A natural-resource-based approach to closed-loop supply chain management: competitive environmental sustainability in the fashion sector

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Purpose: The purpose of this study is to conceptualise a natural-resource-based approach to closed-loop supply chain management, proposing a pollution prevention loop, a product stewardship loop and a clean technologies loop. This is intended to respond to calls for competitive environmental sustainable operations in fashion.
Design/Methodology/Approach: Conceptualisation is based on interrogation of literature. Qualitative content analysis supports identification of existing parallels between the natural-resource-based view and closed-loop supply chain management in literature.
Research Implications: This study bridges the gap between competitiveness and sustainability in closed-loop fashion, adds distinction and competitiveness to closed-loop supply chain management and advocates the application of NRBV resources in sustainable supply chain management.
Practical Implications: In presenting a natural-resource-based approach to closed-loop operations this study responds to the need for enhanced competitiveness and sustainability in fashion.
Originality: This paper forms the base of, and proposes a methodology for, a future empirical study of pollution prevention, product stewardship and clean technologies loops in fashion, and the impact on competitive environmental sustainability.

Key words: Natural-resource-based view; closed-loop supply chain management; competitive sustainability; fashion

1. Introduction

Competitiveness and sustainability present two of the fundamental challenges for the fashion sector (Nagurney & Yu, 2012). An emphasis falls upon the effective operation of the fashion supply chain, in particular, closed-loop supply chain management (Oh and Jeong, 2014). However, existing frameworks for sustainability struggle to maximise the competitive value of such operations (Berger-Walliser & Shrivasta, 2015), often presenting competitive benefits secondary to sustainable obligations (Galbreath, 2009; Li & Lui, 2014; Wilson, 2015). This presents a gap between competitiveness and sustainability in existing closed-loop supply chain management literature, with particular emphasis on environmental operations in fashion (Oh & Jeong, 2014).

Hart's (1995) natural-resource-based view (NRBV) of the firm purposefully seeks competitive rewards from sustainability. More specifically, the NRBV contends that environmental and societal issues can be, and should be, exploited for firm gain. In response, the NRBV offers four competitive and sustainable resources: pollution prevention, product stewardship, clean technologies and base of the pyramid. The first three of these resources, which focus on environmental sustainability and associated benefits of reduced costs and maximised efficiency, emerge with particular significance in closed-loop supply chain management, arguably bridging the competitive-sustainability gap. This inspires conceptualisation of three closed-loop operational approaches to competitive environmental sustainability.

The pollution prevention loop operates on an internal level to prioritise environmental considerations throughout fashion manufacturing. The product stewardship loop operates at supply chain level to reduce negative environmental impacts throughout the fashion lifecycle. The clean technologies loop operates on a broader societal scale, focusing on the development of new circular technologies and systems in pursuit of positive environmental impacts. In line with the NRBV, the exploitation of these three closed-loops maximise both sustainability and competitiveness.

This paper provides a brief overview of the conceptual development of the three natural-resource-based closed-loops. Contributions are three-fold: first, this study bridges the gap between competitiveness and sustainability in closed-loop fashion; second, it adds distinction and competitiveness to closed-loop supply chain management; and third it advocates the application of NRBV resources in sustainable supply chain management. Avenues for a future empirical study exploring the manifestation of the pollution prevention, product stewardship and clean technologies loops are also highlighted. A brief methodology in support of this is proposed.

2. Theoretical Background

Drawing on seminal resource-based theory (Wernerfeldt, 1984), the NRBV conceptualises sustainability as competitive resources. More specifically, the NRBV argues that environmental and social issues can be exploited for competitive gain (Hart, 1995). Such competitive gains primarily focus on financial rewards, but also expands to enhanced efficiency, differentiation and access to scarce resources and unsaturated markets (Hart & Dowell, 2011). By illuminating the business case for sustainability (Berger-Walliser & Shrivasta, 2015) it can be argued that managers are increasingly motivated to meet environmental and social obligations (McDougall, 2018). From this perspective, the NRBV promotes an 'environmental revolution' (Hart, 1997) intended to change the way business operated entirely (Svensson & Wagner, 2012).

