

Dangling between sustainability and resilience supply chain practices: employing paradox theory to explore tensions

Luke Bellamy
Loughborough University

Alok Choudhary (a.choudhary@lboro.ac.uk)
Loughborough University

Grammatoula Papaioannou
Loughborough University

Araz Zirar
Loughborough University

Abstract

Drawing upon paradox theory, this paper conceptually proposes a dualism paradox framework for exploring the relationship between supply chain sustainability and resilience. Building basis from the literature which have collectively explored sustainability and resilience, we use and repurpose a dualism approach to paradox theory as a research lens for the SC context. We demonstrate the applicability of the framework to exploring the SC sustainability and resilience relationship. Our future research will test the proposed framework empirically.

Keywords: Sustainability, Resilience, Supply Chain

Introduction

Today's supply chains (SCs) are increasingly complex, dynamic and interdependent (Gunasekaran et al., 2014; Levalle & Nof, 2015). In this context, SCs must ensure that organisational effectiveness is improved (Gunasekaran et al., 2001) and function is maintained whilst also to meeting the needs of changing and ever-increasing market and stakeholders demand (Sheffi & Rice, 2005). Uncertainty and volatility increase as SCs are more dispersed geographically and diverse, covering a wide variety of products, services and communities (Xiao & Wang 2014). SC collapse has devastating impacts (Burnard et al. 2018), potentially costing lives (Tukamuhabwa et al., 2017).

SC resilience concerns the SC ability to effectively respond to, and recover from, a disruption, preferably to a better state than before (Tukamuhabwa et al., 2015). Unpredictable human and natural events, of any scale, can occur at any point and at any time, disrupting the SC (Zineb et al., 2017); causing problems for dependant business and

stakeholders. Therefore, it is ever more important that SCs develop capabilities to handle unknown threats and function in disruption scenarios. SC sustainability is central to tackling global issues such as climate change, pollution, resource consumption, and social justice, associated with production, consumption and trade. Today, stakeholders and firms concerned about environmental and social issues within the SC are driving action on SC sustainability (Mani et al., 2018). Economic sustainability, underpinning SCs actions, are increasingly dependent on social and environmental SC performance (Carter & Rogers, 2008; Ortiz-de-Mandojana et al., 2016; DesJardine et al., 2017), so sustainable SCs are now increasingly framed as an investment, rather than a business cost; important for competitive advantage, and their survival (Katiyar et al., 2018).

There are three ways of exploring sustainability and resilience as disciplines: resilience as a component of sustainability, sustainability as a component of resilience, or resilience and sustainability as separate objectives (Marchese et al. 2018). These three distinctions in the literature highlight the complexity of joining resilience and sustainability approaches. Joining has so far been unclear (Pizzol, 2015), and in the context of SCs, relatively unexplored (Fahimnia & Jabbarzadeh, 2016; Zahiri et al., 2017). Sustainability and resilience approaches are different: “sustainability prioritizes outcomes, and resilience prioritizes process” (Redman, 2014). Sustainability and resilience share complementary characteristics, however adoption can also lead to conflict, such as sustainability reducing protective redundancies for resource use efficiency gains (Levalle & Nof, 2015). Both sustainability and resilience are important for SC survival and growth, and as a result, neither approach can be ignored in favour of the other.

There is a lack of literature incorporating the relationship between SC sustainability and resilience, which highlights a significant knowledge gap in our understanding of these two issues when taken together. SC managers deal with both sustainability and resilience, and an informed understanding of how those decisions are made and what is the impact on SC performance measures are important for them to know, so that both can be effectively optimised for SC performance. However, prior to this, the relationship between sustainability and resilience requires contextualising in a means that can explore how the relationships can be described. For this purpose, paradox theory has been explored and used for its suitability for application in sustainability research, its novelty for exploring complex relationships and because it has been posited as useful in SC research (Xiao et al., 2019).

Literature Review

There are only a few research papers which have considered sustainable or environmentally sustainable (green) and resilient SC collectively, with a few others also exploring these in the context of agile and lean SC. This review will explore those highlighted connections between sustainability (including green focused) and resilience in context of SC, demonstrating the research gap.

