Enabling Carbon-Neutral Business

The Role of Generative AI, Service Orientation, and Strategic Market Approaches

Kolagar, M.; Scholten, V.E.

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Enabling Carbon-Neutral Business: The Role of Generative AI, Service Orientation, and Strategic Market Approaches

Milad Kolagar

Delft Centre for Entrepreneurship, Faculty of Technology, Policy and Management, TU Delft, Netherlands

Victor Scholten

Delft Centre for Entrepreneurship, Faculty of Technology, Policy and Management, TU Delft, Netherlands

Abstract

The push towards carbon-neutral business models has gained significant traction in response to growing environmental concerns, regulatory pressures, and market demands for sustainability. As businesses explore pathways to achieve carbon neutrality, a multitude of emerging technologies and strategies play crucial roles in this transformation. In particular, the adoption of generative AI, service-oriented business structures, and strategic market activities such as market exploration and exploitation are increasingly being recognized as critical enablers. However, the interactions between these factors remain underexplored, with limited understanding of how they synergize to support the transition to carbon-neutral operations. This study employs a fuzzy set qualitative comparative analysis (fsQCA) to examine how different configurations of generative AI adoption, service orientation, inter-organizational cooperation, market exploration, and market exploitation contribute to achieving carbon-neutral business outcomes. Drawing on survey data from young startup managers and entrepreneurs, our findings reveal multiple pathways to carbon neutrality, highlighting the complexity of the transition process. The study emphasizes that no single factor is sufficient on its own; instead, a holistic combination

of technological, structural, and market-based strategies is required. By providing these insights, this research contributes to the academic discourse on sustainability and digital innovation, offering actionable guidance to practitioners and policymakers seeking to facilitate carbon-neutral transformations in business operations.

Keywords: Carbon neutrality, generative AI, service-oriented structure, market strategies, startup entrepreneurs.

Introduction

The transition to carbon-neutral business practices is one of the most pressing challenges of the 21st century, driven by increasing environmental concerns, regulatory pressures, and a growing demand for sustainable products and services. As industries face significant disruption due to climate change and resource scarcity, the adoption of innovative technologies and sustainable business models has become essential for long-term success. Carbon neutrality, in particular, has emerged as a key goal for businesses across various sectors, with the objective of reducing greenhouse gas emissions to net-zero levels through a range of strategies, including energy efficiency, renewable energy, and sustainable resource management (Parida, Sjödin & Reim, 2019; Pizzichini, Sabatini, Gregori, Cillo & Sasso, 2025). In parallel with the push for sustainability, businesses are increasingly adopting digital technologies such as artificial intelligence (AI), machine learning, and automation to optimize their operations and reduce their environmental footprint. Among these, generative AI stands out due to its ability to create new solutions, optimize processes, and enhance decision-making capabilities (Sjödin, Parida & Kohtamäki, 2023). Generative AI can support sustainability by improving resource allocation, minimizing waste, and providing actionable insights that enable businesses to make data-driven decisions aligned with their carbon-neutral objectives. By integrating generative AI into their operations, businesses can not only enhance operational

efficiency but also develop innovative business models that align with circular economy principles, such as reducing, reusing, and recycling materials (Kirchherr, Yang, Schulze-Spüntrup, Heerink & Hartley, 2023).

Another critical element in transitioning to a carbon-neutral business is the adoption of service-oriented structures, which focus on delivering services rather than products. This shift is essential for achieving sustainability, as service-oriented models prioritize long-term use and resource efficiency over short-term consumption and waste. The rise of servitization, which involves transitioning from product-oriented business models into service and solution-oriented ones, plays a crucial role in enhancing business sustainability. It fosters customer engagement through continuous service offerings, such as maintenance and optimization, which help extend the product lifecycle and reduce environmental impacts (Sjödin, Parida, Kohtamäki & Wincent, 2020). In addition to these technological and structural shifts, market strategies such as market exploration and market exploitation are essential to ensuring the scalability and adaptability of carbon-neutral strategies. Market exploration involves seeking new opportunities, innovations, and market segments, while market exploitation focuses on maximizing value from existing capabilities and offerings. These strategies help businesses navigate the complex landscape of sustainability, ensuring that they can innovate while maintaining a competitive edge (Inoue, 2021; Kolagar, 2024). Together, these strategies create a robust framework for achieving carbon neutrality, enabling businesses to not only reduce their environmental footprint but also capitalize on emerging market opportunities.

Despite the growing recognition of these factors, there is a limited understanding of how they interact and contribute to achieving carbon-neutral outcomes. Most studies focus on isolated elements of this transformation, such as digitalization or market strategies,

without examining how these factors interact to support sustainability goals. This research aims to fill this gap by exploring the configurations of enabling conditions that lead to successful carbon-neutral business outcomes. Specifically, we investigate the interplay between generative AI adoption, service-oriented structures, inter-organizational cooperation, market exploration, and market exploitation. By analyzing survey data collected from young startup managers and entrepreneurs, this study aims to investigate how these factors interact in various ways to support the transition to carbon-neutral businesses. The findings of this research will not only advance academic understanding of the drivers of carbon neutrality but also provide valuable insights for entrepreneurs, practitioners, and policymakers seeking to facilitate the adoption of sustainable business practices.

Methodology

To identify configurations leading to carbon-neutral business outcomes, we employed fuzzy set qualitative comparative analysis (fsQCA) (Kolagar, Parida & Sjödin, 2024; Ragin, 2009). Data were collected from young startup managers and entrepreneurs, focusing on the adoption of generative AI, service-oriented structures, inter-organizational cooperation, market exploration, and market exploitation. fsQCA enabled us to examine the intricate relationships between these factors and their influence on carbon-neutral outcomes.

Preliminary Findings

Preliminary analysis reveals several distinct configurations that lead to successful carbon-neutral business outcomes. Key findings suggest that the adoption of generative AI, when combined with a service-oriented structure, can significantly contribute to achieving

carbon neutrality. Additionally, strong inter-organizational cooperation and active participation in both market exploration and exploitation are critical complementary factors. Specifically, businesses that leverage AI to optimize resource efficiency, while exploring new sustainable market opportunities, are more likely to achieve carbon-neutral outcomes. These findings underscore the need for a comprehensive approach that integrates technological innovation, organizational structure, and market strategies to foster sustainability.

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