2.1 Natural-Resource-Based View Resources

This is supported via its four interconnected resources: pollution prevention, product stewardship, clean technologies and base of the pyramid. Pollution Prevention acknowledged the growing concerns of ecological degradation to promote the minimisation of waste and emissions throughout operations (Hart, 1995). The focus is shifted away from traditional management or disposal of waste and emissions, to instead prevent their initial occurrence (Aragon-Correa & Sharma, 2003). In doing so, pollution prevention is intended to reduce costs associated with waste and emissions and maximise efficiency (Hart, 1995; Russo & Fouts, 1997), encouraging its presentation as a competitive cost cutting strategy (Hart, 1997; Christmann, 2000; Hart & Dowell, 2011).

Product Stewardship expands this environmental prioritisation throughout each stage of the lifecycle to present the natural environment as a key stakeholder (Hart, 1995). Environmentally damaging processes are minimised and conservation and avoidance of harmful productions maximised. Attention is also turned to environmental end-of-life practices, highlighting the value of recyclability, biodegradability or take-back as opposed to traditional disposal methods which pose environmental threats (Hart, 1995; Miemczyk et al, 2016). This the externally focused lifecycle approach is intended to permit access to scarce resources such as raw materials, markets and locations, whilst the creation of wholly, sustainable products may act as a source of differentiation (Hart, 1995; Menguc & Ozanne, 2005). McDougall's (2018) empirical study also find benefits of reduced costs and maximised efficiency.

Clean technologies is presented as 'stage 3', expanding on pollution prevention and product stewardship in pursuit of positive impact operations within an environmental context. Companies '*must* *begin to plan for and invest in tomorrow's technologies'*, building upon the argument that technological innovations provide substitutes for non-renewables. There is a need to move away from traditional routines and processes to support the creative redesign of industries in which sustainability is maximised (Hart & Milstein, 1999). This encourages innovation of high investment on an advanced level (Hart & Dowell, 2011) which supports enhanced efficiency, reduced costs and commercialisation and differentiation opportunities (McDougall, 2018).

Base of the pyramid is considered the socially focused resource of the NRBV, seeking the alleviation of social ills in and support of emerging markets at the base of the economic pyramid via stimulation of economic development (Hart & Christensen, 2002). Base of the pyramid argues that engaging in business with underprivileged areas of the world may ease poverty whilst simultaneously, and somewhat paradoxically, increase profits by serving previously neglected and unsaturated markets (Hart & Milstein, 1999). Such markets offer considerable opportunities for growth (London & Hart, 1994). However, due to an environmental focus, base of the pyramid falls out-with the scope of this paper.

2.2 The Natural-Resource-Based View and Sustainable Supply Chain Management

Due to paralleled intentions of competitiveness and sustainability, there exist prominent links between the NRBV and sustainable supply chain management (Johnsen et al, 2014). In fact, an inherent reliance on the supply chain is implied throughout NRBV literature (e.g. Hart, 1995; Matopoulos et al, 2014), whilst the NRBV exists as a fundamental theory in the development and continued research of sustainable supply chain management (Chicksand et al,2012; Johnsen et al, 2014).

However, in conflict of its intentions of an 'environmental revolution' (Hart, 1997), the NRBV remains an underpinning theory as opposed to a practical framework in sustainable supply chain management. More recent studies have attempted to move away from this theoretical supremacy to advocate practical application of NRBV resources in the supply chain (Shi et al, 2012; Miemczyk et al, 2016; McDougall, 2018). Building on this, this study applies a NRBV approach to closed-loop supply chain management with the intention of maximising competitive environmental sustainability in the fashion sector.

2.2.1 the Natural-Resource-Based View and Closed-Loop Supply Chain Management

The shift away from traditional forward-flowing supply chain management is directly linked with the growing need for environmental sustainability (Bell et al, 2012; Oh & Jeong, 2014; Kazemi et al, 2018). Closed-loop supply chain management incorporates both forward and reverse logistics (Jensen, et al, 2013; Garg et al, 2015) to meet increasing environmental objectives (Eskandarpour et al, 2015). In fact, according to Kazemi et al (2018, p2) closed-loop supply chain management *'is undoubtedly one of the main drivers of sustainability and is defined as one of the primary factors in achieving sustainable operations'*.

