practitioners have referred to this as the ‘death star hit’ which refers to when a reputation-damaging scandal hits the company that deeply conflicts with the sustainability values of the social system in which they operate and that they have projected to the world. This type of misdemeanour threatens to destroy the whole business (Davies, 2021). For example, when news broke that Burberry was burning excess stock worth millions of pounds, it caused a public uproar (Guo *et al.*, 2020).

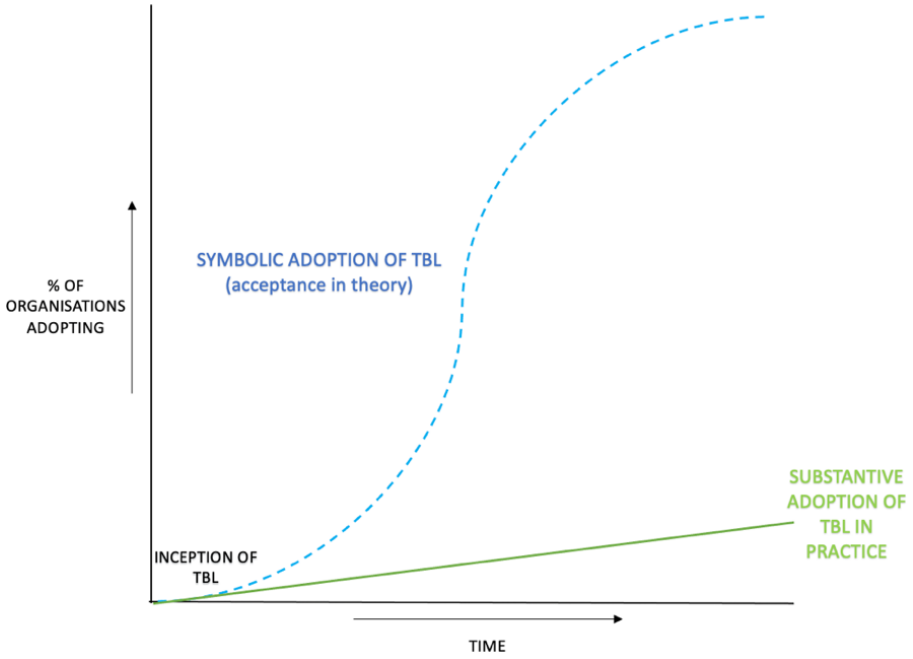


Figure 3. Disparity between symbolic and substantive TBL adoption over time (adapted from Rogers, 2003)

The 'felt need' (felt independently by both the research and managerial team) for addressing this problem was to improve supply chain transparency. The present lack of supply chain transparency results in a two-fold problem. Firstly, companies which have substantively committed to sustainability (like The Milling Company) may not be fully able to gain the benefits or the first mover-advantage that can be gained by being 'innovators' or 'early adopters' (Rogers 2003; Porter, 2004). For example, it means they may struggle to provide proof of provenance or leverage their SSCM credentials into meaningful value propositions to customers. This diminishes the power of the business case for adoption and puts them at risk of 'first-mover disadvantage' (Porter, 2004).

Second, the opaque nature of the supply chain enables information asymmetry which is an underlying assumption of stakeholder theory. This enables what Meyers and Rowan (1977, p. 358) refer to as the "avoidance of inspection and effective evaluation". At present, the risk that symbolic adopters will be inspected, evaluated and essentially 'found out' is relatively low. Hence, the action research project is motivated by a desire to improve supply chain transparency to assist those who have earnestly committed to TBL principles in practice and that have invested financial and human capital to capitalise on their investment by proving their credentials and minimising the opportunity for competitors to greenwash.

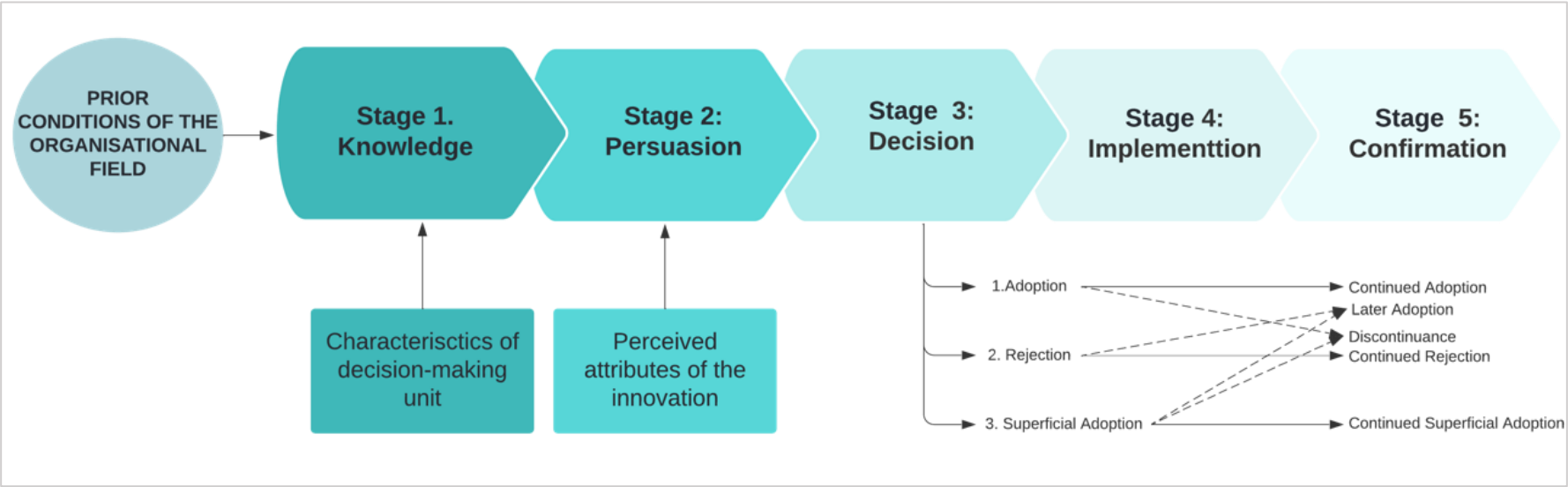


Figure 4. The decision process to adopt sustainable practices (adapted from Rogers, 2003)

The organisation is motivated by a desire to achieve business case outputs such as profitability, legitimacy and reputation, long-term competitive advantage not just for them but for their supply chain partners (synergistic value creation) (Kurucs *et al*. 2008). However, it was the understanding of the lead researcher that the collaborating organisation has a genuine desire to be industry leaders at the forefront of innovation and substantive SSCM adoption.

Rogers (2003 p.171) describes the 'knowledge stage' of innovation adoption as the process in which "an individual or other decision-making unit is exposed to an innovation's existence and gains an understanding of how it functions". The lead researcher started researching BCT in 2018 after smart contract innovations were discussed in the supply chain literature. At this time, the researcher also became aware of Spatially Offset Raman Spectroscopy (SORS) technology and made contact with the chemistry professor.

The lead researcher first contacted the marketing manager in Feb 2020. This led to further discussion in autumn 2020 and early in 2021. Once initial mutual interest in collaborating was established, several scoping meetings took place. The lead researcher visited the The Milling Company Mill in late March 2021 to learn about the company, its people and its supply chain structure (including the complex milling process). This was followed by a workshop session with the lead researcher and the management team to exchange knowledge and discuss ideas.

During the site visit, the lead researcher presented key information from the academic literature on BCT and tracer technologies (e.g. SORS). The management team had an awareness of BCT but had limited knowledge of its functionality, characteristics and application. Although the quality manager was familiar with spectroscopy, they were not familiar with the SORS variant or how handheld variants could be integrated into supply chains. Providing knowledge from academic sources that may not be easily accessible to practitioners is an important part of collaborative management research (Pasmore *et al*., 2008). Zarei *et al*. (2019) sees this exchange as an essential first step of any action research project.

The management team described their motivations for wanting to engage in the project in more detail. These are presented in Table 1 and are supported by illustrative quotes from initial scoping meetings. Before the workshop, the managerial team completed a business model canvas (Appendix 1) that provides a framework for conceptualising business model innovation (Osterwalder & Pigneur, 2010). It has a strong academic

grounding and can help to increase the understanding of existing BMs and identify where and how value can be created, captured and delivered (Joyce & Paquin, 2016). From this, the collaborating organisation were able to talk the lead researcher through the different elements of their business model and to understand the motivations for exploring these types of solutions. When the marketing manager was asked whether the company thought there was a business case for sustainability, they said:

> *"The business case is about making sure the company is there for the next hundred years. It's about making sure that we're relevant for the marketplace [with regards to sustainability]. […] I think there's a lot of businesses that only look at the bottom line and the immediate bottom line. Some businesses don't have the view on the longevity that we do."*

They explained that the company would often prioritise social or environmental goals to the detriment of financial goals. When asked exactly how far the company is willing to go with that approach the marketing manager said:

> *"So, there's going to be short term debt, but the longevity for the next seven or eight generations, that's where the decision lies. We would never bankrupt the company to make the right decision. But it's always a longevity decision. […]. We'll take a hit just to make sure that we're working with the right people in the right place on the right product and learning the right skills".*

Table 1 presents the reasons (BC drivers) why the company wished to engage in the project. These relate to the broader business case rationale which can be seen as a complex combination of legitimacy seeking and profit seeking behaviours (Davies, 2021). These findings were triangulated with researcher journal entries and company sustainability reports, and the completed business model canvas (see Appendix 1).

Table 1. Business case drivers for exploring BCT clusters

Reason	Description	Illustrative quotes
Provide concrete proof of product quality, provenance and SSCM credentials	The company competes on a differentiation strategy (based on quality performance objective). Delivering concrete proof of quality and	*"For me, it's more about having a supply chain that has integrity."* – quality director

	authenticity helps ensure it can compete on these terms and is seen as an effective anti-counterfeit measure.	
Translate sustainability credentials into business value	The company invests significant operational resources into upholding TBL principles. Although short-term profitability is not the principal motivation, it would understandably like to be rewarded financially for this commitment and use its TBL practice to strengthen the aspects of its value proposition related to sustainability.	*"If you can prove, you say through GPS, sort of where the fabric or materials travelled, there's a huge value to that*." – quality director *"I think the story that we could kind of tell would be amazing that we would be able to fully authenticate, as you say, the full supply chain."* – quality director
Eliminate greenwashing	The company is frustrated with organisations (some of which are even their customers) who symbolically adopt TBL principles or certification for 'commercial purposes'. The Milling Company is trying to do the 'right thing' but find it hard to differentiate itself from those who are greenwashing.	*"[Other companies], they've got the millions and millions of pounds to put into the marketing budget and they greenwash. And then you've got the people that are doing the right thing that are struggling to get the messages out there on the same scale*." - marketing manager *"I am finding that quite annoying. Because you've got a [a customer] like [luxury fashion brand 1] that are put on a pedestal for being sustainable and they're driving like mad for [third party certification]. But they don't want to plan for it, and they don't want to pay for it."* – sales director
Meet increasing customer expectations for transparency and sustainability	Fashion brands are increasingly demanding supply chain transparency and accreditation.	"A *commercial buyer is going to want to know that you've got your standards in place that your manufacturing is ISO audited. They want [supply chain] transparency."* - quality director *"The fashion brand will want [the certification standard] and they won't work with you unless you have it"* – sales director *"So recently, of course, because of this kind of sustainability trend, that there is an awareness. […] people are very conscious about it."* – quality director
Desire to maintain Royal Warrant status (reputation drivers)	Royal Warrant holders must reapply every five years. The company is aware of the increasing amount of supply chain transparency and sustainability credentials expected of Royal Warrant holders are expected to have. It believes such expectations will	*"[The Royal Warrant] is incredibly important because it's a seal of quality. There are not that many Royal Warrant holders in the country. To be one, I feel, is a real privilege".* – sales director *"I think the next time we come to renew ours, we probably will have a king, and that king will be Prince Charles, and I think*

	increase three-fold when Prince Charles ascends to the throne, as he has championed sustainable development for over 50 years (Prince of Wales, 2022).	*it will be triply as hard because he is the driver of this [sustainable development]. I think [sustainability] is going to be a massive part of getting that Royal Warrant*."- sales director
Frustrations with current accreditation schemes	The company regards sustainability and quality standards as meaningless. They lack rigour in terms of auditing and are open to corruption (firms can symbolically adopt whilst circumventing substantive adoption).	*"We've started working with [third-party accreditation scheme], they're actually, it almost feels very amateur. […].In terms of proving the chain of custody, you just got to prove that the kilos in was in as the kilos out. […] They've got some Dropbox file, you know, an address where you just send a spreadsheet, and then somebody takes it from that side. […] there's no automation […] so actually blockchain would have been ideal."* – quality director *"I think [sustainability certification] is in its infancy enough to challenge it. I think we've got to we've got to play the game to some extent, and I've pushed for it. But you know, I think if we had some alternative that we were confident with…"* – sales director *"Because the certification cost is quite expensive as and there's probably lots of farms out there that have really good standards but aren't part of the scheme because of the costs."* – quality director *"You could easily pick up lots of faults with the existing standards. If you were to educate some of our customers, quite how easy it is to fiddle and be able to get [anonymous sustainability standard] without really actually adhering to the requirements"* – quality director
Making auditing processes more efficient	Current sustainability and quality auditing processes are complex, time-consuming, and costly. Improving supply chain metrics helps ease the auditing process.	*"One of the difficulties of doing it is obviously, you need to prove at each stage that whoever is managing that element isn't adding something else to it, contaminating it, mixing it with other things. That's where the certification also comes in."* – quality director *"What we're having to do to get the certification is actually something that's quite bulky and quite clumsy in terms of the the information that we're having to carry to prove that we're not adding anything to the fibre as we're processing it."* – quality director
A general organisational desire to innovate	The company has a desire to position itself as respecting the past and preserving its heritage	*"We're always trying to make things stronger, lighter, more water resistant, more fire resistant, and trying to*

	and traditions whilst also being seen to be at the forefront of innovation and technology.	*constantly push [innovation].”* – senior process engineer
Education	The company regards education as an important route to progressing sustainable development in society.	*“There's lots of education needed. [Our sustainability reports and marketing research] gives us a really nice piece to go out there and talk about education and get involved in different educational projects to do with slow fashion.”* – assistant marketing manager
Engaging supply chain partners	The company regards these types of technologies as attractive to suppliers.	*“It also allows others that don't necessarily have the technology [infrastructure] to be able to engage with it so the [sheep] farmer could engage*.” – sales director
Support sustainable and circular business models and concepts	The company is a proponent of the ‘slow fashion’ movement and has a circular fashion business launching on the site of the Milling Company mill.	*“We are investing in circularity and bringing recycling capabilities onsite so that we can continue to reduce waste and also explore opportunities in new markets”* – marketing manager

In summary, the main identified problem is a lack of supply chain transparency that enables a large degree of information asymmetry and institutional decoupling (i.e. greenwashing) that limits the progression of TBL in the sector overall. Information asymmetry and institutional decoupling are central tenets of stakeholder theory and institutional theory respectively. These two elements It limits the amount of value that The Milling Company can leverage from good TBL performance and limits its ability to differentiate itself from symbolic TBL adopters who are presently shielded from scrutiny. Following the pre-step stage, the decision was made to proceed with Cycle 1 exploring the combination of BCT and SORS.