Some of the papers exploring elements of sustainability and resilience, also explore lean and sometimes agile aspects of supply chain management, and their relationship, whilst for the sustainability component, the environmental aspect is the emphasis. Govindan et al. (2014) proposed a conceptual model for implementation of lean, green and resilient practices, in focal, upstream and downstream contexts. In looking at the relationship resilience practices had on SC sustainability, ‘flexible transportation’ and ‘flexible sourcing’ did not have a significant impact. Green practices ‘ISO 14001 certification’ or ‘reverse logistics’ also did not have a significant impact. However, resilience practices ‘SC risk management’, ‘waste elimination’ and ‘cleaner production’

did have a significant impact. This research considered only a small number of practices, and were categorised into upstream, focal and downstream components. This research, although recognising the existence of conflicting practices, did not consider them as part of the research. Govindan et al. (2015) explored the simultaneous implementation of lean, resilience and green paradigms for SC competitiveness, however, integration of these techniques and identifying issues related to these techniques remains problematic. When measuring for customer satisfaction, the practices deployed for improving performance do not interfere for this performance measure. Using this approach, it was possible to validate the practices which contribute most to competitive advantage. These are just-in-time (lean), flexible transportation (resilient) and environmentally friendly packaging (green). Azevedo et al. (2013) explored how green and resilience in combination can form an “eco-silience” measure for SC. Upstream green and resilience were united, with validity confirmed through a case study, however, this index weighs the two approaches without considering implications for their trade-offs, with no deductions for conflicting practices.

Carvalho et al. (2011) explored synergies and divergences between lean, agile, resilient and green paradigms and the effect of those paradigm practices on SC attributes. Between green and resilience aspects, there were divergences in context of capacity surplus, inventory level and replenishment frequency, but synergies in the level of integration and lead time. Cabral et al., (2012) builds on this work by developing an integrated analytical process to support decision making when making appropriate lean, agile, resilient and green practices, and KPIs to be implemented in a SC with a focus on SC competitiveness. The importance of the paradigms for their impact on SC competitiveness were ranked, with the most appropriate agile, followed by lean and resilient equally, and finally green. Green is the least important, as it is seen as an inconvenience by SC decision makers, and efforts usually go to minimum necessary requirements, however, many green initiatives are done so with the intention of reducing costs. The relationship between these different approaches were otherwise not discussed, with no conclusions drawn concerning green and resilience practices.

Ruiz-Benítez et al. (2017) explores the relationship between resilience, lean and green practices, in an aerospace context for SC environmental performance, concluding that lean practices are drivers of green and resilient SC practices. Whilst Ruiz- Benítez et al., (2018) explores resilience and lean practice implication on SC sustainability performance, concluding that lean practice drive resilience practices, which overall drive sustainability performance. Most papers look at a one-dimensional view of practice to performance with sustainability and resilience, whereas exploring their practice and performance relationship collectively could provide new insight.

In recognising that research in SC sustainability and resilience is limited, Fahimnia & Jabbarzadeh (2016) conducted a trade-off analysis on how sustainability practices impacted the capacity for SCs to tolerate uncertain disruptions. With a multi-objective optimisation model, sustainability performance was assessed, and the model tested in a case study. The case study demonstrated that a SC designed to a business-as-usual sustainability scenario was unable to cope with disruptions and satisfy demand, whereas a resiliently-sustainable SC designed for disruption and business-as-usual scenario was able to meet demand at a slight increase in SC cost (Fahimnia & Jabbarzadeh, 2016). Whilst this paper explores the relationship between sustainability practice, as defined by the type of SC design adopted, and resilience performance, the findings cannot be generalised as their model needs further validation, further the model does not consider resilience practice.

Ivanov, (2017) through a simulation study, explored the interconnections between sustainability and resilience in SC. Disruption propagation and sustainability factors were analysed for creating a resilient SC which mitigated ripple effect and improved sustainability. If a disruption cannot be localised, a ripple effect occurs impacting SC performance. Sustainability factors such as sustainable sourcing enhances the ripple effect, whereas facility fortification mitigates it and improves sustainability. Storage facility reduction in downstream SC also improves sustainability but can cause the ripple effect. This paper highlights the relationship between event and outcome for both a measure of resilience and sustainability. However, this is just limited to three practices, and further practices need to be explored for broader managerial insight, particularly with resilience practices on sustainability.

Eltantawy (2016) argues that in supply management, for sustainability to be achieved, trade-offs between economic, environmental and social outcomes must be effective and ensure longevity for the firm. However, trade-offs are challenging because of tensions between divergent demands. In approaching resilience as a core component of sustainability, supply management ambidexterity, pursued through a paradox lens, is considered to describe two approaches for resilience, resisting damage from an event (exploitation) and quick recovery from that event (exploration). As the author considered resilience as a nested attribute of sustainability, the philosophical approach excludes considerations between sustainability and resilience. Supply management resilience framework for sustainable performance incorporates engineering resilience (through cultural and operational competency) and ecological resilience (through situational awareness, and access to keystone vulnerabilities). Popadopoulos et al. (2017) also considers resilience as a component of sustainability in exploring a framework which considers SC and infrastructure resilience as an important component of community and resource resilience. Using big data, it is argued that swift trust, public private partnership, and quality information sharing enable shaping SC resilience and critical infrastructure resilience.