In correspondence with the NRBV, closed-loop supply chain management warrants prominent links with competitive gain (Ashby et al, 2012; Bell et al, 2012; Garg et al, 2015; Govidan et al, 2015; Miemczyk et al, 2016). Such links surround enhanced efficiency (Jensen et al, 2013), waste and cost reduction (Miemczyk et al, 2016; Kazemi et al, 2018) and profits from end-of-life recovery (Oh & Jeong, 2014; Govidan et al, 2016; Kazemi et al, 2018). Implicating exploitation for competitive gain, Govidan et al (2015, p603) defines closed-loop supply chain management as *'the design, control, and operation of a system to maximize value creation over the entire life cycle of a product with dynamic recovery of value'*. Adding further significance, McDougall's (2018) empirical exploration of NRBV resources identified circularity as a key theme is realising the competitive rewards of each resource.

In spite of this, Oh and Jeong (2014) identify a gap between sustainability goals and competitive goals in existing closed-loop research in fashion. A NRBV-closed-loop amalgamation may bridge this gap and responds to calls for enhanced sustainable operations in fashion (Nagurney & Yu, 2012). Moreover, a mutli-level pollution prevention, product stewardship and clean technologies approach may add some distinction to the broad topic of closed-loop supply chain management.

3. Conceptual Framework

Thus, expanding on parallels between the NRBV and sustainable supply chain management and in response to the need for competitive environmental operations in fashion, this study proposes three natural-resource-based closed-loops: the pollution prevention loop; the product stewardship loop; and the clean technologies loop: The conceptual development of these loops derives from interrogation of existing literature, highlighting parallels between each resource and closed-loop supply chain management. This was supported by qualitative content analysis which allows the researcher to *'extend conceptually a theoretical framework* [....] *to provide predictions about the variables of interest or about the relationships among variables, helping to determine the initial coding scheme'* (Hsieh & Shannon, 2005, p1281).

3.1. The Pollution Prevention Closed-Loop

Whilst McDougall (2018) identify circularity as a theme in empirical investigation of each NRBV resource, there are no explicit links with pollution prevention in existing literature. In some part this may be due to the internal nature of pollution prevention (Shi et al, 2012) which is distanced from the typical externalities of a supply chain discipline. However, closed-loop supply chain management does incorporate internal elements via prioritisation of environmental considerations throughout manufacturing systems (Oh & Jeong, 2014; Garg et al, 2015), network design (Garg et al, 2015; Govidan et al, 2015) and internal acquisition (Miemczyk et al, 2016). This supports the recapturing and reuse of by-products, unsold products and effluents in a way which creates added-value (Ashby et al, 2012; Bell et al, 2012; Garg et al, 2015; Govindan et al, 2015). Thus, an internal-closed loop approach resonates with pollution prevention's shift away from traditional management and disposal of waste and effluents to promote competitive environmental internal systems (Hart, 1995).

Based on this, this study proposes a pollution prevention closed-loop which operates at an internal level. Whilst this may support the minimisation of waste and emissions in internal operations, it may simultaneously reduce costs and maximise efficiency. Thus, in line with Hart's (1995) conceptualisation, the pollution prevention closed loop should purposefully be exploited as a competitive cost cutting strategy.

This may be of particular significance in fashion, where the negative environmental impacts of fashion manufacturing are well noted (Nagurney & Yu, 2012). Kozlowski et al (2012) identify wastewater emissions, solid waste production and significant depletion of resources from consumption of water, minerals, fossil fuels and energy as significant areas of significance waste and pollution in fashion. The pollution prevention loop offers recapturing opportunities which minimise such wastes and pollutions. This may include sensor-controlled machinery to preserve energy, internal recapturing systems to prevent run-off and promote reuse, or precision manufacturing to prevent waste. Reinforcing the competitive NRBV underpinnings of this paper, Oh and Jeong (2014) suggest that such activities in fashion deliver economic benefits.