4.2 Cycle 1: Technology cluster 1 – blockchain technology and spatially offset raman spectroscopy

4.2.1. Brief background on spatially offset raman spectroscopy in the literature

Raman Spectroscopy has been widely used in the field of Chemistry since the 1920s. It utilises a light source (typically lasers) to determine the chemical structure of solids, liquids, solutions, and gases (Vandenabeele, 2013). SORS is a comparatively recent variant of Raman (Matousek *et al*., 2005). SORS differs from conventional Raman because it can penetrate opaque packaging, simultaneously providing a chemical fingerprint of both packaging (surface) and contents (subsurface) within seconds (Ellis *et al*., 2015). Handheld SORS scanning devices are an even more recent innovation enabling “rapid complex chemical composition analysis”, through packaging, at any geographical location within a supply chain network (Ellis *et al*., 2017, p. 1). Handheld SORS devices

have been successfully piloted in a whisky supply chain analysing and identifying markers of counterfeit alcohol in situ (Ellis *et al,* 2017). However, the latent potential of SORS remains largely untapped in supply chains (Ellis *et al*. 2017; Ellis *et al*., 2015).

4.2.2 Cycle 1 findings

The lead researcher and the quality director mapped the supply chain and production processes (see Appendix 2) which facilitated discussions with the chemistry team. This was to highlight where chemical transformations occur and where the company would be looking to determine the 'chemical fingerprint' of The Milling Company wool, to differentiate it from counterfeit or poor-quality products. It was decided that the wool from five different breeds of sheep would be tested using the research-grade Raman instrument at the Surface Science Centre. The main objective was to determine whether the Raman could distinguish between the high-quality raw fibres of Merino Wool (The Milling Company wool) and the wool from other breeds of sheep (lower in quality than Merino).

> *"Although we deal with quite trusted merchants that we have a good relationship with. There's always the opportunity that […] they could add a portion of something coarser into there because obviously, that makes it a cheaper blend for them, and we could buy that unknowingly. I know that in the industry there are people that have done and, do that, and they know what they can get away with in terms of something that would be not noticeable by hand [(feel of the fibre)]. […] If we could […] [detect] if somebody has tried to add 10% of something else into the blend, then that would be very valuable." – quality director*

Presently, micronage (fibre diameter) testing is only conducted by the Australian Wool Testing Authority who draw a small sample out of each 'bale' of wool. Lower micronages equates to higher quality fibres (finer and softer) and higher prices. While this approach is an established one, as the authority is a respected third-party independent auditor, it was still deemed as a weak point in the supply chain where errors and chances of corruption could hypothetically exist.

The laboratory experiments took place at the Surface Science Centre in July 2021. The lab results revealed that: 1) there were no significant differences in the Raman spectra between samples from different sources and breeds of wool; 2) it was possible to obtain

good quality Raman spectra from individual fibres. Therefore, it would be possible to add a 'tracer' element as an identifier; 3) the micronage could be measured using the SORS technique. Although the results were promising, they did not support the main objective of being able to distinguish amongst wool fibres in their raw state without having to add a tracer element. Although the findings do not rule out the application of SORS in wool supply chains, the chemistry professor advised that further exploration would entail more extensive lab testing.

Table 2 summarises the decision-making factors discussed across several project team meetings, using the DoI theory's attributes of innovations typology (Rogers, 2003).

Table 2. Decision-making process for SORS implementation

Attributes of SORS (Perception of project team)	**Notes on main decision-making factors**
Relative advantage (LOW)	• The costs of researching SORS further (let alone implementing it) were prohibitively expensive. It would take a considerable amount of lab research time (1-3 years). • The outcomes of the lab tests meant there was a large degree of uncertainty regarding the relative advantage of the innovation (how SORS could potentially increase either reputation and/or profitability for the company). There were too many unknowns regarding whether this would lead to a business case for adoption. • Time was a concern and the fact that other competitors could make moves on similar innovations sooner than The Milling Company. • There was a large degree of uncertainty regarding the perceived benefits (from the customer perspective). The company were not sure how it would increase customer willingness to pay for the product. There were concerns about cost of SORS adoption and whether this price would have to be transferred to the customer (via the product). • Generally, the return on investment was uncertain.
Compatibility (LOW)	• SORS did not meet the 'felt needs' of the research team. The allure of SORS was the hope that the wool would not require the introduction of a chemical tracer to the product and that a unique reading could be obtained from its natural state.
Complexity (HIGH)	• Handheld SORS devices have the potential to be difficult to use. Operating the devices requires the user to have a knowledge of spectra reading or be trained to be able to read them. • Research SORS further would be complex and would involve extensive lab testing with no guarantee of findings a tracer element that a) is uniquely identifiable b)

	does not negatively impact the wool quality c) could be added upstream in the supply chain. • Potential challenges with linking SORS data with blockchain.
Trialability (LOW)	• To proceed with SORS would have involved committing to extensive laboratory experiments (limited trialability) with no guarantee of achieving the desired outcome.
Observability (LOW)	• There was a sense amongst the project team that SORS may be low in observability and that it might be difficult to understand for both internal stakeholders (e.g. employees) and external stakeholders (e.g. customers and accreditation bodies).

Explorations into the potential combination of SORS with BCT happened in tandem with the lab tests. Conversations with leading SORS manufacturers revealed that the handheld devices have networking capability, therefore, can be linked with BCT. The research team identified blockchain platforms such as Provenance and Verisium (Provenance, 2021; Verisium, 2021) as viable partners as both had previously conducted pilot BCT studies in luxury fashion. However, the immaturity of the SORS means the relative advantage (benefit to cost ratio, as perceived by the company) was not clear enough presently. Further SORS research would be complex, time-consuming and prohibitively expensive with no guarantees of a satisfactory conclusion (too many unknowns). In conclusion, it was not ready for the 'implementation' phase of adoption (Rogers, 2003). Following the evaluation stage of Cycle 1, it was decided to discontinue exploring SORS. From a TOE perspective, there were significant technological barriers that impacted its compatibility with organisational needs and its ability to form a BCT cluster at the present time.

As stated by Coghlan (2019, p.129), "action research has a large degree of messiness and unpredictability about it. […] As the story unfolds, unforeseen events are likely to occur". The experiments proved that tracers could be detected on wool fibres which has important implications for chemistry and textile supply chains. However, continuing with this line of inquiry would detract from the goals of the project. Action research should remain orientated towards achieving desired practical outcomes (Reason & Bradbury, 2001). This is an example of where it is important to avoid 'pro-innovation bias' (Rogers, 2003). Diffusion research typically focuses on successful adoption cases but understanding why innovations are rejected can help provide equally valuable insights (*Ibid*). According to Rogers (2003, p.12) "it should not be assumed that the diffusion and adoption of all innovations are necessarily desirable". During the evaluation stage of

Cycle 1, contingency plans were discussed which led to the decision to explore an alternate BCT cluster.

4.3 Cycle 2: Technology cluster 2 – blockchain technology and bioluminescent nano-particle photon markers

4.3.1 Discovery of the FibreTrace technology platform

FibreTrace utilises a fine bioluminescent ceramic pigment that can be combined in various formulas to create unique 'serial codes' (Bauck, 2021; Greene & Stenning, 2019). These could then be added to cotton fibres upstream in the supply chain and tracked throughout by an infrared scanning device to transmit the scan data to the blockchain via Bluetooth technology. At that time, FibreTrace had only conducted pilot studies in cotton (Bauck, 2021).

In August 2021 (the evaluation stage of Cycle 1), the lead researcher contacted FibreTrace after discovering that they were in the process of conducting trials with wool. A collaboration between the companies presented an opportunity to test the system in a Merino Wool supply chain for the first time. FibreTrace is built on the Hyperledger blockchain which adopts a proof-of-stake consensus mechanism which is less environmentally damaging than blockchains like Ethereum and has been used for large scale pilots with corporations such as Walmart and Maersk (Wang *et al*., 2019).

4.3.2 Cycle 2 Findings

In September 2021, a meeting was held between the core project team and FibreTrace (founder and the operations director). This provided an opportunity to answer key technical questions. For example, the project team questioned if the system could be reversed engineered, to which the founder explained why it would be nigh-on impossible to do so because of the unique pigment codes. The project team also wondered what would stop the reader from being used at a non-authorised facility. The operations manager replied, "*we put a geo-coded fence around the scanner so that they can't be used outside of the facility that they've designated to".* There were questions regarding security and adoption costs.

The quality manager asked whether FibreTrace had approached any sustainability and quality certification bodies. It is difficult for customers to verify the authenticity of products. Hence, they look to certification labels on products (Azzi, *et al*. 2020). The FibreTrace operations director explained that they were *"open to working with anybody"* but that some of the certification bodies were not too keen on tracer technologies because

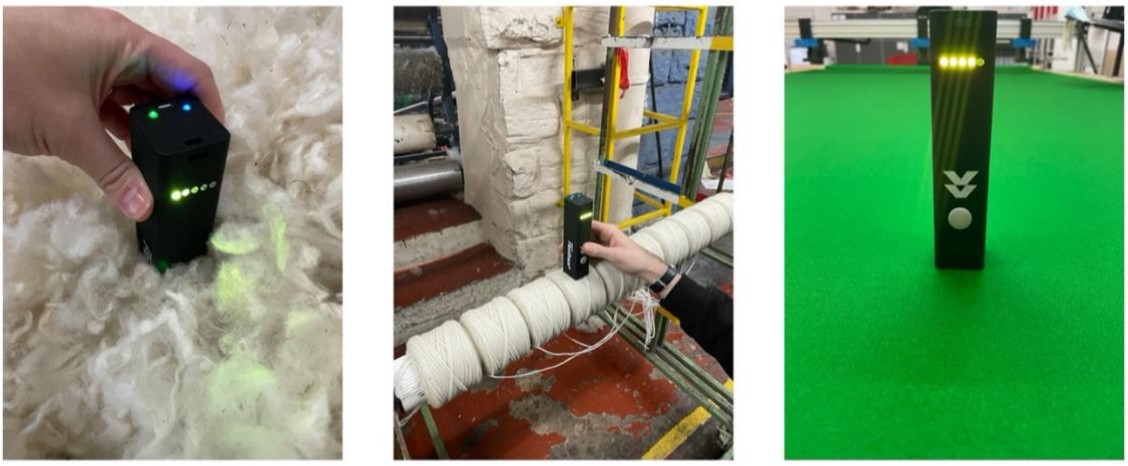
they threatened their business model. The operations manager said, *"it is science going against a human auditor […] the data doesn't lie".* Recent literature has noted that a "growing number of private, voluntary and mandatory sustainability standards have recently emerged" (Silvestre *et al.*, 2020, p. 1873). The discussion suggests certification bodies may feel conflicted about endorsing innovations as they essentially pose a threat to their business model.

Following the initial scoping call, the management team seemed enthusiastic about engaging in a FibreTrace pilot. The marketing manager provided some the following feedback:

> *"It sounds really exciting and really interesting. It sounds as though it's what we've been after and what the market is looking for. It sounds super simple. If it's as easy as they're saying, then it would be crazy not to be considering [adopting] it".*

In October 2021, the FibreTrace founder visited the mill to demonstrate the FibreTrace system with real fabric samples. The initial perception of the FibreTrace scanners was that they were easy to understand (low in complexity), and made it easy to see the innovation in action (high in observability) (Rogers, 2003). Following the visit, The Milling Company decided to progress with a FibreTrace proof-of-concept trial. From a DoI perspective, this is the adoption decision point that leads to the 'implementation' stage where the users seek to acquire more information about the innovation before confirming whether they will continue using it (Rogers, 2003).

The proof-of-concept trial began in early January 2022 and lasted for 6 weeks (lead time for the fabric that was being trialled) and went through the The Milling Company production process (see Appendix 2). The FibreTrace scanner was used by the process engineering team to take 10 different readings of the tracer pigment after each production stage (see Figure 5). The trial was completed successfully with the pigment clearly detectable during the entire production process (see Appendix 3 for results).



(a) (b) (c)

Figure 5. FibreTrace trial showing successful scans after the blending stage (image a), carding stage (image b) and fabric finishing stage (image c) of the wool production process

Following the trial, the team evaluated and reflected upon the action that had been taken in Cycle 2. Table 3 summarises some of the decision-making factors for FibreTrace adoption. This was discussed across several project team meetings, using DoI theory's attributes of innovations typology (Rogers, 2003).

