

# **Beyond a Journey: A Theory of the Supply Chain Sustainability and Circularity Odyssey**

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## **ABSTRACT**

In response to the increasingly complex challenges posed by technology, public expectations, social and environmental issues, organizational stakeholders seek a comprehensive understanding of managerial responsibilities. It is hoped that businesses can serve both economic and societal purposes by proactively engaging in industry-wide solutions and multi-stakeholder initiatives. Such initiatives often take the form of sustainable supply chains and material circularity efforts. This paper presents theory development which integrates key concepts from the vast literature on this topic while using an empirical case study of a UK-based initiative and simulation to precisely specify concepts, test assumptions, and analyze long-term implications. Policy analysis using the ODYSSEUS model (The **L**ong-Term **D**ynamics of Collective Responsibility of Busine**SS** and Soci**E**ty in **S**ustainability) echoes previous calls for collective learning, while also recommending greater attention to the importance of rigorous strategy design and stakeholder aspects of managerial responsibility, specifically discerning two distinct types of stakeholder policy. Using simulation to synthesize concepts from previous research raises numerous intriguing research questions for future study.

Keywords:

Green operations and supply chain management; sustainable impact & innovation; Stakeholder Theory; Innovation; Sustainable Supply Chain Management; Circular Economy; Theory Development; Sustainability; Process Theory; Simulation

# 1 INTRODUCTION

This article addresses the growing complexity of managerial responsibilities in organizations, driven by technological, social, and environmental challenges. It focuses on the sustainable supply chain and circular economy nexus (SSCM-CE), which has become central to multi-stakeholder initiatives in various industries. While there is considerable research on strategies used by companies in such initiatives, the long-term behavior and underlying causal structures remain underexplored.

The paper seeks to fill this gap by developing a simulation model, ODYSSEUS, that integrates insights from empirical case studies and existing literature. It emphasizes the importance of understanding SSCM-CE as a turbulent, long-term process, likened to an odyssey, where success depends on more than the journey prescribed in the literature: a proactive strategy. Instead, forces outside business have the potential to derail the traveler, and thus understanding SSCM-CE's long term dynamics requires going beyond a journey. The model also highlights the need for collective learning, rigorous strategy design, and improving stakeholder policies to address the complexities of SSCM-CE initiatives. Through simulation, the paper raises new research questions for future study on long-term dynamics and managerial responsibility.

# 2 METHODS

System dynamics modeling (SDM) is used. This method blends qualitative and quantitative elements of research (Sterman, 2018; Yearworth & White, 2013) in an iterative approach (Randers, 1973) where modelers cycle many times through study phases: from beginning to end and back to the beginning again. Model evaluation is a cornerstone of the method (Senge & Forrester, 1980; Sterman, 2000),

Literature and empirical evidence that provide information about model structure or behavior were collected. Empirical information from a case study were also utilized to develop and evaluate the model. Literature describing long term dynamics and structure was useful.

SDM was used for theory development, as in numerous other studies(de Gooyert, 2018),

## **2.1 Case study background**

This case study examines a partnership between a UK grocery retailer, a waste reduction organization, and two universities (one in the UK and one in the US). UK retailers face environmental scrutiny from both government and consumers, pushing them to address social and environmental priorities alongside economic imperatives. The Courtauld Commitment, coordinated by WRAP UK, is a voluntary agreement to reduce food waste, with retailers encouraged to reduce waste in their operations, partner with suppliers, and address household waste. The central client in the study is the case study retailer, a company with a decade of experience in Courtauld, thus in a practical application of many SSCM-CE principles including targeting, measuring and acting to reduce food waste across their supply chain.

## **2.2 Model and scenarios overview**

The ODYSSEUS (LONg-Term DYnamicS of Collective Responsibility of Business and SociEty in SUSTainability) model explores the long-term dynamics of sustainable supply chains and circular economy (SSCM-CE) development. Named after Odysseus, the model reflects themes of leadership, intellectuality, and ethical curiosity, aiming to represent some of the key insights gained through simulation.

ODYSSEUS is designed as a generic simulation tool to examine how interactions between stakeholders, harm perception, company pressures and company/supply chain action evolve over time. The model considers various factors, such as harms along the product life cycle, stakeholder expectations, and supply chain sustainability at an aggregate level while excluding

business systems like inventory management and marketing. The model uses scenarios to generate insights for SSCM-CE theory and practice. In six baseline scenarios, the model serves as a tool for understanding long-term sustainability capabilities and testing the internal coherence and long-term performance of business response strategies described in the literature. After noting the resulting familiar insights, the scenarios are then re-tested in a sensitivity analysis to see how well each strategy performs when policies are better or worse than in the baseline for stakeholder issues, namely stakeholder integration and stakeholder integrity.