3.2 The Product Stewardship Closed Loop

Closed-loop supply chain management emerges with particular significance in product stewardship literature (Hart & Milstein, 1999; Vachon & Klassen, 2008; Ashby et al, 2012; Golicic & Smith, 2013; Matopoulos et al, 2014). Product stewardship's lifecycle approach and emphasis on recyclability (Hart, 1995) corresponds with closed-loop supply chain management's incorporation of both forward and reverse logistics and (Jensen, et al, 2013; Garg et al, 2015; Kazemi et al, 2018) and dynamic recovery (Govidan et al, 2015). More specifically, closed-loop supply chains permit by-products, unsold products and effluents to be reincorporated into the supply chain to be reused in a way which creates added-value (Ashby et al, 2012; Bell et al, 2012; Garg et al, 2015; Govidan et al, 2015), in line with the goals of product stewardship. This involves product acquisition, inspection and disposition, remanufacturing, refurbishment and repair and remarketing throughout the supply chain (Jensen et al, 2013). It is for such reasons that Jensen & Remmen (2017, p381) suggest that '*product stewardship is a concept that relates to the realm of the circular economy'*. This is enforced in Miemczyk et al's (2016) study which empirically verifies that closing the loop drives successful sustainable stewardship throughout the supply chain.

Expanding on this, this study proposes a product stewardship closed loop. This operates at supply chain level, reducing negative environmental impacts throughout the lifecycle and promoting conservation and end-of-life practices surrounding recyclability, reusability and biodegradability. In line with a NRBV underpinning (Hart, 1995; McDougall, 2018), this purposefully seeks competitive reward surrounding access to scarce resources, differentiation, costs and efficiency.

This product stewardship loop aligns with the growing need for the fashion industry to consider environmental impacts from a holistic (Nagurney & Yu, 2012) lifecycle perspective (Kozlowski et al

(2012). According to Oh & Jeong (2012) a closed-loop approach in the fashion supply chain supports recycling, remanufacturing and repair, and renders competitive benefits. This often involves the by-product of one supply chain partner being transferred for use by another partner. The environmental impacts of distribution and transportation should also be considered in fashion (Kozlowski et al, 2012; Nagurney & Yu, 2012), and as such fuel-efficient and green vehicles, load-optimization and shared logistics emerge with significance. Such initiatives in the fashion supply chain have been found to deliver cost and efficiency benefits (Kozlowski et al, 2012) in line with product stewardship. These benefits, along with maximised environmentalism, are embedded in the finished product, creating shared-value and rendering opportunities for differentiation.

Pertinently, an effective fashion closed-loop approach expands to post-purchase behaviour, calling for consumers to re-enter end-of-life clothing into the supply chain for recycling and reuse (Oh & Jeong, 2012). Given the fashion sector's *'consumption of the new and the discard of the old'* (Kozlowski et al, 2012, p18), this could dramatically reduce the amount of product ending up in landfill (Kazemi et al, 2018). Examples of this include in-store drop-off points and mail-return options, which are often incentivised. As well as opportunities for differentiation, this facilitates the development of an increasingly competitive recycled goods market (Oh & Jeong, 2012) in which product stewardship's access to scare resources (Hart, 1995) can be recognised.

3.3 The Clean Technologies Loop

As with pollution prevention, clean technologies has not been explicitly linked with closed-loop supply chain management in existing literature but parallels are notable. Pernick & Wilder (2007, p2) describe clean technologies as '*any product, service or process that delivers value using limited or zero non-renewable resources and/or creates significantly less waste than traditional offerings'*. Closed-loop supply chain management supports this, with its dynamic recovery (Govidan et al, 2015) facilitating the creation of renewable energies (Jensen et al, 2013) and environmental technologies (Bell et al, 2012). From this perspective, closed-loop supply chain management can be considered a powerful environmental innovation (Jensen et al, 2013; Szekely & Strebel, 2013) offering the divergence from traditional routines and processes (Hart & Milstein, 1999) and advanced development of new, lower impact processes (Hart, 1997) that clean technologies calls for.

Thus a clean technologies loop is proposed, which operates on a broader level than that of pollution prevention and product stewardship to support development of new technologies and systems that promote industry or society-wide environmentalism. More specifically, such technologies and systems seek environmental benefits beyond the needs of the firm towards positive environmental impacts on a global scale. This may involve collaboration from externalities such as government or NGO bodies, which Kazemi et al (2018) find is increasingly common in closed-loop supply chain management. In line with conceptualisation of clean technologies (Hart, 1997), the patenting or licensing of such technologies and systems or sale of their outputs may deliver commercialisation opportunities, whilst associated advancements in manufacturing and production may deliver cost and efficiency benefits.