Table 3. Decision-making process for FibreTrace implementation

Attributes of FibreTrace (Perception of project team)	**Notes on main decision-making factors**
Relative advantage (Potentially HIGH but still many unknowns)	• Potential to be a good anti-counterfeit measure. Proving the provenance protects company reputation for quality and uniqueness. The unique identifier (pigment) makes it virtually impossible for bad faith actors to try and imitate The Milling Company wool. • There is the potential for FibreTrace to improve profitability through value creation (enhanced reputation) but there are still many unknowns regarding how it would add value to company business model or translate into economic value (return on investment etc). Wider trials would be needed to ascertain customer reaction over time and to understand how it may influence business model innovation.
Compatibility (HIGH)	• FibreTrace pigment is seen as compatible with The Milling Company's sustainability values and beliefs as it is an organic substance certified by the Global Organic Textile Standard (GOTS). • The BCT used by FibreTrace is Hyperledger, a proof-of-stake blockchain (less energy intensive) therefore was seen

	as being compatible with The Milling Company's sustainability goals. • FibreTrace has a high degree of compatibility with existing The Milling Company production processes. The pigment is carried on a nylon fibre which can be blended in easily at the blending stage of the wool production process (see Milling process diagram – Appendix 2). This could occur further upstream in the supply chain if needed. • FibreTrace had a high level of compatibility with company needs. The following points are indicative of this: 1) It did not negatively impact the quality of the finished fabric. 2) The pigment could survive the intensive milling process. 3) The devices are easy to operate (simple green and red-light) 4) Pigment blends can be unique to The Milling Company (and their customers e.g., fashion houses) 5) The platform allows the company to input other TBL metrics (water consumption and carbon emissions). 6) The platform has a customer-facing website portal making all blockchain data easily accessible (Figure 6). 7) The pigments do not require any specialist storage so the fibre can be stored at the mill in the 'wool store' with all other raw materials.
Complexity (LOW)	• FibreTrace was seen as easy to understand and easy to use by project team and operatives involved in the proof-of-concept trial. No technical knowledge is required to operate the scanners and basic computing skills needed to input TBL metrics on the BCT platform.
Trialability (HIGH)	• FibreTrace could be experimented with on an extremely small-scale basis. This was first witnessed when the FibreTrace founder visited the mill and demonstrated the technology to the The Milling Company management team and lead researcher. This undoubtedly aided the decision by the The Milling Company management team to proceed with the proof-of-concept. • The Milling Company was able to conduct a proof-of-concept trial before having to commit to a larger scale trial. • A larger scale trial could be completed with The Milling Company supply chain partners before committing to a full roll of the FibreTrace system.
Observability (HIGH)	• The scanners provided an easy-to-understand visual confirmation that the fabric contained the correct pigment. It requires no knowledge of the patented FibreTrace technology or of blockchain technology. • Although the observability was perceived to be high from an intra-organisational perspective there are still quite a lot of unknowns regarding how observable the innovation is to customers and end consumers. This could only be determined by a larger roll out of the system involving customers and end consumers. From this the benefits or value

	of using the FibreTrace system can be confirmed (Rogers, 2003).

The project team's perception of the FibreTrace system was positive overall. As evidenced in Table 3, its attributes were considered to satisfy many of the collaborating organisation's technical and operational requirements. However, as explained by the TOE framework, technological elements are just one of three categories that should be considered during the adoption decision-making process. Organisational factors (O) and the external factors (E) at play within the organisational field also need consideration. This echoes the academic business model discourse which emphasises that the value of technology is dependent on the context in which it is applied in practice (Chesbrough & Rosenbloom, 2002). The notion of 'relative advantage' strongly aligns with business case logic as both seek to understand the benefits of adopting the innovation to the adopter (typically expressed through a desire to achieve a combination of legitimacy and profitability) (Rogers, 2003; Davies 2021). Therefore, it is logical to explore the technology cluster in relation to the business model (incorporating the TBL view) as a vehicle for delivering these benefits to the collaborating organisation leading to business case development.

4.4 Cycle 3: Exploring the business case for FibreTrace adoption

Cycle 3 occurred concurrently with Cycle 2. Whilst Cycles 1 and 2 predominantly focused on the technological aspects of the TOE framework, Cycle 3 sought to further explore the compatibility of BCT cluster 2 (FibreTrace) with the TBL and the business model concept. This involves considering both the organisational factors (O) and the external factors (E) and the related stakeholder and institutional pressures that may influence managerial decision making (business case development). As highlighted in Figure 1, SSCM BCs can be achieved through the synthesis of the TBL, technology clusters and business model innovation.

Value-driven BMs differ from cost-driven models as they focus more specifically on creating value for their customer segments rather than reducing costs (Osterwalder and Pigneur, 2010). During the meeting with the FibreTrace founder in October 2021, the quality director said, *"I think there's so many different ways of using [FibreTrace] and I can see the benefits of it"*. The sales director added, *"I think it's about planning it out and actually speaking to people that would engage with us on actually using this to get their buy-in. You know, make sure that's used properly and that we get what we want from it"*.

The quality director agreed and said *"if we can do the proof-of-concept trial. And in the meantime, we'll look at strategically how it would be implemented if it all worked"*. As explained by the instrumental stakeholder theory perspective, it is important that customers (as salient stakeholders) must buy into the value proposition that FibreTrace helps support. Although, some scholars have suggested that organisations need to see beyond profit which may mean not prioritising customer demands (Montabon *et al*., 2016), others suggest sustainable SCs are only validated if the customer desires and accepts the final product (Seuring & Müller, 2008). This is also in line with DoI theory, which in this context would suggest that communicating the relative advantage of the innovation to the social system is a key part of its diffusion (Rogers, 2003).

It is a well-recognised problem in sectors such as luxury fashion that customers are not provided with enough information to be able to make an informed evaluation about sustainable products and practices (Davies, 2021). There is a bewildering amount of SSCM standards that are not well understood by customers (Davies, 2021; Silvestre, 2020). The FibreTrace customer-facing portal (see Figure 6) has the potential to support 'customer channels' i.e. the part of the business model that communicates and deliver a TBL and quality-based value proposition to customers (Osterwalder & Pigneur, 2010; Rogers, 2003). The Fibretrace platform also enables The Milling Company to record other TBL metrics (water consumption and carbon emissions data) onto the Hyperledger blockchain via the FibreTrace platform portal and share the journey of the product with customers. The platform is currently accessed via a web browser and can be accessed via a mobile phone allowing customers to 'observe' (Rogers, 2003) the substantive adoption of TBL principles by The Milling Company.

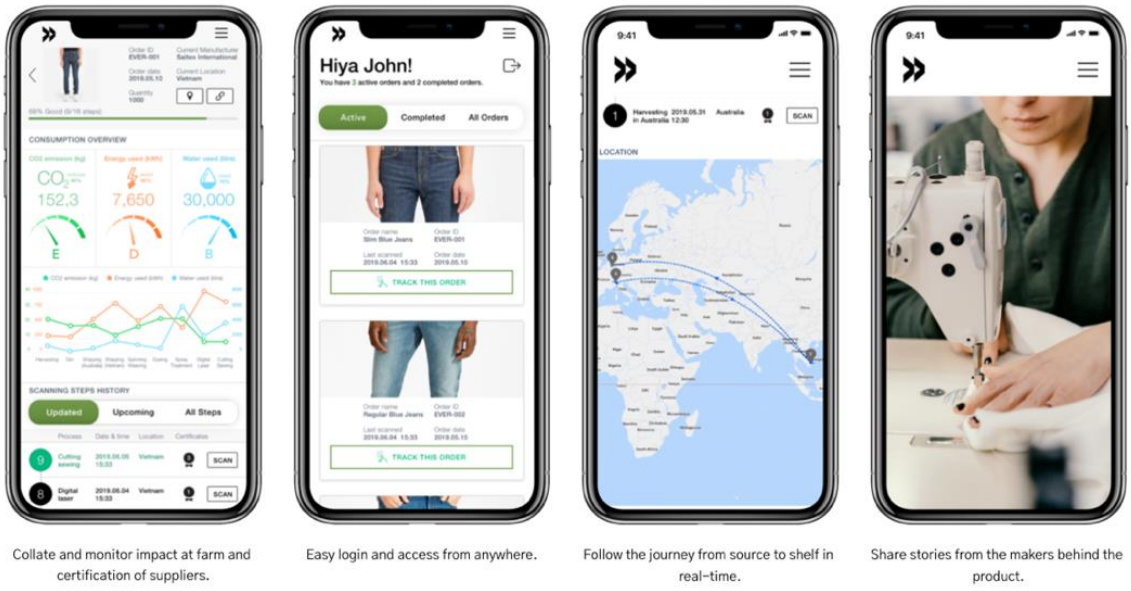


Figure 6. The FibreTrace platform customer facing portal (FibreTrace, 2020)

Despite the ability of the FibreTrace system to record and deliver provenance and TBL data and SSCM credentials, questions remained over how much value customers may derive from this. As explained by DoI, the acceptance of the innovation is significantly influenced by the norms of the social system in which it is designed to be used. The BMC, completed during the pre-step, highlighted that The Milling Company already considered sustainability to be part of its 'value proposition' (as perceived by their customer segments) (Osterwalder and Pigneur, 2010). However, during early meetings, it became clear that the extent to which their customers and end consumers (their customer's customers) desired sustainability credentials was still relatively uncertain. The sales director said, "*I think it's this commercial drive. Could be wrong. But that's my feeling, generally*" indicating a tendency for symbolic adoption. This was in alignment with prior research conducted by the lead researcher who had discovered that it was not just companies that were greenwashing. Other stakeholder groups (e.g. customers, captains of industry, the media) were capable of 'virtue signalling' (Wallace *et al*., 2020) which can be understood as a form of greenwashing from a sustainability perspective, coining the term 'fauxercive pressure' which can be described as coercive pressure based on disingenuous demand (Davies, 2021). In essence, customers may signal an intention to adopt sustainable consumption behaviours without committing to buying sustainable products or changing consumption behaviours. Generally, there is still a lot of ambiguity regarding the true picture of customer demand for sustainability.

In February and March 2022, the project team held a series of workshops and meetings to explore the relative advantage of FibreTrace adoption and to understand how it fits with the present business model and whether there was a genuine business case for adoption. The results of Cycle 2 provided reassurance that FibreTrace could work from a technical perspective. The need for some further testing was identified (e.g. ensuring that FibreTrace would work well in other variations of fabric, and also checking that the pigment could survive the laundering process). However, generally, the managerial team seemed confident that it could be rolled out on a larger scale across their supply chain. In a meeting with the senior process manager and his assistant the team commented that, even from an intraorganisational perspective (the 'O' of the TOE framework), they could see a clear business case for adopting the system regardless of the external (customer) perception of it ('E' of the TOE framework). The senior process manager said the following:

> *"Because the [operational] impact of implementing [FibreTrace] is actually fairly low. […] even if it's not recognised [(valued)] by our customer, it's just an extra level of insurance for ourselves to guarantee that, you know, what we're saying is [provable]. […] I think it's more of like an internal extra safety measure. […]. I would put it forward [as a recommendation] just as an internal quality assurance and then someone else can do the cost-benefit analysis and make the final decision."*

They also felt it was something that could easily be adopted by supply partners upstream in the supply chain and that their partners would be *"open to it"*. Furthermore, they said the endlessly unique number of compositions (serial codes) that could be created by FibreTrace would potentially help make their internal processes more efficient. For example, the unique FibreTrace identifier could be changed yearly to enable more efficient batch control. For example, in the past, customers had made claims that the fabric had not been as durable as expected and claimed they had only had the fabric (used on a snooker table) for a week. Upon closer inspection, it was discovered the customer ordered it 3 years prior. Batch controlling with FibreTrace would make this process much more efficient and protect the company from false claims.

The assistant process engineer suggested that FibreTrace could be adopted by third-party sustainability certification bodies who could have their own unique serial code

(bioluminescent pigment) that was recognised sector-wide. The lead researcher informed them of the barriers that FibreTrace had already come across, especially with certain accreditation bodies. They found it hypocritical that the accreditation bodies were encouraging businesses to have costly sustainability certificates and to prove product provenance but were unwilling to partner with technology providers that could help with the verification and auditing process. The senior process engineer felt that both sustainability accreditation bodies and technology platforms like FibreTrace could potentially work in harmony bit did see how FibreTrace could be seen as a threat to third-party accreditation schemes.

From an external market perspective, despite the market ambiguity and greenwashing in the sector, the company could see the potential benefits in adopting FibreTrace and saw it as an opportunity for business model innovation based on supply chain transparency. They felt it would work well as an anti-counterfeit measure and provide assurances to customers. The senior process engineer said, *"I think counterfeits are a constant battle for every manufacturer. Especially those at the top end [of the market], the ones being copied. So, I think [verification of provenance and quality] is something that's needed and will be in demand [from customers]".* They also felt it could help provide a clear point of differentiation in the market. The senior process manager said, *"I think the [certification standard], it's a Unique Selling Point (USP) for [some luxury fashion houses]. […] we're certified, and we're prepared for it because I think we believe [the demand is] going to start increasing".* They added that if adopting these standards 'takes off' with the *"top end fashion houses […] then it's going to start filtering down to the lower price points […] so if we can have FibreTrace prepared as well…]".*

They commented that The Milling Company's approach toward innovation (process and technologically) and business model innovation is *"one of the reasons why [the company] has lasted so long"* and described how many of their competitors had 'gone under' in the last couple of years because they haven't innovated or diversified their business model. They said The Milling Company were "*always trying to diversify [their business model] and look for other [opportunities] to get into* […] *because we know that we're the market leader now, but in two years, other people might have caught up […]. We still have to be looking to develop our next level of innovation so that when people do catch up, hopefully, we can launch our new innovation and maintain our position"*.

In summary, the adoption of the FibreTrace system can be justified from a business case perspective based on all three dimensions of the TOE framework. The technical side

has been well justified using the DoI perceived attributes for evaluating the system on an operational level - it is seemingly a good fit. However, fully understanding the relative advantage of technology in relation to the TBL and the existing business model of the company is a more complex task. It is essentially the process of considering the 'T' aspects of the TOE framework in conjunction with the 'O' and the 'E' elements, with the consideration of both stakeholder and institutional pressures experienced by the company in their organisational field.

The company has begun exploring the next phase of adoption and is continuing to test FibreTrace to ensure it works on a technical level across all woollen fabric variants. They are also looking to conduct larger scale pilots with their most trusted customers and suppliers to deepen their understanding of the business case for adoption before fully committing. The sales director said they would want to be certain that this is a long-term commitment before making any public announcements. From a public relations perspective, they said *"you'd have to have a really strong understanding of its worth before you actually launched it as a marketing thing. Because there's no going back. If you're saying you've got something that makes your product authentic... then [if] it's not there anymore. You're worth less than you were before"*. They are actively engaged in the process of assessing interest of supply chain partners.