### 3 RESULTS

In order to build understanding of the structure of SSCM-CE and how company strategies shape long-term sustainability outcomes, model analysis with ODYSSEUS examines how strategic responses to a triggering event—a sudden increase in perceived harms at 10 months—can shift a system from an undesirable equilibrium toward a more socially desirable one.

Three scenarios are analyzed: Business-as-usual (BAU), which involves a company focused on sustainability under pressure but without circularity or innovation; Case Study (Case), where the company has strong circularity capabilities; and Best Case Scenario (BCS), which adds a commitment to radical change through innovation and double-loop learning. Each scenario is tested with and without supply chain collaboration.

The analysis focuses on four phases from SSCM-CE literature, assessing the effects of business and stakeholder policies on reducing actual harms. Additional scenarios explore the impact of varying levels of stakeholder integration, showing how disruptions in stakeholder awareness influence key variables in the model..

### 3.1 Baseline Scenarios and Phases

The scenario results are described in four phases, adapted from the ODYSSEUS model and Sethi's (1979) framework:

1. **Phase 1 - Pre-Problem (months 1-10):** A period of calm before increasing stakeholder pressure, representing the unsustainable old normal.
2. **Phase 2 - Identification (months 10-30):** A wave of rising stakeholder pressure disrupts the status quo, driving systemic changes.
3. **Phase 3 - Remedy & Relief (months 30-100):** Strategic capabilities help businesses leverage pressure to make qualitative changes in mental and business models.
4. **Phase 4 - Prevention (months 100-240):** After pressure subsides, businesses work through systemic delays to establish a more sustainable equilibrium, gradually reducing harms.

These phases illustrate how businesses respond to waves of stakeholder pressure, with the best case scenario leading to the most effective long-term harm reduction. Sensitivity runs then show how the long-term equilibrium reached by even the most effective strategies could be unsustainable if stakeholder policies are less than ideal.

### 3.2 Propositions

In the past centuries, business has been described in general terms as materials, practices, and products (MPPs). Since the early 1970s, studies highlight differences in strategy across companies, typically explained through the various policies that make up these strategies. In the same way, the policies in ODYSSEUS are conceptualized as levers within stock-flow and causal loop structures, defined in measurable terms, and grouped into strategies representing different levels of proactivity, as in the literature: from less proactive (business-as-usual) to more proactive (case study and best-case scenarios).

Five key policies are identified in ODYSSEUS for driving sustainable changes:

1. **Adoption** (setting a goal to adopt reduce harm by adapting MPPs),
2. **Innovation** (reconsideration of old MPPs),
3. **Implementation** (implementation of harm-reducing MPPs),
4. **Circularity** (time to reduce cumulative harm), and
5. **Supply Chain Collaboration** (direct pressure on supply chain companies).

Two additional policies relate to stakeholder issues:

6. **Stakeholder Integration** (company capability for stakeholder response), and
7. **Stakeholder Integrity** (stakeholders' current commitment to their expectations).

These policies align with the literature on proactive and reactive strategies for SSCM-CE, which has been widely described but often lacks explicit details and rarely builds on prior work. The ODYSSEUS model's ability to represent these policies dynamically confirms its useful conceptual structure. The model highlights the importance of a proactive strategy for long-term sustainable change, which requires evolving mental, business, and institutional models.

Proactive strategies involve intentional decisions to foster both formal self-regulation and informal responsibility, alongside collaboration across organizations and sectors. The model suggests that a new managerial identity, rooted in systems thinking, is essential for organizations pursuing proactive SSCM-CE strategies. This approach minimizes the gap between decision-making and its harmful outcomes, a concept implied in SSCM-CE literature but explicitly discussed in foundational research.

In summary, ODYSSEUS offers a structured way to understand and simulate the policies that shape proactive and reactive strategies in SSCM-CE, contributing to a deeper understanding of

how sustainable business strategies evolve over time. These insights are documented as theoretical propositions (see Proposition 1 in (Allen, 2023)).