According to Oh & Jeong (2014) closed-loop environmental technologies should be prioritised as a key focus in the modern fashion supply chain. Kozlowski et al (2012) place a particular emphasis on the need for advanced closed-loop manufacturing and production technologies surrounding new sustainable energies and materials. Examples of this include circular water systems which re-capture and process water used in fashion manufacturing or renewable technologies which support self-generating green energies. This allows the brand to become self-sufficient, thus delivering clean technologies' cost and efficiency benefits (Hart, 1997). However, going beyond pollution prevention and product stewardship, self-generated water and energies exceed the needs of the firm, allowing their external use in pursuit of positive impact operations at societal level. In markets at the base of the economic pyramid, re-filtered water may provide clean drinking water, whilst in developed markets it often facilitates the development of on-site wildlife conservation areas. Excess green energies are often sold on, reducing the reliance on the earth's depleting natural resources and generating additional income for the brand.

Table 1 Natural-Resource-Based Closed-Loops

	Operating Level	**Environmental Approach**	**Competitive Benefits**
Pollution Prevention Loop	Internal	Minimisation of waste and emissions in internal operations	Competitive cost cutting, maximised efficiency
Product Stewardship Loop	Supply Chain	Reducing negative environmental impacts and promotion of conservation throughout the lifecycle.	Access to scarce resources, differentiation, costs and efficiency benefits
Clean Technologies Loop	Industry/ Society	Development and promotion of new circular manufacturing technologies and processes in pursuit of positive impact operations.	Commercialisation opportunities; cost cutting

3.4 Interconnectivity

Seminal resource-based theory stresses the significance of combinative resource bundles (Teece et al, 1997), and drawing on this Hart (1995) proposes that NRBV resources are of greater value when implemented conjunctively. In a later paper, Hart (1997) suggests that the realisation of each resource can be advanced by its forerunner, placing clear dependencies between pollution prevention, product stewardship and clean technologies. Reinforcing this, Miemczyk et al’s (2016) paper suggests that a product stewardship approach to closed-loop supply chain management is reliant on internal pollution prevention capacities.

Thus, the interconnectivity of the three closed-loops warrants some consideration. Taking resource-based theory’s combinative resource bundles aside, interconnectivity assumes some logic. That is, the primary goal of each loop is to maximise environmental operations in pursuit of competitive gain. Thus, it is environmental capacities developed at each level may support realisation of advanced environmental operations at the next level. More specifically, the internal environmental operations undertaken in the pollution prevention loop may support uptake and promotion of external environmental operations throughout the supply chain as required in the product stewardship loop. Such environmental internal and external environmental operations may in turn render opportunities from which new closed-loop technologies and systems can be derived for the clean technologies loop.

Moreover, questions may also be raised to the progression of competitive environmental sustainability as the firm moves from one loop to the next. Seminal resource-based theory contends that resources should be valuable, rare, inimitable or non-substitutable to be competitive (Barney, 2001). As such, as the complexity of each loop intensifies, competitiveness may increase. That is, clean technologies in fashion is likely to be more rare and inimitable than pollution prevention. The possession of all three loops may advance this further. Thus, interconnectivity and the impact on competitive environmental sustainability between the three natural-resource-based closed loops emerges as an interesting topic for study.