5. Discussion

5.1 Blockchain technology clusters and sustainable innovation clusters

The findings from Cycle 1 demonstrate that the success of tracer technologies is highly context specific. The success of SORS achieved in whisky supply chain pilot studies was not replicated to the same degree in the Merino wool supply chain and did not achieve satisfactory 'task-technology-fit' (Goodhue & Thompson, 1995). The attributes of Fibretrace were perceived much more favourably than BCT cluster 1. The managerial team felt adoption could potentially be justified purely on the perceived organisational benefits (e.g. improved efficiencies). However, the relative advantage of the innovation (as perceived by the firm) strongly depends on the 'buy in' of external stakeholder groups (e.g. customers and end consumers). It emerged as one of the most important factors in influencing the business case (supporting the instrumental stakeholder view). In essence, stakeholders need to see the beneficial consequences (relative advantage) of the innovation.

The conceptual model (Figure 1) helped in understanding that the perceived benefits of FibreTrace were evaluated in relation to the company's business model and their TBL practice (part of the value proposition). Expanding on the DoI concept of 'technology clusters' proposed by Rogers (2003) and the experience of the action research project, the term 'innovation clusters', and specifically 'sustainable innovation clusters' is introduced. 'Innovation cluster' is a better representation of the concept originally described by Rogers (2003), explained by the following proposed definition:

> An innovation cluster refers to a combination of ideas, behaviours, or objects (tangible or intangible) that are distinguishable, yet closely interrelated elements of innovation, perceived as new by the unit of adoption.

This leads to the next proposition:

> **P1.** The symbiotic relationship between three forms of innovation: 1) TBL concept; 2) technological innovation(s); 3) business model innovation can be best represented by the notion of a 'sustainable innovation cluster'.

The findings of Cycle 3 highlight that the latent value in substantive TBL adoption is unlocked by the BCT cluster that underpins the FibreTrace platform. This helps create and capture sustainability-based value by providing concrete proof of sustainability and quality credentials. However, a key part of a business model is how it delivers value (Osterwalder and Pigneur, 2010). Drawing on DoI theory, the way that the relative advantage of the innovation(s) is communicated to the social system can significantly impact the rate of adoption (Rogers, 2003). The FibreTrace platform provides an essential user-friendly interface that connects multiple stakeholders, from end-to-end of the supply chain with the sustainable innovation cluster. In essence, it provides a new business model communication channel which can be described as "the way in which a company communicates with and reaches its customer segments to deliver a value proposition" (Osterwalder and Pigneur, 2010, p.26). The 'platform' concept is a key feature of the digital business literature and is described as "a simple sounding yet transformative concept that is radically changing business, the economy, and society at large" (Parker *et al.*, 2016, p. 3). A platform can be described as a "business based on enabling value-creating interactions between […] producers and consumers" whose main purpose is to

"facilitate the exchange of goods, services, or social currency [e.g. TBL value], thereby enabling value creation for all participants". This leads to the next proposition.

> **P2.** Platforms underpinned by sustainable innovation clusters that integrate BCT clusters (e.g. BCT and tracer technologies) can help businesses to capture, create and deliver value from their substantive TBL adoption, helping them to strengthen or achieve their desired business case outputs.

The findings of this action research have implications for the broader issues at hand i.e. the slow diffusion of substantive TBL adoption (see Figure 3). This research has shown that creating a value-driven SSCM-based business case for BCT adoption is still a major challenge for an exemplar firm with strong TBL performance using an exemplar technology platform solution. The process consumed a considerable amount of managerial and researcher time and company and university resources (including lab time). This aligns with the findings of Kirchoff *et al*. (2016) who found that managers of firms that exhibited outstanding SSCM practice still face major barriers when developing a business case for sustainability initiative adoption. This helps to explain how non-exemplars may be struggling to create a business case for substantive TBL adoption and supporting technology solutions.

In section 4.1, Roger's distinction between incremental and preventative innovation is used to explain why there was a clear business case for some aspects of TBL (typically incremental innovation connected to the narrow view of BC) and not for others (aspects of TBL adoption more closely associated with preventative innovation and the broader business case view). The findings of this research suggest that platforms like FibreTrace can help firms to be rewarded for their investment in TBL adoption (particularly in those considered 'preventative innovations') in a shorter-term time frame than could otherwise be achieved. This is illustrated in Figure 7. This leads to the following proposition:

> **P3.** Platforms underpinned by sustainable innovation clusters that integrate BCT clusters (e.g. BCT and tracer technologies) can help reduce the delay (lapse of time) between the adoption of TBL practices (viewed as preventative innovations) and the reward for adoption.

If market leaders and organisations with a strong culture for innovation (early adopters like the collaborating organisation) can demonstrate there is a business case for the adoption of TBL practice (both in terms of incremental and preventative innovations), then there could be significant implications for industry and wider society.

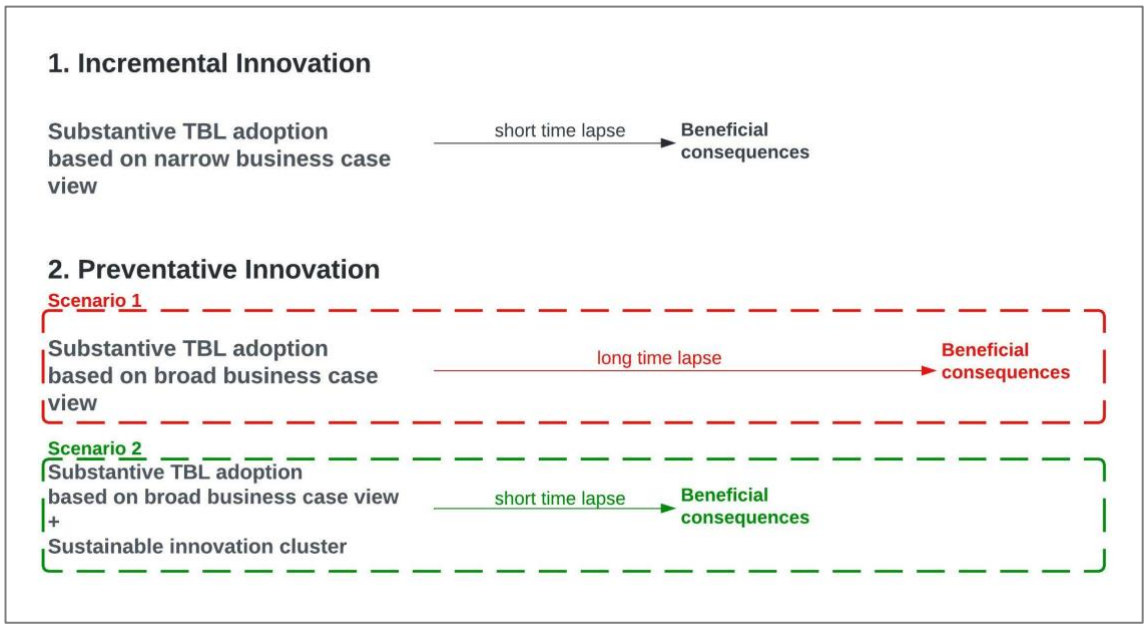


Figure 7. Rate of supply chain substantive TBL adoption based on notions of incremental and preventative innovations (adapted from Rogers, 2003)

5.2 Encouraging wider systemic change

The internet and mobile technologies have been central to increasing transparency and reducing information asymmetry in supply chains, bringing us closer to the state of 'perfect information' (Granados & Gupta, 2013). The emergence of BCT and smart contracts have brought us closer still. The BCT clusters that have been empirically examined in this research offer unprecedented transparency and supply chain verification. The FibreTrace platform provides solutions to the two-fold problem related to a lack of supply chain transparency outlined in Section 4.1. Firstly, companies which have substantively adopted TBL have the means to deliver concrete proof of provenance and SSCM credentials. It provides an opportunity for a unique selling point (USP) and to capitalise on first-mover advantage and be rewarded for early commitment to TBL practice. Furthermore, it offers protection against bad-faith supply chain actors who may seek to corrupt the supply chain or produce counterfeit products.

If market leaders adopt sustainable innovation clusters like the FibreTrace platform, then there is the potential for these 'packages of innovation' to start diffusing through the

sector and wider industry more rapidly. Multiply this diffusion of sustainable innovation clusters over different sectors and industries and the "new wave of TBL innovation and deployment" that Elkington (2018) called for could start happening in earnest. From an institutional theory perspective, these sustainable innovation clusters may help to change the normative, coercive, and mimetic isomorphisms within the organisational field, changing the requirements for firms to gain the level of legitimacy they need to continue competing (DiMaggio and Powell, 1983). Once sustainable innovation clusters are successfully exploited by market leaders, then coercive and mimetic pressures for other firms to leverage the approach will likely be very strong, consequently, new institutional norms will quickly form.

'New norms' will quickly establish, because the acceptance of ideas about sustainability and the TBL has already diffused widely through many social systems (see. Figure 3 for visual representation). This rate of diffusion is of course highly dependent on institutional context. However, global societies are far more conscious of sustainable development now than when the concept was first published in the Brundtland report in 1987 (World Commission on Environment and Development., 1987). There is a society-wide normative and coercive incentive to become more sustainable. Therefore, if more firms start providing complete assurance of provenance and SSCM performance then it may enable salient stakeholder groups to start coercing firms to mimic the BMs of successful competitors (conforming to mimetic pressure). They are essentially forced to play 'business model catch-up' (Mitchell & Coles, 2003).

As is the case in many sectors, maintaining legitimacy and avoiding reputational risk is a major business case driver in the luxury fashion sector (Davies, 2021). Greenwashers may find that hiding behind the smokescreen of supply chain opaqueness and information asymmetry may no longer protect them from scrutiny. To date, greenwashing has been a relatively low risk, to maximum-reputational reward endeavour. The wave of BCT clusters that may emerge in the coming years, can change the rules of the game for supply chain transparency. Over time, greenwashing (institutional decoupling) and avoiding inspection or evaluation by other stakeholders (Meyer and Rowan (1977) becomes an untenable organisational position to hold. If platforms like FibreTrace start becoming the norm, then the risk to company reputation for non-conforming firms becomes significantly higher. Therefore, the opportunity cost of not investing in sustainable innovation clusters and developing related competencies potentially becomes an extinction-level event for firms. Once platforms such as FibreTrace become the industry

expectation there is the potential for this to rapidly change customer requirements for substantive TBL adoption and become the inflection point of substantive TBL adoption diffusion. This may be better explained as a 'technological singularity' point of business practice, adopted from mathematician John von Neumann, who used it to describe an inflection point in the history of the human race "beyond which our affairs, as we know them, could not continue" (Ulam, 1958, p. 5). A visual representation of this is provided in Figure 8. This leads to our final set of propositions, expressing varied aspects of the concept discussed above:

P4a. Sustainable innovation clusters can provide the opportunity for levelling the playing field, in terms of reducing information asymmetry and hence the opportunity for greenwashing, by challenging institutional norms and increasing reputational risk.

P4b: Sustainable innovation clusters can help firms (and their supply chain partners) who substantively adopt TBL to gain first-mover and competitive advantage.

P4c. Sustainable innovation clusters can help increase coercive, mimetic, and normative institutional pressures for organisations to conform by committing to substantive TBL adoption and new standards to maintain the legitimacy required to continue competing in the organisational field.

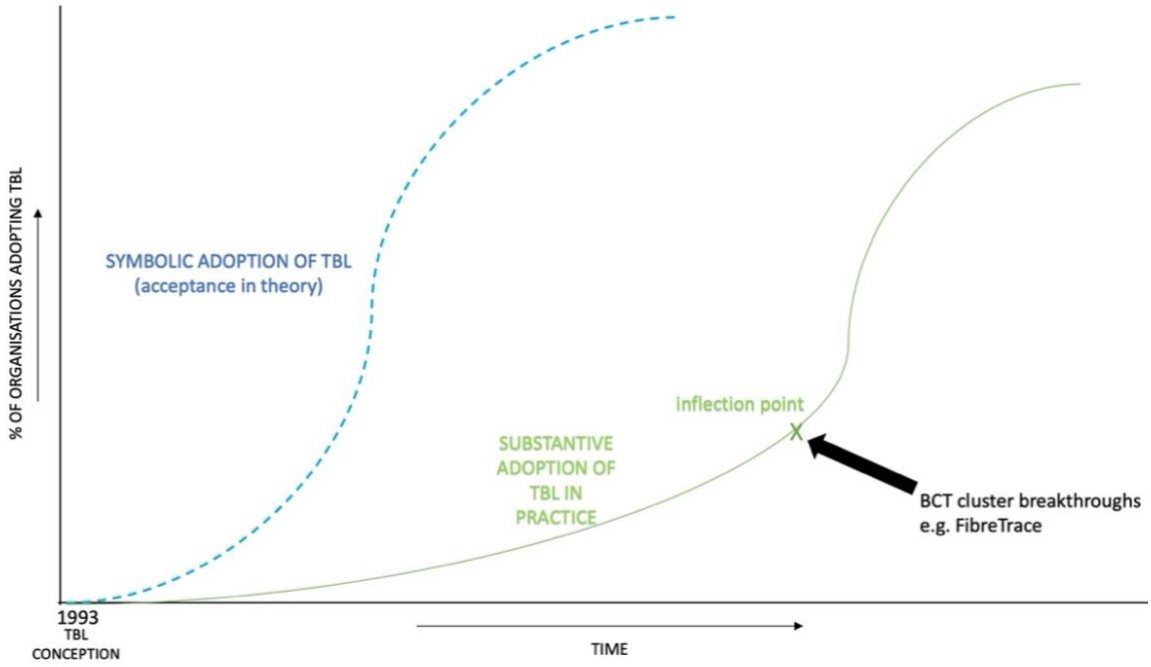


Figure 8. Potential substantive TBL adoption over time (adapted from Rogers, 2003)

6. Conclusion

The findings of this research offer a realistic picture of the exploration of two examples of BCT clusters in practice. It has contributed to theory by applying the DoI lens to BCT for SSCM and has expanded upon it by taking one of its central facets (technology clusters) and proposing that technology clusters should not be evaluated in isolation but in relation to the other forms of innovation that are intended to support them (innovation clusters and sustainable innovation clusters). It has also posited that sustainable innovation clusters can help firms to reduce the time it takes between investing in sustainability initiatives based upon a broader business case (value creation view) and realising its beneficial consequences (relative advantage).