In the sustainability in business research, stakeholders exert pressure on companies. These descriptions may note how this pressure comes from perceptions and evolving goals. ODYSSEUS includes structure for this dynamic, based in path dependence theory and the concept of "Floating Goals," originally introduced by Forrester (1968)(Forrester, 1968). Floating Goals occur when goals are set relative to past performance, leading to a feedback loop where both goals and system states adjust to each other over time. This feedback can create either a virtuous cycle of long-term harm prevention or a vicious cycle of stagnation and harm preservation, and the difference depends more on stakeholder policies than business strategy.

The length of time it takes to adjust goals, termed Goal Adjustment Time (GAT), is a critical factor in stakeholder integrity. Companies with high stakeholder integrity proactively set and act on sustainability goals, recognizing the harm as part of business operations and working with stakeholders in a life-cycle analysis so they know the current harms and set their own goals independently and based on the best available information, and act in an accurate understanding of the best long-term interests of nature and society and of business' capabilities. In contrast, low stakeholder integrity is characterized by the status quo, where companies withhold important information from stakeholders, act on limited information about companies, assess companies as lacking commitment to society and nature and capabilities to reduce harm, and then act based on their private interest and a limited understanding. Low integrity causes inertia, where companies fail to address sustainability challenges effectively, dragging the system toward unsustainability.

The case study retailer exemplifies moderate stakeholder integrity, where waste reduction goals are set, measured, and acted upon in collaboration with nonprofit issue advocacy

stakeholders. High stakeholder integrity involves a more integrated approach, with timely action and multi-stakeholder collaboration. The idea of path dependence in SSCM-CE challenges the traditional linear view of stakeholder pressure and shifts the focus to learning and adaptability, offering a more measurable and modifiable framework for research and policy than prior work.

### **3.3 Managerial implications**

To use a model like ODYSSEUS, a team would collect information using more detailed analysis. This should probably start with a short-term model. For example, to evaluate the harm of traditional and potential more sustainable MPPs (i.e., for ODYSSEUS), a policy analysis team can cycle between short- and long-term models. In short-term learning cycles, models like PHILOETIUS can improve understanding of MPPs and harms. If teams test policies by leaving time for the delays in the model to play out in real time (i.e., for PHILOETIUS, 100 days) before updating, there will be significant chances for learning about the model's assumptions as well as about MPPs. Over time, they would gain confidence about key information needed in long-term learning cycles. This approach suggests alternating between learning in short and long term, operations and strategy.

## **4 CONCLUSION**

The ODYSSEUS model explores how supply chains evolve their SSCM-CE strategy in response to stakeholder pressure to reduce harms, and how stakeholders evolve their pressure in response to their perception of SSCM-CE strategy's harm reduction effectiveness. It highlights the complex dynamics of stakeholder pressure, supply chain collaboration, and harm reduction, represented by patterns like S-shaped performance curves, inverse S-shaped harm reduction, and waves of stakeholder pressure. The policies are adopted as managers' mental models expand to include the feedback loops which could cause these harm reduction patterns.

SSCM-CE is in the literature described as a long-term journey requiring adaptation and learning, with companies, supply chain partners, and stakeholders interacting continuously. This description is synthesized and reiterated. It is also improved: ODYSSEUS simulation results indicate the importance of understanding that harm is cumulative, caused by from both current and past material production processes (MPPs), and reducing harm requires proactive business strategies to adopt sustainable alternatives to traditional MPPs, as well as a proactive approach to stakeholder integration and multi-stakeholder initiatives in which company behavior enhances the initiative's integrity. However, nonlinear relationships between effort and harm reduction often limit the effectiveness of these strategies, since these are difficult to predict accurately.

Stakeholders adapt their perceptions and expectations over time, influencing the pressure they exert. A holistic understanding of stakeholders is critical for avoiding unsustainable outcomes. ODYSSEUS introduces a strong process perspective, emphasizing the long-term phases of SSCM-CE and how proactive strategies can lead to structural changes and a new equilibrium of sustainability, a strong sustainability view.

The model critiques the assumption that self-regulation alone can reduce harm, highlighting the importance of understanding feedback loops and accumulation dynamics. It presents four key feedback loop processes and evaluates different strategies—BAU (reactive), Case (values-driven), and BCS (purpose-driven)—for their impact on harm reduction. Stakeholders are shown to be essential drivers of sustainability outcomes, influencing how businesses adapt and reduce harm. The model points out that stakeholder pressure is often underappreciated, particularly in the feedback loops between business, nature, and society.

Ultimately, ODYSSEUS argues for a deeper recognition of stakeholder roles in closing key feedback loops and driving sustainable transformations in supply chains. Managers coming to this recognition and acting accordingly involves developing a new managerial identity.

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