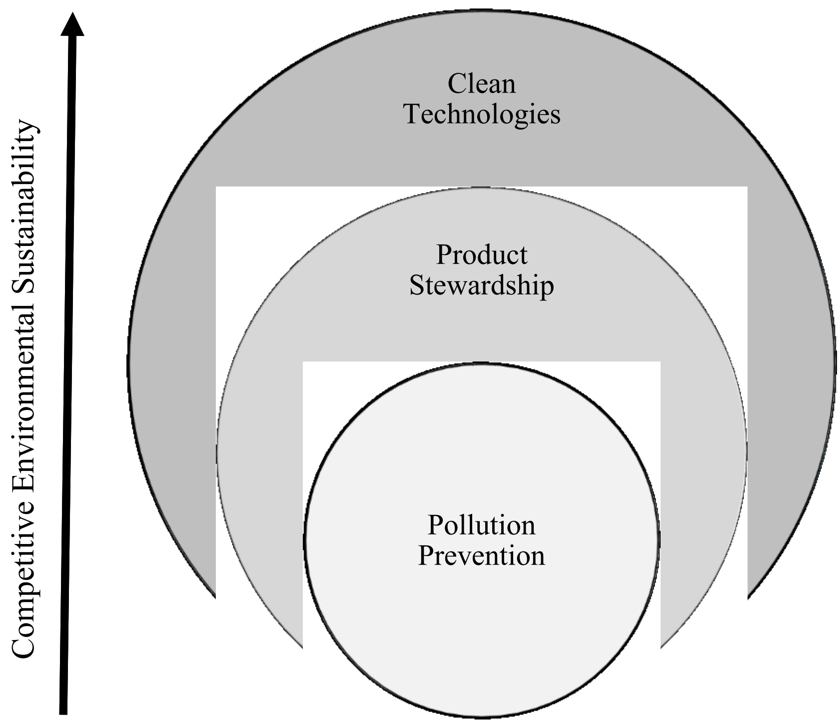

Figure 1 The three interconnected natural-resource-based loops

4. Conclusions

This paper conceptualises a natural-resource-based approach to closed-loop supply chain management, comprising a pollution prevention loop, a product stewardship loop and a clean technologies loop.

Contributions are three-fold: first, this study bridges the gap between competitiveness and sustainability in closed-loop fashion; second, it adds distinction and competitiveness to closed-loop supply chain management; and third it advocates the application of NRBV resources in sustainable supply chain management.

4.1 Future Research

Whilst the need for closed-loop supply chain management in fashion is well documented (Oh & Jeong, 2014), there remains a lack of empirical research surrounding its application (Kazemi et al, 2018). Thus, an empirical study testing the conceptual framework proposed in this study is called for. The principal aim of this empirical study is to explain the manifestation and competitive environmental impacts of the pollution prevention loop, product stewardship loop and clean technologies loop in fashion. Secondary research aims derive from exploration of the interconnectivity of the three loops.

Qualitative case studies emerge as an appropriate method for such empirical study. Each closed-loop should be considered its own entity, operating tacitly in existing fashion operations. From this perspective, the loops can be accessed by the researcher (Saunders et al, 2012), with observational and discursive data collected via participant observation and in-depth interviews from each stage and representing members *(table 2).* Analysis of this data, supported by inter-coder reliability assessments, will allow elucidation of the manifestation of the pollution prevention, product stewardship and clean technologies loops and assessment of their competitive environmental out-puts. A similar approach can be seen in Jensen et al's (2013) study of a closed-loop bakery chain.

UK fashion brands in the premium sector who demonstrate expertise in competitive environmental sustainability will be this study's sample. In order to explore interconnectivity, brands that implicate a closed-loop approach across all three levels (internal, supply chain, industry/society) are prioritised. According to Oh and Jeong (2014) the fashion closed-loop consists of raw material supplier, yarn manufacturer, fabric manufacturer, apparel manufacturer, customer and collectors (those involved in recovery). However, as this study seeks exploration of the three loops, closed-loop members at each operating level will differ, as defined in table 2 below.

Table 2 Natural-Resource-Based Closed-Loop Members

	Operating Level	Closed-Loop Members
Pollution Prevention Loop	Internal	Managers, employees
Product Stewardship Loop	Supply Chain	Raw material supplier, yarn manufacturer, fabric manufacturer, apparel manufacturer, customer, collectors, distributors
Clean Technologies Loop	Industry/ Society	Internal, supply chain, customers (commercial), government/NGO bodies

Anticipated findings will evidence the existence of the pollution prevention, product stewardship and clean technologies loop within the fashion sector, and support their exploitation for competitive environmental gain. This in turn may facilitate the development of a multi-level natural-resource-based closed-loop framework with which to guide managers towards a competitively maximised approach of environmental operations in the fashion sector.

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