Developing 'sustainable innovation clusters' that have the necessary technological capability to support both TBL and business case objectives (enabled by business model innovation) will be key for more rapid diffusion of the TBL in global supply chain networks. The research showed that a value-driven business case for adoption of technology-assisted TBL is not a straightforward process. Sustainable innovation clusters that consider TBL practice (as forms of innovation), technology clusters (as enabling innovations) and business model innovation (as the architecture that enables and justifies the business case for SSCM) will be among the very limited routes to change the norms of organisational fields and broader social systems so that the gap between the symbolic adoption of the TBL (acceptance of the idea in theory) and its substantive adoption (implementation of the idea in practice) can begin to close.

To conclude, Elkington (2018) commented that "to truly shift the needle [with sustainable development] we need a new wave of TBL innovation and deployment". This study has demonstrated that emerging technological innovations are bringing us ever closer to providing the means to deliver the transparency requirements to enable substantive TBL adoption in supply chains. However, the means must be coupled with the will and desire of multiple stakeholder groups to change perceptions and behaviours.

6.1 Managerial implications

This research has important implications for managers looking to specifically improve the rate of TBL adoption in practice or create value from existing SSCM 'best practice' by employing BCT clusters. Managers should consider evaluating technological innovations not only in terms of their individual attributes but also their relationship to the perceived attributes of other forms of innovation (either technological or conceptual).

Furthermore, the customer (and/or end consumer) perception of the total package of innovations should be considered as a critical part of business case development.

Being an early adopter of BCT clusters (as part of a broader sustainable innovation cluster) may enable differentiation and the related first-mover advantage from which economic benefits (either direct or indirect) can be derived. However, first movers can also face disadvantages as they can be forced to accept 'pioneering costs' and the risks that conditions will change (Porter, 2004). Managers should be aware that BCT and tracer technologies are rapidly evolving, and their successful application is highly context dependent. Therefore, managers should be wary of first-mover disadvantages when considering adoption. This action research should serve as a reminder to managers that not all innovations warrant adoption (Rogers, 2003). Finally, the findings highlight the significance that the platform concept plays in determining the BC. Managers should look for technology providers that provide a platform that interfaces with supply chain stakeholders, from end-to-end of the supply chain, to ensure the benefits of the innovation are fully observable and understood.

6.1 Limitations and future research opportunities

The action research was undertaken in collaboration with one company with a largely vertically integrated supply chain. Therefore, findings may be limited in terms of their generalisability to the wider supply chain view. Some scholars have highlighted that prior SSCM research has typically been conducted with 'exemplar' firms (Kirchoff *et al.*, 2016). The collaborating organisation in the research can be considered exemplar as they already demonstrate what could be considered as TBL 'best practice' and can be described as 'innovators' or 'early adopters' of innovation (Rogers, 2003). The research focused on how it can create value and differentiate itself on these grounds and reduce the likelihood of competitors being able to engage in opportunistic behaviours (greenwashing). Future research should seek to assess the feasibility of different BCT clusters and their usefulness for SSCM practice in a) different industrial contexts; b) with non-exemplar organisations (which may need to integrate the technologies to improve SSCM practice as a precursory activity to creating sustainability-based value).

This research has proposed the TOE framework, underpinned by DoI, stakeholder theory, and institutional theory, as a suitable theoretical lens for exploring the nexus of TBL, technology and business model innovation, as a means of strengthening the business case for SSCM. Integrating the combined theoretical view helps overcome the

simplistic nature (Zhu & Kraemer, 2005) of the TOE framework, strengthening its explanatory potential. The framework is useful for both researchers and practitioners and offers new explanations of the research problem, contributing to a deeper understanding of it, and enabling researchers to contribute better predictions and prescriptions (Makadok *et al*., 2018) as to how these issues may be overcome. Future research may consider underpinning the TOE with different combinations of mid-range organisational theories (see Hwang *et al*., 2016; Davies, 2022) to offer new perspectives.

More interdisciplinary research is needed to understand BCT for SSCM (see Saberi *et al*., 2019). This study has contributed to this call and suggests that further collaborative action research with practitioners will be needed to assess the practical viability of BCT clusters that incorporate tracer technologies.

Appendix 1

The Milling Company Business Model (adapted from Osterwalder and Pigneur, 2010)

Appendix 2

The Milling Company supply chain and process mapping

Figure 1. Diagram to show the chemical transformation processes that occur throughout the Hainsworth wool supply chain

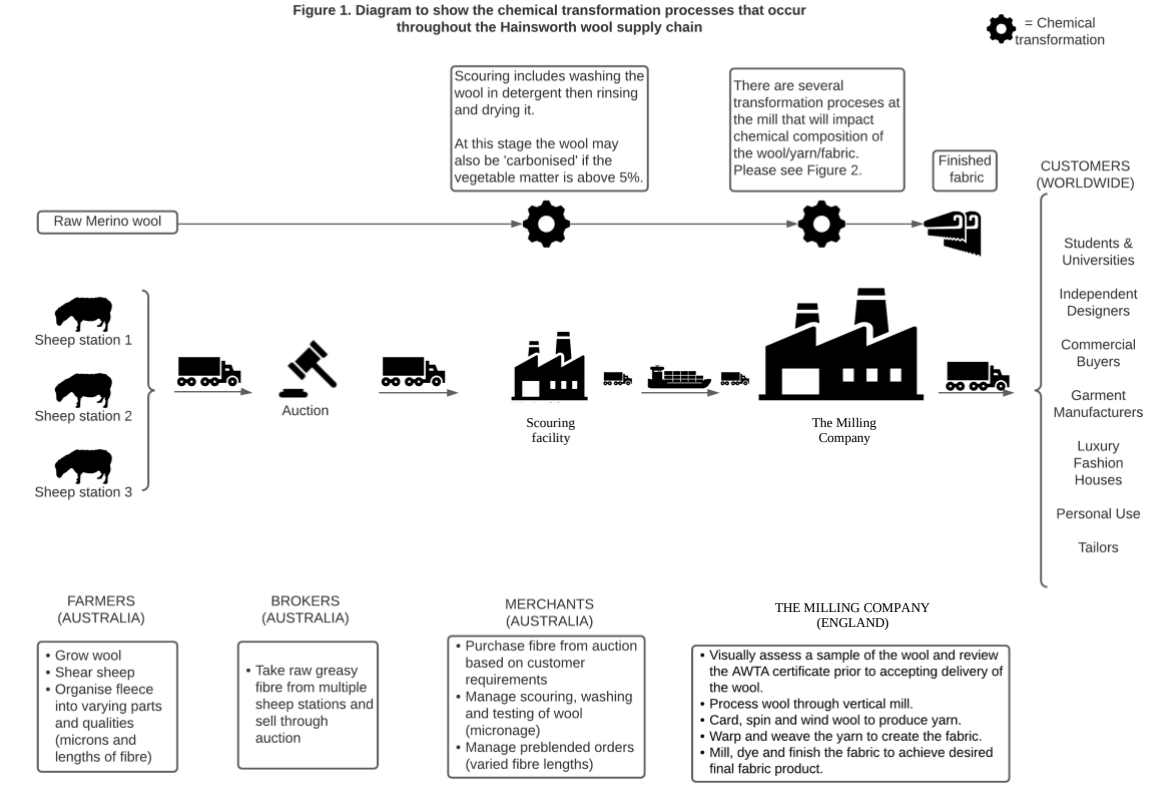
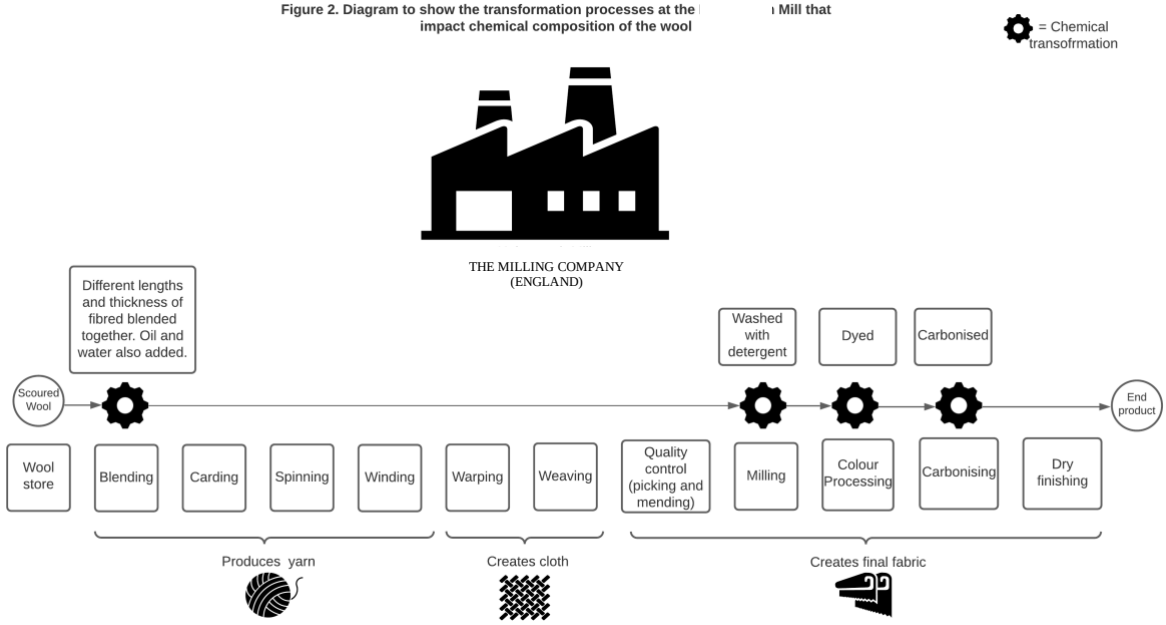


Figure 2. Diagram to show the transformation processes at the ı Mill that impact chemical composition of the wool



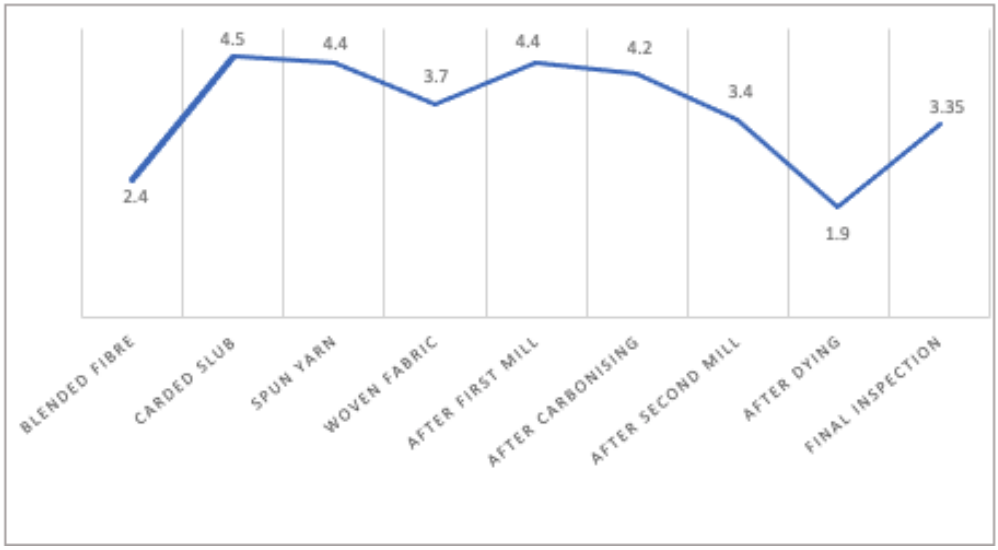
Appendix 3

FibreTrace x The Milling Company proof of concept scan results (Lambert, 2022)

10 readings taken from across the full width of the sample piece. Repeated 4 times along the length of the piece.

FIBRE TRACE RESULTS – FULL PRODUCTION PROCESS									
Sample / Test	Blended Fibre	Carded Slub	Spun Yarn	Woven Fabric	After First Mill	After Carbonising	After Second Mill	After Dying	Final Inspection
1	2	4	4	2	4	5	3	2	Please see the table below for more details.
2	3	5	4	4	5	5	3	2	
3	1	5	5	4	3	4	4	1	
4	1	5	5	4	4	4	4	2	
5	4	4	5	3	5	4	3	2	
6	1	4	4	4	5	4	3	3	
7	4	5	4	3	4	4	3	2	
8	2	4	5	4	5	5	4	2	
9	2	5	5	5	4	4	4	1	
10	4	4	3	4	5	3	3	2	
Average	2.4	4.5	4.4	3.7	4.4	4.2	3.4	1.9	3.35

FIBRE TRACE RESULTS – FINAL INS.				
Test	12m into the piece	22m into the piece	33m into the piece	42m into the piece
1	3	2	4	4
2	4	3	4	3
3	5	3	4	3
4	4	3	4	4
5	3	3	4	3
6	3	2	4	3
7	3	3	5	3
8	3	2	4	4
9	3	3	4	3
10	3	2	4	3
Average	3.4	2.6	4.1	3.3



Average FibreTrace reading signal strength.

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Chapter 5 – Discussion and Conclusion

1. Discussion

With a focus on luxury fashion supply chains, this research set out to examine why the TBL concept was not progressing as quickly as theoretically expected and to explore solutions to this problem. It began with an observation of a problem in practice, noting a growing disparity between symbolic and substantive TBL adoption (greenwashing) in the luxury fashion sector. The initial investigations revealed a body of literature (both academic and practitioner) that supported the initial observations, not just within the luxury fashion sector but across the industry more generally. Even the originator of the TBL concept acknowledged the problem, suggesting that businesses seemed to be struggling to see the benefit in its substantive adoption (Elkington, 2018). In short, there appeared to be consensus about an increasing gap between TBL theory and practice which needed to be addressed.

The first research objective was to examine the problem from a theoretical perspective. A more traditional narrative approach to reviewing the literature was used. This was to provide context and to explore the literature on luxury fashion so as to get a better understanding of why the sector seemed to be struggling with its sustainability transformation. Although TBL and luxury fashion are compatible in many ways, the pursuit of mass-market strategies in the sector, and the negative implications this had on SSCM practice, was causing confusion about what a luxury brand and product actually is. Some proposed sustainability could become a new CSF for luxury and that the CSFs may require revision if wider societal trends such as sustainability continued to develop (Brun & Castelli, 2013). Some suggested that differentiation strategies could be formulated on the grounds of sustainability. Whilst some luxury fashion companies seemed to be taking advantage of this on a superficial level it was hard to distinguish who was ‘walking the walk’ and not just ‘talking the talk’.