A multi-objective decision-making model for designing a pharmaceutical SC was tested in a case study. The pharmaceutical industry is vulnerable to both internal and external disasters, and with stakeholder interest in environmental and social issues, objectives of minimising harm of disruption and to the society and environment were sought. The paper provides a series of optimisation and SC design recommendations (Zahiri et al. 2017). The approach to sustainability and resilience in SC for this paper focuses specifically on the characteristics of the SC design and the decision-making process in how to make optimisations and does not contribute in terms of practice or relationship to the research approach set out in this report, however the performance measures could be utilised.

Karutz et al. (2018), attempts to conceptually connect SSCM and RSCM through case study research in automotive SC. SSCM is prioritised over RSCM by SC managers. In their framework, connections are highlighted between SSCM and RSCM, with diversity and transparency enabling strategies of both approaches. This paper made some initial steps toward connecting SSCM and RSCM, proposing possible interconnections between objectives. However, the role of practices or strategies to performance is not yet considered and this paper requires expansion and further empirical analysis to validate and build upon their initial findings.

As highlighted in the literature review, there are several previous studies exploring interconnection between aspects of sustainability (or environmental sustainability) and resilience in SC context, but this research area is underdeveloped and the relationships

unexplored in context of how sustainability and resilience relate considering tensions and trade-offs among practices and particularly their collective impact on SC performance. Building upon the literature and to address this research gap, a framework for a sustainable-resilient SC is required.

Theory and framework development

In developing a sustainability and resilience relationship framework for SC context, their relationship was initially explored. Other literature has explored the relationship outside of SC context as a form of tension (Redman, 2014; Lizarralde et al., 2015). Conflicting interests generate tensions, and as the different goals of sustainability (outcome-oriented) and resilience (process-oriented) have conflicting interests, the tension literature is a suitable means for exploring this relationship. Lizarralde et al. (2015) highlights the nature of the tensions between sustainability and resilience (Table 1), informed from an urbanism perspective.

Table 1. Tension between sustainability and resilience (adapted from Lizarralde et al. (2015)).

Area of tension	Sustainability	Resilience
Goal	Transition	Adaptation
Process	Incremental changes	Capabilities developed from learning mistakes and past events
Performance outcome	Efficiency	Redundancy
Threat rate of change	Constant degradation (environmental/social/economic)	Shock change, unknown extent and time
Agenda	Achievement	Capacity

Tensions are described as conflicts between two factors and often explored in sustainability challenges. There are four approaches to sustainability tensions, these are: win-win, trade-off, integrative and paradox (Van der Byl & Slawinski, 2015; Brix-Asala et al., 2018). The win-win approach attempts to reconcile either the social and/or environmental performance with economic performance; trade-off accepts the goals as being in conflict, requiring that a choice is made; integrative approach attempts to ensure that all three approaches to sustainability are equally balanced; whilst paradox seeks to understand the nature of tensions along with how actors work with them, enabling the ability to view and evaluate complex sustainability issues and embrace them (Van der Byl & Slawinski, 2015; Brix-Asala et al., 2018). A paradox tension can be derived as having three main core components (Brix-Asala et al., 2018: 426):

1. Actors embrace the tensions between goals rather than resisting or avoiding tensions;
2. Actors attend to competing and interrelated demands simultaneously;
3. Paradoxes are dynamic demands which can be managed only by continuous cyclical responses in the form of practices.

Currently, research utilising paradox has been rarely applied in SSCM, despite its relevance (Matthews et al., 2016). Whilst most researchers utilise an instrumental perspective to explore conflict, Xiao et al. (2019) utilises a paradox perspective. Due to both complementing and contradicting components of the sustainability and resilience relationship, paradox theory is appropriate. A tension can be viewed in multiple ways, however, seeking to treat the issue as a paradox will enable solutions to these tensions beyond instrumental confines (Xiao et al., 2019). There are three kinds of paradox which

are highlighted in the literature, these are paradox (including duality), dilemma and dialectic (Smith & Lewis, 2011):

- Paradox consists of “contradictory yet interrelated elements that exist simultaneously and persist over time; such elements seem logical when considered in isolation, but irrational, inconsistent and absurd when juxtaposed”.
 - Dualities, two opposites which exist within a unified whole, have an internal boundary which highlights opposing elements, the external boundary demonstrates a synergy between them.
- Dilemmas are competing choices with advantages and disadvantages. This can become paradoxical when those choices contradict and interrelate in a way that choices between them are short lived and their tension resultantly resurfaces.
- Dialectic contradictions (of two propositions) are resolved through integration, which overtime will gain new opposition. This can become a paradox when elements are contradictory and interrelated. Combining elements promotes similarities, neglecting differences, resulting in temporary integration. The new formulation and opposition therefore maintain the core characteristics of the original contradictory elements.