There had been calls within the literature for more research that employed combined theoretical perspectives. The SLR revealed that most research did not employ a theoretical lens or only used one theory in isolation. Furthermore, it had been approached from a wide array of perspectives. There was, however, some element of consensus with stakeholder theory, institutional theory and RBV emerging as the most popular theories. With closer examination, there appeared to be different opinions about which variant of stakeholder theory was most appropriate for SSCM research (instrumental or normative).

Papers adopting the normative view were limited to conceptual studies, suggesting a need for more empirical studies that take this perspective. Interestingly, the 'descriptive stakeholder theory' approach, accommodative of both ethical and instrumental views (more of a spectrum rather than a dichotomy), had received little attention in the literature.

Despite the fragmented nature of theoretical approaches, aspects of institutional theory (institutional decoupling) and underlying assumptions of stakeholder theory (information asymmetry) helped provide powerful explanations of the observed problem, respectively explaining why and how greenwashing was able to occur. Institutional theory also offered clear explanations as to why the TBL concept seemed to be progressing better in some organisational fields than others. The two theories were deemed complementary, as both explained organisational needs for legitimacy. Institutional theory focused on external macro pressures to become sustainable. This was moderated by stakeholder theory that could span different levels of analysis from the individual inside the organisation, to the group and societal level, as well as viewing 'the environment' as a stakeholder.

With the combined theoretical foundation in place, the second research objective was to explore the theory-practice gap from the practice side. The findings of the *first paper* presented a realistic picture of the pressures and tensions that impact SSCM business case development development. A myriad of practical challenges was revealed. The sector seemed to suffer from a lack of formal coercive institutional pressures (e.g. government regulation), which is a key difference from the food industry. Moreover, there was ambiguity regarding true customer demand for sustainable products and services. This suggested other stakeholder groups (not just firms) were capable of a decoupling of sorts, best described as 'virtue signalling'. The term 'fauxercive pressure' was introduced to explain the occurrence of disingenuous demand (virtue signalling) and the asymmetry of cost at play. In essence, voicing demand for sustainable products on social media costs stakeholders nothing. As with greenwashing firms, there is no guarantee that projected stakeholder image will be coupled with substantive sustainable actions in practice.

Unsurprisingly, all participants agreed that attending to the TBL was important. However, there were too many conflicting pressures, tensions and trade-offs involved. Although there was evidence that the BCs could be developed for the 'easy wins' of the TBL (e.g. waste and cost reduction), BCs that were value-driven, or where rewards were likely to be longer-term and felt indirectly, or were adopted to prevent unwanted events from occurring, appeared to be much harder to develop. Although participants were hopeful that regulations could come into effect, the findings suggested that UK

government regulations were unlikely to be introduced soon. The government seem unwilling to step in and influence the market (change the rules of the competition). Hence, other than relying on the altruism of owners, trying to develop a clearer value-driven business case seemed like one of the only viable ways forward to enact institutional change.

The study also examined industry attitudes towards technology solutions such as BCT. However, the findings of the first paper suggested that luxury fashion is generally considered a 'slow adopter' of supply chain technology. This phrase was used by one of the participants during the study. It was interesting that the DoI terminology (Rogers, 2003) had become part of the business lexicon. There appeared to be an interest in technologies such as BCT but also a lot of uncertainties and even scepticism about the benefits of adoption - *BCT needed its own business case for to justify investing in it.*

The *second and third studies* switched focus in an effort to find new ideas and solutions to the research problem. BCT seemed to have a great deal of potential for addressing the barriers to TBL adoption that the theory had helped to explain (e.g. decoupling and information asymmetry). Its transparency and traceability capabilities could solve many TBL supply chain issues, yet the interest in adoption was seemingly limited. The second paper sought to build on the first by conceptually examining the barriers to BCT and proposing solutions for overcoming them. The findings from the first study had suggested that: a) firms were struggling to develop value-driven BCs; b) they were struggling to understand how BCT would lead to sustainability-based business benefits (value). Hence, the extended inquiry shifted focus to understanding how BCT could be harnessed to create sustainability-based value in a way that appealed to multiple stakeholder groups.

The *second study* built on the work of Saberi *et al*. (2019), who had explored the relationship between BCT and SSCM, and the work of Kouhizadeh (2021), who had employed the TOE framework to categorise barriers to BCT for SSCM. The study examined recent developments in the field of BCT, namely the emergence of tokenisation and NFTs, which has changed the value proposition of BCT significantly. New reports were emerging, suggesting that consumers were seeing the value in NFTs as a digital representation of unique and collectable assets. The behavioural psychology and gamification literature helped to explain why NFTs are being perceived as valuable by customers. The study led to several propositions about ways in which NFTs could help incentivise BCT for SSCM adoption. The study did not focus on luxury fashion specifically, as the propositions were likely to have relevance for the wider academic

community. However, the outcomes highlighted how NFTs would likely be more suitable to luxury companies, at least initially.

The second paper outlined part of the way in which BCT could become more of a viable solution for leveraging sustainability-based value. The emerging literature increasingly suggested that BCT was dependent on being combined with feeding and reading technologies for the value of its adoption to be realised. In 2018 the researcher and an associate, a Dr of Chemistry with many years of experience working in technical textiles, began discussing what is now referred to in the literature as 'tracer technologies' (Azzi *et al.*, 2019). This was based on findings from a successful pilot study employing handheld SORS devices in the whisky supply chain. It was hypothesised that SORS devices, providing SORS could read fibres and that the devices had networking capabilities, so could be linked with the blockchain. It seemed plausible to think that BCT and SORS could be applied in an luxury fashion supply chain.

It was understood that in some contexts, the pairing of BCT combined with feeding and reading technologies (e.g. RFID) may not provide the means to the ends. Generally, the combination of these technologies could help improve the effectiveness of BCT in certain contexts, but it may not provide the optimal solution in all contexts and would still leave some supply chains open to corruption. Information asymmetry, as a key cause of the present situation, could still exist. There seemed to be a need for 'tamperproof technologies' that could securely link the product with the corresponding blockchain data.

The *third study* sought to complement and build on elements of the conceptual work (the second paper), addressing the fifth research objective of the research. From a theoretical perspective, the study kept the combination of institutional theory and stakeholder theory as its focus. However, these theories were used to underpin the TOE framework that had been identified as a suitable framework for BCT for SSCM research. Based on the SLR findings, and the empirical evidence from the first paper, the decision was made to introduce and integrate the DoI theory into the theoretical perspective underpinning the TOE, to help support the 'T' (technology) angle. Generally, the approach explained the diffusion of new ideas related to behaviours in organisational and external contexts of the broader social system within which the organisation was embedded.

Dewey's pragmatist mode of inquiry (1910) (introduced in Chapter 1, Section 4.1) guided the overall thesis and the action research cycles in the third paper. For example, prior research in chemistry found that SORS could be used to identify whisky in its raw

state. It was therefore hypothesised that the technologies could also be used to read woollen textiles in their raw state in textile supply chains. After empirically testing this technology it was apparent that the action taken did not deliver the expected results. Therefore, from that study cycle, the hypothesis was amended to suggest that SORS can be used to read whisky in its raw state but for wool, an additive tracer substance was needed.

The third paper served to demonstrate why fixing beliefs simply by what is "agreeable to reason" is not the ultimate way to secure them (Haack, 2015). Following a scientific method (adoption of a scientific attitude) and actively seeking to understand the practical consequences is the best way to form stable beliefs upon which one is prepared to act (*Ibid*). The SORS lab tests did not secure the beliefs of the project team to a point where anyone was willing to act on it further at that point. Empirically testing BCT and the bioluminescent nano-particle photon marker tracer system (FibreTrace) has helped to form a warrantably assertible belief upon which the action research project is willing to act further.

The hypothesis of the action research project team was that FibreTrace can form a key part of a 'sustainable innovation cluster' and create sustainability-based value. Over time, it may become apparent that customers and other stakeholders do not see the value in this. If that indeed is the case, then the means will have failed to achieve the desired ends. This may be because of unforeseen technical barriers or because our presuppositions about the changing norms in society around sustainability were wrong. The inquiry into solutions will continue across different product lines and by involving more supply chain partners of the collaborating organisation. In time, we can evaluate whether the beliefs formed during the study are secure enough to continue acting upon in the longer term.

There have been four key stages of this research (SLR and three papers) in response to the observed problem. Individually, each stage has met the research objectives that were set. Collectively, they have helped to address the overarching research question outlined in Chapter 1:

Overarching research question: What factors are preventing the TBL concept from becoming a ubiquitous framework for luxury supply chains contexts and how can they be addressed?

The answer is complex, however, can be summarised as follows: Although there is sufficient evidence to suggest the concept of SSCM (as defined through TBL principles) has been well-accepted by both academic communities and with industry practitioners, its adoption in practice is not as advanced at present. There are numerous factors preventing this from happening that all connect to difficulties to develop a business case for SSCM adoption in practice (as evidenced in Paper 1). These include institutional complexity of certain sectors which make it challenging to achieve states which aid SSCM, such as supply chain collaboration and alignment; market uncertainty for sustainable products and practices; lack of robust government regulations and enforcement, inconsistency in corporate approaches to sustainability; Supply chain transparency issues; limitations with current technology systems and lack of clear business case for the adoption of new ones such as BCT. To address the second part of the overarching research question, this thesis has explored the potential of BCT, BCT clusters (e.g. BCT plus tracer technologies) and recent innovations in BCT such as NFTs as a means of helping to increase BCT adoption and provide the means to address many of the aforementioned factors limiting the progression of the TBL principles in practice. In doing so, it has contributed to a deeper understanding of the problem and of the potential solutions for addressing it. The contributions to the knowledge will be discussed in the subsequent sections, which have been broadly divided between theory and practice.

1.1 Theoretical contributions

The research has examined mid-range theory usage from a TBL perspective (a view found to be missing in the existing literature). This examination was necessary given that a significant amount of time has elapsed since SLRs examining theory usage in SSCM more generally had been published (e.g. Touboulic & Walker, 2015). Moreover, the TBL view of SSCM had become the dominant view in recent years (the SLR results supported this). The SLR offered an in-depth look at the employment of the most popular theories and discovered what the pragmatists would call ‘untenable dualisms’ or ‘false dichotomies’ emerging in researchers’ approaches to stakeholder theory. This research has proposed that the descriptive view of stakeholder theory can be a more appropriate lens for TBL-focused SSCM studies as a more accommodating position.

Zorzini *et al*. (2015) posited that the ‘theory expansion’ is the best way of contributing to our understanding of a given phenomenon. Theory expansion entails the “theory itself [being] applied in a detailed manner, leading to a new understanding of the phenomenon

being studied and also to an expansion of the theory itself in the context of [the given field of study]". The action research project took institutional theory and stakeholder theory and integrated the lesser-employed DoI theory to bring a new explanatory lens. Guided by the architectural framework of the TOE, it was possible to examine the problem from different yet complementary perspectives. This research has contributed to the development of a useful theoretical framework for exploring TBL innovation research. Its development suggests that a possible way forward for theoretical development in SSCM may be to strive for theoretical consensus on one hand, whilst simultaneously being open to exploring new theoretical perspectives that may help aid our inquiry on the other.

Drawing upon the decoupling aspect of institutional theory, but from a DoI perspective, made it possible to examine the theory-practice gap (decoupling) in a new light and explain why there may be widespread diffusion of the idea in principle without the diffusion of substantive adoption. Hence DoI is expanded in this regard, distinguishing between symbolic adoption (adoption of abstract concept) and substantive adoption concept (adoption of concrete ideas put into practice). Additionally, this research makes a clear distinction that the theory-practice gap does not necessarily equate to a gap between researchers and practitioners. The literature has indicated the theory-practice gap occurs within the industry itself (He *et al*., 2019), and the study conducted in the first paper supports this view. The difference lies between the acceptance of the idea and its adoption in practice across social systems in general.

The research has contributed to the development of some key concepts. The application of DoI in the third study also included drawing and expanding upon aspects of the theory, such as the concept of a 'technology cluster' (Rogers, 2003). Rogers' reasoning being that whilst it is much simpler for scholars to view different innovations as independent entities, it is a distortion of reality (Rogers, 2003). Building on the notion of 'technology clusters', the third study extended the concept further to include interrelated forms of innovation more generally. The terms 'innovation clusters' and specifically 'sustainable innovation clusters' were put forward with the latter referring to packages of new ideas, technologies and behaviours aimed at contributing to the new wave of TBL innovation and their deployment.

The research has addressed some existing concepts that seem to exhibit false dichotomies. For example, in the *first paper*, the literature on the business case (as an underlying concept of organisational decision making) for sustainability had presented

the profit-seeking and legitimacy-seeking rationale as a dichotomy. For example, the question put forward by Schaltegger and Hörisch (2017) was about was the dominant rationale between legitimacy or profit-seeking. Rogers (2003) states that, whilst useful to categorise these aspects in this way, it creates a false dichotomy that is not realistic of the situation in practice.

The literature, although not explicitly, suggested that the rationales for the business case were intertwined, suggesting that the reality in practice was probably a complex mixture of the two rationales. Interestingly, Schaltegger and Hörisch have themselves noted that distinguishing between the two rationales is complex. However, in response to what has been observed as an emergent problem with the conceptualisation of the business case within the literature, this research has contributed a conceptual model for visualising business case rationales for SSCM in the broader context of the organisational field (see Chapter 2).

The model that has been presented in paper 2 presents them as interrelated rationale with shared objectives. The two rationales have also been linked with different views of the business case that were observed within the literature. The direct-profit seeking view is more closely, yet not exclusively, aligned with the narrow view of the BC, whereas the legitimacy-seeking rationale is aligned more closely, yet not exclusively, with the broader business case view. The findings from the first study did suggest that an accurate picture of SSCM business case development could be more complex. The literature has assumed that firms act in either a self-interested or a morally altruistic way. The pragmatists would perhaps encourage a move away from this dualism. Some potential avenues for future research connected to this are discussed in Section 4.

The *second study* contributed to the knowledge on BCT as a solution by conceptually exploring how the recent innovations of NFTs could help its adoption for SSCM purposes. According to Dewey (1910, p.184) conceptions are "capable of development without reference to direct observation, and the "habit of tracing their connection with one another as just ideas or meaning is absolutely indispensable to the growth of science". The outcomes from the study contributed to the knowledge by proposing several ways in which NFTs could help overcome the existing barriers to BCT for SSCM that have been highlighted in the existing literature (see Saberi *et al.*, 2019 and Kouhizadeh *et al.* 2021). However, as Dewey puts it, there is a "need of final tests of concepts" (1910, p.184). He posits that conceptions can be "rich and plausible", however, their validity cannot be

determined until they been observed in practice. It is hoped that the paper provides a good foundation for future empirical research exploring NFTs in supply chain contexts.

The *third study* employs the TOE framework proposed in the second paper, and with a combined theoretical perspective that had been constructed during the earlier stages of the research. It presented a complementary view to the first paper (and organisational field view of SSCM business case development) by presenting a detailed look at business case development for BCT for SSCM adoption. The study has responded to calls for more empirical BCT research, and has made some key contributions to the knowledge at the more concrete operational level.

Building on the notion of 'technology clusters', it has contributed empirical evidence for two 'BCT clusters', examining the pairing of BCT with tracer technologies i.e. SORS and a bioluminescent nano-particle photon marker tracer system (marketed as FibreTrace®). The action research cycles have allowed for the careful study of these BCT clusters using Rogers' (2003) categories of perceived innovation attributes as a framework for evaluation. The results, as discussed before, proved that despite the successful application of SORS in whisky production, it is presently not suitable for wool supply chains, as it could not read the wool in its raw state and would need other additive tracer elements. This has important implications for researchers, as it suggests that the success of tracer technologies is highly dependent on the nature of the product. The findings do not rule out its usage in wool supply chains, but it does make its adoption far more complex presently, prohibitively so in the case of the action research project.

The second pairing explored in the second cycle of the action research project (BCT and the patented bioluminescent nano-particle photon marker tracer system) delivered a successful proof-of-concept trial. This study was one of the first in the world to evaluate this technology in the wool supply chain and the first to test it with Merino wool. It has implications for fashion and textile supply chain researchers and those researching BCT applications in supply chains generally.

In summary, the research contributes to the knowledge by demonstrating that BCT clusters that include tracer technologies can help overcome some of the barriers to BCT for SSCM adoption, particularly the limitations with the 'feeding and reading' technologies. The proposition of the 'sustainable innovation clusters' concept provides a framework for understanding that technological innovations have no inherent value (Chesbrough & Rosenbloom, 2002) and must be coupled with other forms of innovation, e.g. TBL, as a new set of ideas and behaviours, and also business model innovation as a

new way of creating value based on those behaviours. When combined, they enable a way forward for overcoming present struggles with SSCM business case development. The relationship between TBL, BCT and business model innovation was developed following a summary of the literature in the third paper. The findings that emerged during the action research project have led to the development of a theoretical causal model (see Figure 1).

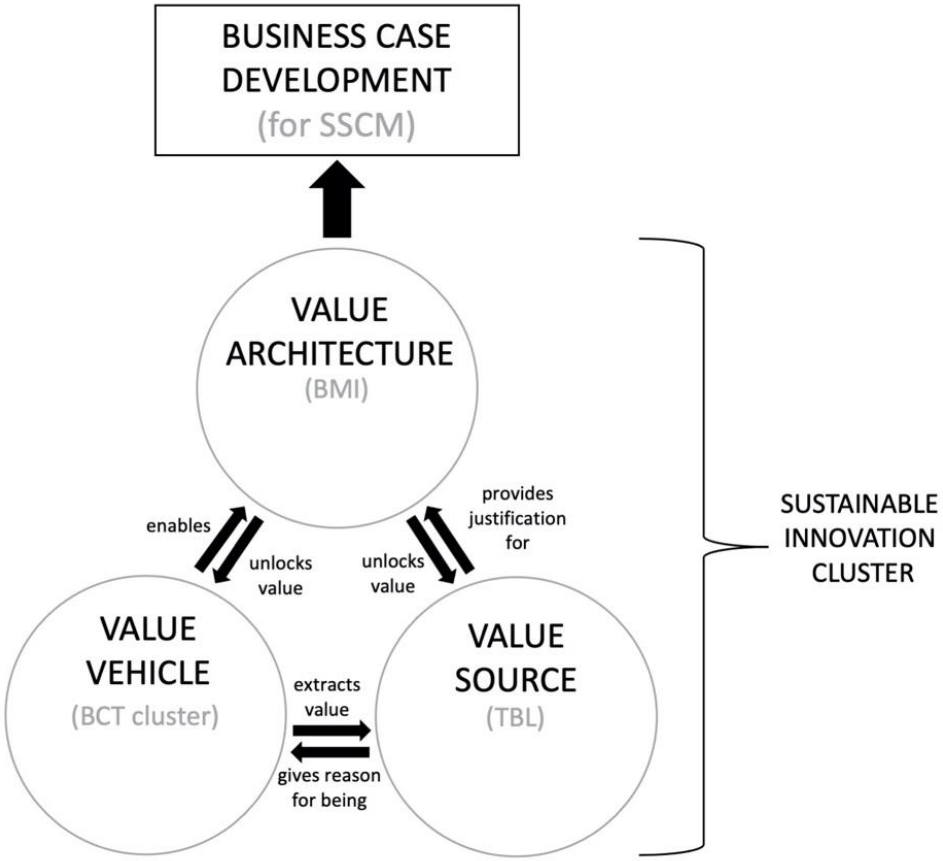

Figure 1. Theoretical causal model to show how a sustainable innovation cluster supports SSCM business case development

This thesis has focused extensively on the luxury fashion sector as an example of sector which lags behind in its sustainability journey (Moore, 2011; Karasoman et al. 2020). In Chapter 1 (Section 3.3, Table 2) a list of TBL related supply chain sustainability issues found in the relevant academic literature was presented. Table 1 below revisits this table and briefly summarises how either BCT, NFTs or BCT clusters may help to address each of these issues.

Table 1. How BCT and NFTs address luxury fashion SSCM issues

	KEY ISSUE	DESCRIPTION	Does BCT/NFTs help?
ENVIRONMENTAL SUPPLY CHAIN ISSUES	Toxic dyes	The use of toxic synthetic dyes (eg. azo dyes which release carcinogenic amines) used during production.	Data regarding dyes can be stored on the blockchain and the information made accessible to customers. Info could be incorporated in to NFT certificate.
	Mercury	The use of mercury for tanning leather skins.	Not specifically but data providing assurances regarding lack of Mercury use coud be stored on the blockchain and made accessible to customers.
	Pesticides	The large volumes of pesticides used in growing natural fibres, for example cotton (the farming of which consumes 25% of all the pesticides used in America), which can lead to water pollution, soil erosion and the emission of greenhouse gases, such as a nitrogen peroxide.	Data regarding dyes can be stored on the blockchain and the information made accessible to customers. Info could be incorporated in to NFT certificate.
	Water consumption	Excessive water usage to produce cotton fibres.	Data regarding water consumption can be stored on the blockchain and the information made accessible to customers. Info could be incorporated in to NFT certificate. For example FibreTrace platform makes this info available to customers.
	CO^2 emissions	The transportation of fibres/textiles/finished garments between all stages of the SC and its impact on carbon dioxide emissions and consumption of finite resources, such as oil.	Data regarding emissions can be stored on the blockchain and the information made accessible to customers. Info could be incorporated in to NFT certificate. For example, FibreTrace platform makes this info available to customers.
	Deforestation	The high demand for leather in the industry, that can lead to deforestation caused by cattle ranching.	Information about product provenance could be stored on the blockchain and presented as NFTs.
	Garment maintenance	Laundering clothes uses lots of energy and can release harmful chemicals, such as nonylphenol ethoxylates and nonylphenols (NPEs/NPs), considered to be endocrine disruptors, into the water supply.	N/A
	Textile waste	The overproduction and overconsumption of garments. Overconsumption of garments is often cited as being propelled by the fast-fashion sector, and the increased textile waste entering landfills. This is heightened in countries, such as the UK, by a reported lack of basic sewing skills, leading to poor choices when faced with a repair-or-	NFTs show significant promise for reducing textile waste through 'NFT first, physical item second' approach. They could also help support more circular business models in the luxury fashion sector reducing the amount of textile waste that goes to landfill.

		dispose dilemma. Overproduction has been the topic of much discussion in the luxury fashion sector, where recently Burberry were caught burning excess stock to protect perceived brand value.	
	Over-exploitation of rare resources	The luxury fashion industry over-exploiting rare resources, such as leather, exotic skins and furs, precious metals, and precious gemstones, such as diamonds.	BCT clusters may help to provide assurances that luxury raw materials are being acquired in ways that are not environmentally or socially damaging. For example, a BCT cluster platform, like FibreTrace, would be able to assure that products were from certified suppliers and could help verify this with GPS location etc.
SOCIAL SUPPLY CHAIN ISSUES	Child labour	The use of child labour for textile farming and garment manufacturing.	The pairing of BCT with tracking technology such as RFID or tracer technology will help provide assurances that luxury goods are only acquired from factories with good sustainability credentials.
	Unsafe working conditions	Working conditions in 'sweatshops' have resulted in some of the worst industrial accidents ever recorded.	Same as above
	Low wages	The low wages of garment workers that are far below what would be deemed a 'living wage'.	Same as above
	Forced labour	Forced labour and excessively long hours.	Same as above
	Violence against workers	Violence against the workers, particularly against women who, on average, make up around 70% of the garment manufacturing workforce and in some developing countries make up to 90%.	Same as above
	Law enforcement	A lack of access to legal representation when worker's rights are violated.	BCT systems could help support law enforcement by enabling a complete immutable record of relevant supply chain information. For example, it could help to support the enforcement of modern slavery legislation.
	Animal Welfare	The unethical treatment of animals through the sourcing of raw materials, such as skins and fur.	The pairing of BCT with tracking technology such as RFID or tracer technology will help provide assurances that luxury goods are only acquired from factories with good animal welfare credentials.
	Fraud	Fashion garments being mis sold in the in the UK as 'faux-fur', when they actually were found to be made from real animal fur. Also, there are significant issues with luxury fashion goods and counterfeiting.	Both NFTs and BCT clusters (specifically BCT plus tracer technologies) show significant potential for addressing issues relating to counterfieit goods and product adulteration.
	Unemployment	Unemployment due to the relocation of labour to countries where business can access cheap labour.	N/A
	Skills shortages	The loss of textile and garment manufacturing capability and	N/A

		subsequent skills shortages which block the growth of industry, in the UK/Europe.	
	Social impacts of environmental issues	There are several social issues, that occur as a result of environmental issues. These include but are not exclusively limited to: contaminated water sources; severe health issues due to exposure to toxic chemicals used in farming and manufacturing processes; concerns for end-consumer safety as a result of exposure to toxic chemicals in the finished garment.	Data regarding all manner of social sustainability issues can be stored on the blockchain and the information made accessible to customers. Info could be incorporated in to NFT certificate.

1.2 Practical implications

Drawing on institutional and stakeholder theory, the *first paper* highlighted several implications for practitioners and policymakers. It highlighted five key areas of desired institutional change for successful SSCM business case development in the sector: 1) Institutional robustness i.e. appropriate and well-enforced regulations; 2) Strong, genuine customer demand for sustainable products; 3) Appropriate voluntary industry SSCM standards that are useful for managers and customers; 4) Institutional environments in which effective supply chain collaboration is easier to achieve; 5) Ideal technologies that offer unprecedented levels of transparency and connectivity.

The first paper suggested that more regulation was needed in luxury fashion and the fashion industry more generally. The government have the power to influence the 'rules of the game for organisational survival' and incentivise behaviour (Porter, 2008). The food industry can be looked to as a blueprint in that regard (although not without its issues). What is clear is that policy should be realistic and developed with the collective input from multiple stakeholder groups. Policymakers need to think very carefully about any unintended consequences of new regulations. Strict supply chain regulations that are not well-enforced can lead to circumvention and corruption (decoupling practices). However, even if the regulations are strict and well-enforced, their introduction might produce a chain of unintended negative consequences at a global political level. For example, as stated in the third paper, the collaborating organisation commit to TBL because they feel it is the best thing to do for society and their long-term survival, but this costs money and puts them at risk of being at a competitive disadvantage. If we view that problem on a global scale, we can see that it has important implications for global power dynamics. Governments influence the rules of the game for organisational survival. Bodies such as the United Nations, which first published the concept of sustainable

development (World Commission on Environment and Development., 1987) continue to seek to influence the rules of the game for global governments through international treaties. In summary, yes, stricter policy creation could help the luxury fashion sector in achieving its sustainability transformation, but it is a complex and perhaps a longer-term goal for the sector. This is something that could be enabled by the types of technology explored in this research.

The theme that was clear from the luxury fashion sector was that government policy was unlikely to change any time soon. Therefore, whilst firms and their stakeholders should keep pressuring the government for change, energy is best spent on other areas for improvement where change might be more likely at this stage. The need for education of TBL ideas emerged as a key theme from the first paper. Applying a DoI lens, we can see that education relies on successful communication. The diffusion of ideas depends on clear communication channels among the members of a social system (Rogers, 2003). This research has proposed that BCT clusters can enable channels through which consumers can be informed and empowered to sustainable consumption choices. As salient stakeholders, getting their "buy-in" is essential to support the supply chain objectives (Seuring & Müller, 2008). However, this will ultimately depend on the perceived value of the sustainable product or practice. The second paper has proposed that NFTs can also help incentivise customers.

The *third study* advocates that BCT clusters, particularly those which employ tracer technologies, can help to create new and meaningful standards. There are significant practical implications for the auditing process of sustainable practice and may lead to the development of clearer more standardised metrics. Collaborations between BCT solution providers and established sustainability certification bodies could enable rapid and significant positive change in this area. One would assume that sustainability verification bodies would welcome innovations such as the FibreTrace system. However, this research suggests that this is not how things are unfolding in practice, and that they may see technology providers as a threat to their existence.

Sustainability accreditation bodies may refuse to collaborate with technology providers. This could complicate matters and they run the risk of being superseded by a new wave of decentralised BCT cluster-backed sustainability certifications. This has important implications for managers looking to authenticate and verify their SSCM practice. If managers commit to a technology solution that is not endorsed or even repudiated by a sustainability certification body that they are certified by, then it may

undermine their sustainability customer marketing messages. The findings of the paper suggest there is room for existing standards and new technology solutions to co-exist, where the benefits of collaboration will be realised, otherwise it could further delay progression.