The dilemma and dualism approaches to paradox are potentially particularly appropriate means of viewing the issues, with literature sought to explore those types of paradoxical relationships. Papers discussing practice-performance relationships in paradox context were explored. A paper exploring dualistic paradox in management science (Fajoun, 2010) offered a relevant framework in which sustainable and resilience SC management relationship with performance can be applied.

Farjoun (2010) explored stability and change as a duality paradox. Stability and change are interrelated, complementary practice and performance process and outcomes, whilst simultaneously capable of practice-performance contradictions. This relationship is highlighted in their duality framework which classifies stability and change relationships. This relationship highlights that stability, existing in opposition with change, matches the organisational paradox of exploitation vs. exploration, whereby firms utilise both to enable success, despite strategies also existing in tension (Andriopoulos & Lewis, 2009). Stability and change in these circumstances of exploitation/exploration exhibit different practices and outcomes, which do not complement. However, there are circumstances when stability and change are dependent on each other. Change can enable stability through managing variables which ensure that the performance goal is static around changing circumstances, whilst stability can enable change through provision of systems that are designed to manage elements of unpredictability or to encourage innovation (Farjoun, 2010).

Through the exploration of existing application of paradox theory on practice and performance relationships, a framework has been borrowed and applied to SC management in the context of sustainability and resilience approaches and their relationship to SC performance. As highlighted in other research exploring sustainability and resilience (Redman, 2014; Lizarralde et al., 2015; Wilson, 2018), the relationship between sustainability and resilience exhibits synergistic and conflicting components, demonstrating tension across disciplines. Previous research utilises an instrumental perspective to explore tensions (Xiao et al., 2019), however, paradox is increasingly seen as a means, suitable to sustainability related issues, which can be used to manage tensions. Existing literature has informed how to frame the paradox relationship between sustainability and resilience. Smith & Lewis (2011) identified three kinds of paradox in their literature: dualism, dilemma and dialectic. A dualism framework from operations

management was located (Farjoun, 2010) and borrowed for SC context, replacing stability and change dualism with sustainability and resilience. Stability and change organisational practices are a dualistic paradox (Farjoun, 2010). Dualism explains a paradox as two components, which separately are conflicting, yet must exist together as they are co-dependent (Smith & Lewis, 2011). Sustainability and resilience align with the dualism of stability and change as sustainability and resilience share similar complementing and conflicting components. Whilst Farjoun (2010) explores stability and change as practices of exploitation (stability enabling stability) and exploration (change enabling change) respectively, and exploitation and exploration approaches can be applied to resilience through resistance (exploitation) or adaptation (exploration) (Eltantawy, 2016), this approach does not accurately describe the relationship between sustainability and resilience. Sustainability and resilience are best categorised in terms of success requirements: sustainability as structured (standards, quotas, KPIs) and resilience as adaptive (redundancy, flexibility, agility) (Redman, 2014; Lizarralde et al., 2015). Like exploitation and exploration, structured improvement and adaptive improvement reflect working with known (exploitation, structured improvement) and unknown (exploration, adaptive improvement) outcomes.

Whilst structured and adaptive processes are placed in opposition, the dualism aspect of this paradox emerges when considering how complementing approaches also apply. Resilience practices can enable sustainability (integration, communication), and sustainability practices can enable resilience (improving reputation, sustainability risk assessment). Using Farjoun's (2010) framework as a template, these relationships are structured into four quadrants (Figure 1), which show oppositional elements (Q1 and Q4) and complementary elements (Q2 and Q3). Quadrants are summarised below.