This research suggests that BCT clusters may help managers collaborate with multiple stakeholder groups from end-to-end of the supply chain as part of a value chain. This type of collaboration may be more suited to facets of the luxury fashion sector (e.g. traditional luxury) that have a high degree of vertical integrations and longstanding strategic partnerships. It could inspire the progression of 'slow fashion' supply chains and a move away from the fast-paced, trend-driven product cycles that have made collaboration challenging in the sector. Managers of luxury fashion brands should consider the possible trade-offs with this proposition. Design innovation is central to the success of the overall market (Brun & Castelli, 2013). There needs to be room for emotional and artistic expression, both of which are advocated by Peirce and Dewey and also found in the work of Darwin (Darwin, 2013; Dewey, 2005; Turley, 2010). Luxury fashion has been likened to art and clothes are often referred to as a form of personal expression (Kapferer & Bastien, 2012). Design classics were once new design innovations and have become classics over time. Therefore, managers of luxury fashion brands perhaps need to strike a balance between moving to seasonless trends, whilst still allowing for creative freedom so that future design classics continue to emerge.

The *first study* suggested a move towards the adoption of 'ideal technologies', that is, technologies that enable the level of transparency required to help support SSCM business case development. A large portion of this thesis has focused on how technology can help to advance the TBL agenda, from which managerial implications can be derived. It has provided conceptualisations of how the latest innovations in BCT (NFTs) could impact SSCM practice (*second paper*), highlighting opportunities for value creation whilst also flagging the potential risks and negative consequences of adoption. While the practical consequences have been discussed in length, empirical testing of propositions is needed.

The *third study* has shown that categorisation of innovation attributes (Rogers, 2003) used in DoI theory can provide a useful managerial framework for evaluating technology adoption for SSCM purposes, particularly in relation to the TBL, business model and business case concepts. The action research project presented the practical application of novel tracer technologies and BCT ('BCT clusters') offering insight into the exploration. The concept of a 'sustainable innovation cluster' helps managers to think about three

forms of innovation which must be considered (technology, TBL, business model innovation) when implementing a technology to unlock value from substantive TBL adoption.

The action research project also demonstrated that TOE, although abstract in nature, is a useful framework that helps managers think about how the technological innovation is perceived at three different levels: 1) its technological capability; 2) its compatibility with the technical requirements and values of the organisation of the organisation; 3) its compatibility with the requirements and values of the external social system beyond the boundaries of the organisation (e.g. the supply network, the organisational field and broader society). A model for visualising this is presented in Figure 2.

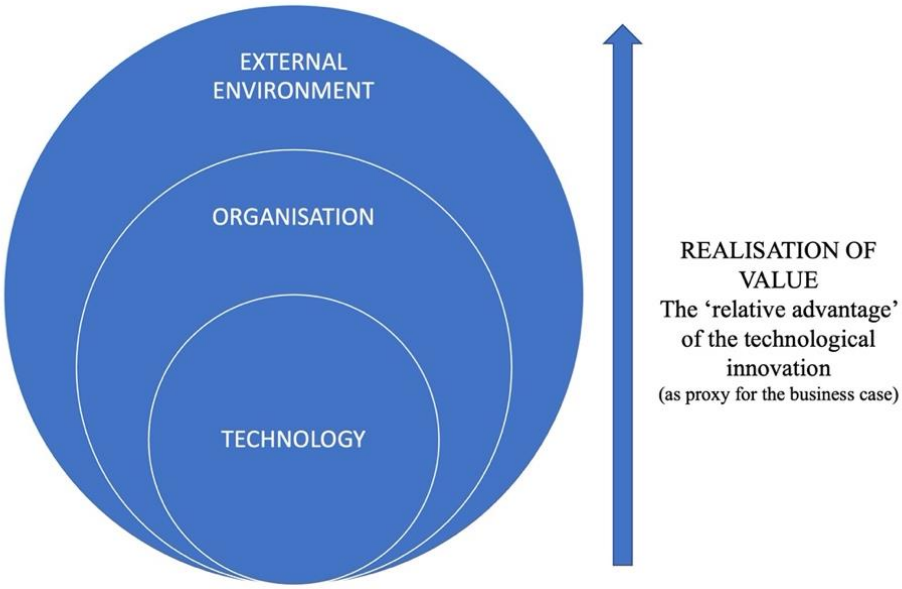

Figure 2. A model to show the realisation of value (BC) of a technological innovation using TOE framework

2. Dissemination and publication

The research in this thesis has been disseminated in both academic and practitioner circles. A development paper was presented at the British Academy of Management in September 2018. Findings of the SLR were published and presented as a conference paper at the 27th EurOMA 2020 conference in July 2020 (Davies, 2020). A conference-length version of the first paper (Davies, 2021) was published and presented at the 28th EurOMA conference in 2021 in the SSCM track. At the time of writing, the second paper is currently under review for Supply Chain Management: An International Journal.

In November 2018, the researcher was invited to speak about their research on BCT as part of the 'Transformation of Fashion' panel at the Barbican Beyond conference produced by the Arts & Humanities Research Council, as part of the UK's Industrial Strategy. The author was invited by the British Fashion Council and sat on the panel alongside the Chair, Caroline Rush (British Fashion Council), Prof Jane Harris (London College of Fashion), Lynda Petherick (Accenture UK), Prof Stephen Russell (Uni of Leeds), and Jonathan Chippindale (Holition). The researcher has twice been invited to the House of Lords by the Textile Institute, which aims to promote professionalism within the textile industry. This has provided opportunities to share the knowledge acquired during this research. The researcher has been invited to the IBM Garage and IBM headquarters in London on several occasions during the period of study to discuss their research about the IBM Fashion Trust and was also invited to participate in roundtable discussions with IBM and notable retailer, Selfridges, to discuss BCT in 2019.

3. Limitations

This research has been undertaken with a pragmatic 'scientific attitude' that is a genuine desire to understand how things are (Haack, 2015). Every effort has been made to conduct the research with quality and integrity in a way that contributes actionable insight. However, there are some research limitations that could be addressed in future research.

Firstly, the pre-cursory SLR looked at TBL-focused SSCM research. It is worth mentioning that there were varying degrees to which the TBL was featured. All papers referred to the TBL in some form. However, for some articles it was the primary focus whereas for others it was simply used as a means of defining SSCM. The SLR focused on analysing the use of the most popular theories that had been used in the field. Therefore, a limitation is that some of the lesser-used theories in the field were not analysed in depth. This would be an interesting avenue for future research and may offer further insight.

The first paper featured in-depth semi-structured interviews with a range of stakeholders in the organisational field. Although this provided rich findings the sample size of participants (21) may be considered a potential limitation. Because of the spread of stakeholder viewpoints that were represented in the study, the number of participants assuming each position was therefore relatively small. In some instances, this was dictated by the total population of potential candidates that could have been interviewed for each perspective. For example, there were only a limited number of MPs involved

with the ‘Fixing Fashion’ EAC report, therefore an extremely limited number of people who could have spoken about it with the necessary degree of understanding and experience to provide the level of insight required.

Paper 2 conceptually explored NFTs in the context of SSCM. The conceptual nature of the study, coupled with the fact that NFTs are a very recent development in BCT, calls for far more empirical testing of the propositions. The paper highlighted several avenues for research. However, understanding the realities of how the ideas may play out in practice is needed to determine how useful the conceived ideas may actually be. BCT itself is still considered to be in its early stages, making NFTs an even more recent development, and therefore we can gain new knowledge about their application all the time. New propositions need to be developed and adapted as we continue to learn more about this emerging innovation, especially as they continue to diffuse throughout society.

The third and final study, was a collaboration with just one organisation. The company is a fair representation of the vertically integrated supply chain it operates within and the study-maintained validity during the research in line with guidelines for quality action research proposed by Bradbury and Reason (2001). However, there may be limitations with generalisability. The action research was conducted with the intention that the technology solution could be rolled out across the collaborating organisation’s supply chain both upstream and downstream. Due to the largely vertical structure of the mill and the highly novel nature of the technology, the action research project largely focused on the internal supply chain stages that are under the collaborating organisation’s control.

A select group of trusted supply chain partners were consulted to assess the potential “buy-in” of the technology platform adoption. However, a larger roll-out from end-to-end of the supply chain would help develop a deeper understanding of how the involvement of a larger number of supply chain players would play out in practice. As the collaborating organisation are a dominant player in their supply chain setting within the luxury textiles sector, questions could be raised about the transferability of the technology to more horizontally integrated supply chain contexts and/or in developing countries where supply chain partners may face different adoption challenges. They can also be seen as an exemplar firm in terms of economic and social and environmental performance. Collaborating with them is certainly justifiable, given their position as market leaders. They are well positioned to influence the behaviour of competing organisations in the sector. However, SSCM scholars have highlighted the tendency of researchers to work with exemplars. This can lead to a misrepresentation of general

attitudes and practices of more typical organisations in a given organisational field (Kirchoff *et al*., 2016). This can be seen as a limitation of the study. More examination of sustainable innovation clusters in the context of the supply chains of non-exemplar firms is needed to fully assess the viability in practice.

The action research project was also bound by time limitations (18 months) and therefore its scope. However, it has paved the way for the next phase of implementation to continue, creating interesting avenues for future research.

4. Future research

Establishing a consensus regarding the theoretical toolkit for SSCM research is a desirable objective. However, being open to new theoretical perspectives can also help shed new light on the situation. Future research could look to explore different theoretical lenses for understanding the TBL and could examine their integration with other new theories or with more established theories in the field.

Future research could examine different combined theoretical perspectives to support the TOE framework. The third paper employed three of many theoretical perspectives put forward by Hwang *et al*. (2016) as suitable underpinnings for the TOE framework. Future TBL research, particularly that which has a technology focus, could explore other combinations of mid-range theories (e.g. institutional theory, dynamic capabilities theory and IPT) and could open the door to new insights.

The SLR suggested that normative stakeholder theory research is largely conceptual. Hence, more empirical research is needed to see how realistic this perspective is in practice. This research has suggested (based on the SLR and the findings of the first paper) that the descriptive variant of stakeholder theory may provide a better lens for viewing organisational decision-making about SSCM. It has suggested looking to the field of evolutionary biology, particularly to the theory of 'reciprocal altruism', to explain altruistic complexity in supply chain behaviour.

The game of survival in nature is complex. Logically, this complexity translates to organisational survival also. Trivers (1971) highlighted that reciprocal altruism occurring in nature is akin to game theorists' 'Prisoner's Dilemma' metaphor. This has been explained in the field of 'green entrepreneurialism' by scholars such as Pacheco *et al*. (2010). They suggest that "entrepreneurs face a system of incentives that fail to encourage sustainable practices" which they refer to as 'the green prison' (p.465). They posit that the only way out is to try and change the rules of the game. This metaphor summarises

the situation that the collaborating organisation in the action research project are in position perfectly. Breaking free from the confines of the prison involves changing the rules of the game. The rules can be influenced in formal ways such as government regulation. However, in the absence of formal coercive pressure, firms are reliant on whatever means gives them the necessary agency to detect and therefore limit the likelihood of other firms greenwashing (cheating). This research has posited that sustainable innovation clusters (and BCT clusters with tracer technologies) empower firms to change the rules of the game, deserving further investigation in the field.

Evolutionary behavioural theories such as reciprocal altruism (Trivers, 1971) and behavioural psychology theories such as 'delayed gratification' (Mischel & Ebbesen, 1970) would also be worth exploring, given that often a firm's investments in TBL practice are done so in the hope that they will be rewarded at some point in the future. These could be good lenses for NFT purchases too as investors (collectors) often purchase rare items with the hope that they will increase in value over time (reward for investment). This research has also proposed that the relationship between SSCM and gamification provides a fertile ground for interesting future research into understanding how to incentivise society to engage with SSCM and deliver appropriate awareness and education.

On a practical level, there are lots of interesting future research directions with regards to BCT clusters and sustainable innovation clusters and platforms. Far more empirical research is needed into tracer technologies, their pairing with BCT and their pairing with other technologies (e.g. AI, 5G, IoT, RFID). All kinds of technology clusters may be possible to investigate as Industry 4.0 continues to progress. Empirical evidence of their effectiveness as SSCM solutions will help the academic and practitioner communities gain a clear picture of what technology clusters may be suited to certain contexts. This research has highlighted that the success of tracer technologies can be highly context dependent. The propositions from the second paper provide the basis for different avenues of future research with regards to BCT tokenisation as a means of incentivising substantive TBL adoption. Again, far more empirical research is needed here. The action research project in paper 3 is still ongoing and will look to explore the potential of some of the propositions put forward in the second paper. For example, reports suggest that the Hyperledger blockchain is developing fungible, semi-fungible and NFTs. Future cycles of action research could look at issuing semi-fungible tokens with fabric purchases. For example, a token could be issued per metre of fabric.

More interdisciplinary studies for BCT for SSCM research has been called for by Saberi *et al*. (2019) and has been supported by the action research study. Drawing on philosophical pragmatism, Susan Haack has advocated for a 'federation of sciences' working together to support common goals related to human flourishment (Haack, 2010). The action research project bought together an interdisciplinary research team from the fields of operations and supply chain management and chemistry. Interestingly, there are parallels between this and what Rogers (2003) described within DoI research as the 'invisible college'. DoI researchers have commented that "it cannot be far wrong to assert that every one of the social sciences and humanities has at least intermittently, given attention to the question of how ideas and practices – get from here to there" (Katz, 1999, p. 145).

5. Concluding remarks

This research has contributed to Elkington's call for the new wave of TBL innovation and deployment. It has offered new perspectives on the limited adoption to date and has explored emerging solutions that might advance its substantive diffusion. During this research, the Covid-19 pandemic hit, bringing the luxury fashion sector to a complete standstill in spring 2020. Commentators noted this presented a moment of reckoning for the luxury fashion industry and that it had an opportunity to embark upon a more sustainable future (Indvik, 2020). Time will reveal which path it decides to take. This research has studied novel technologies that have the potential to offer exceptional levels of supply chain transparency. However, it has also given rise to concerns that there may come a point where limitations in supply chain technology and transparency can no longer be to blame for the lack of progression. In which case, we will have to ask deeper questions about our willingness as a society to ensure that future generations can meet their own needs. Their survival may depend on it.

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Appendices

Appendix 1

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