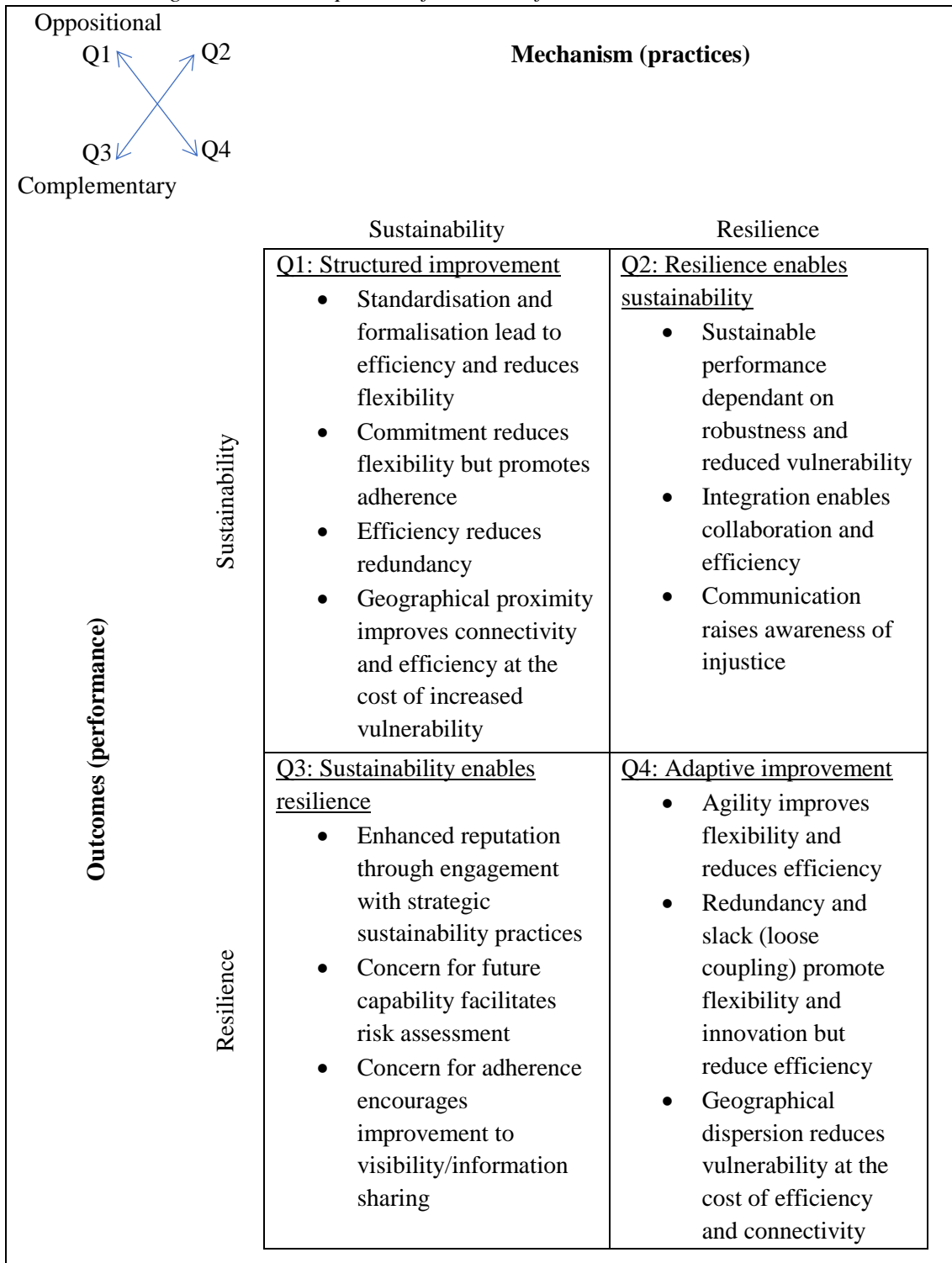
Quadrant one, structured improvement: This focuses on how sustainability approaches can lead to sustainability outcomes, with attention focused around efficiency measures, commitment and maintaining standards.

Quadrant two, resilience enables sustainability: This quadrant focuses on how resilience approaches contributes to sustainability outcomes in process-oriented considerations, with the role of longevity in sustainability, integrating systems and communication highlights a core component of this section.

Quadrant three, sustainability enables resilience: This quadrant focuses on how sustainability approaches contributes to resilience outcomes in outcome-oriented considerations that have consequences for reputation, risk assessment and visibility.

Quadrant four, adaptive improvement: This focuses on how resilience approaches lead to resilience outcomes, with attention on agility, flexibility and redundancy.

Figure 1. Dualism paradox framework for sustainable-resilient SC.



Next steps

To develop this framework further and explore its potential contribution empirically SC managers will be interviewed to thematically understanding their experiences and knowledge with regards to SC sustainability and resilience practice implementation. This will be followed by quantitative analysis exploring practice implementation consequences.

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