Research Article

Enhancing Environmental Performance through Lean Practices: The Mediating Role of Circular Economy

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Abstract: This paper explores how the combination of Lean Practices (LP) with Circular Economy (CE) principles can improve Environmental Performance (EP), focusing on CE as a mediator. This study is to establish the relationship between Lean Practices and Environmental Performance with specific reference to CE. This conceptual paper elucidates that CE can improve Lean's efficiency to attain improved environmental results. It is also proposed that CE can have a crucial role in the relationship between Lean Practice and environmental performance. This paper advances the literature by offering a novel integration model for LP and CE toward creating sustainability. It presents some tangible suggestions for managers and policymakers with a focus on coordination for a long time in environmental conservation. The study offers suggestions to testing this framework on other types of industries to provide fruitful insight how the use of technologies can impact ecological performance.

Keywords: Total quality management practices, organizational innovation, organizational performance

1. Introduction

CE has developed as an innovative framework of reaction to environmental pressures and in the last decades there has been more attention to utilizing the strategy to minimize undesirable effects of production. CE is a notion formed out of two principles of industrial ecology developed based on the principles of minimum resource extraction and waste production [1].Therefore, its implementation on policies, and especially in the European and Chinese frameworks, illustrates that it is possible to integrate economic objectives with environmental ones. Although the meaning of CE is clear, scholars argue about the deeper meaning of CE's environmental impact and its connection to other management frameworks more broadly [2] [3]. While, Lean practices is focused on waste reduction, operational efficiency, and responsiveness to customer's needs [4]. Lean methods leverage technical practices such as process standardization and social practices, continuous improvement and workforce engagement to drive organizational excellence [5]. Yet, as industries face increasing environmental obligations, attention is being paid towards integrating Lean with more sustainable framework-oriented approaches like CE [6].

Lean Practices and CE Interaction is a promising route for environmental performance improvement. While Lean's structured approach may support the adoption of CE principles, the mediating role of CE in translating Lean strategies into tangible environmental outcomes has been underexplored. Incorporation of CE in Lean frameworks reportedly resulted in considerable benefits environmentally, socially, and economically [7]. However, empirical evidence linking Lean Practices, CE, and environmental performance remains rather limited, calling for further research. This study seeks to bridge this gap by addressing the following research questions:

To what extent do Lean Practices (LP) can influence environmental performance (EP) through the mediating role of Circular Economy (CE) principles?

Does the integration of Circular Economy (CE) principles can enhance the effectiveness of Lean Practices in improving environmental performance (EP)?

This conceptual paper contributes by exploring the relationship between Lean Practices as an independent variable, CE as a mediating variable, and environmental performance as the dependent variable. By garnering insights from previous literature, this research would provide a robust understanding of the influence of Lean strategies on environmental outcomes through CE and add to the larger discussion on sustainable production systems.

2. Literature Review

2.1 Lean Practices: An Overview

Lean Practices (LP) have evolved into a socio-technical system aiming to enhance process efficiency and minimize waste [8]. These include practices like process standardization, just-in-time production, and statistical process control, alongside social practices such as employee involvement, leadership, and continuous improvement [9]. Collectively, these practices drive operational efficiency and organizational excellence However, Lean, which was centered on waste elimination and speed, is analyzed following the difficulties in the environment [10].

2.2 Circular Economy as Mediator

CE presents a new way of improving the overall conditions of sustainable development in terms of resource use, waste, and loops [11]. CE complements views of industrial and ecological efficiency and presents an opportunity to balance the economic and environmental targets [12]. CE aligns with principles of industrial and ecological sustainability, offering a route to resolve economic and environmental goals [13]. The literature shows that CE principles may improve Lean's aim of reducing waste by protecting product and material loops [3]. However, more research is essential to thoroughly and completely explain how CE acts as a mediator between the concept of Lean and environmental outcomes resulting from its execution. This research fill the gap by exploring the connection between Lean Practices, Circular Economy and Environmental Performance. It explores how CE navigates these dynamics and provides an example of how Lean practice has been implemented in an environmental context, thus adding to the literature on sustainable manufacturing.

Proposition 1: CE can mediates the relationship between lean practices and environmental performance.

3. Conceptual model:

Figure.1 Conceptual Framework

4. Conclusion and implications

This conceptual paper presents a critical theoretical contribution based on exploring the integration of LP with CE principles towards improving EP. In general, this research addresses the gap that has so long been absent in the literature by providing the first exploration of how CE could mediate the relationship between Lean strategies and concrete

environmental outcomes. This papers elucidate indicative of how CE, properly integrated with the principles of Lean, enables an organization to attain impressive resource efficiencies, waste elimination, and sustainability. Finally, it shows the true potential of CE that can enable not only a support structure for Lean waste-reduction purposes but also can have a significant amplification factor for Lean's environmental impact. By providing an overall understanding of this interaction, the paper contributes to the broader discourse on sustainable production systems and organizational excellence.

The paper also assesses the need for CE as a mediator in attaining environmental results from Lean practices. The research contributes to the theoretical literature by suggesting that CE can enhance Lean's effectiveness, especially in manufacturing contexts where resource utilization and environmental obligations are becoming increasingly critical. This paper have broader implications for both researchers and practitioners interested in advancing sustainable practices in production systems. This paper can also act as a foundational work for further studies on lean and CE principle synergies in improving environmental performance organizationally.

4.1 Practical Implications

Managers, policymakers, and government bodies find value-added insights from the study by learning how practices of lean can be improved incorporating the concept of CE to lead to a sustainable environment. It can be appropriate for managers to integrate these principles of CE within their available Lean frameworks that can produce higher resource efficiency, a reduction in the operational wastes, and decrease footprints that harm the environment. For policymakers, this research indicates the need for policies that promote the implementation of CE practices together with Lean strategies to fulfill environmental regulations and sustainability targets. This is where governments can play a great role in facilitating this integration through incentives, standards, and industry collaboration to drive adoption at scale.

4.2 Theoretical Implications

This research contributes to the understanding of the relationship between Lean Practices, CE, and Environmental Performance through the establishment of CE as a mediating variable. It fills a gap in the literature by proposing a model that links Lean practices with environmental outcomes through CE, offering a more nuanced perspective on how sustainable practices can be effectively integrated into production systems. This model can serve as a guide for future theoretical development and empirical research in the areas of sustainability, operations management, and environmental performance.

4.3 Future Research Direction

Future research will be directed toward the adaptation of LP and CE to specific industries, as each industry may face unique challenges. Empirical studies are needed to validate the relationships between Lean, CE, and environmental performance, providing concrete evidence to refine the conceptual framework. Moreover, the role of leadership and organizational culture in the successful implementation of these practices can be seen as an insight into overcoming adoption barriers. Future research can also explore the effect of emerging technologies such as digitalization and AI in supporting the integration of Lean and CE to enhance resource utilization and decision-making. Further, it will investigate how government policies and incentives influence the adoption of these practices, which can guide policymakers in the design of supportive frameworks. Finally, long-term studies are needed to evaluate the sustained environmental and economic benefits of integrating Lean and CE, offering insights into their long-term impact on sustainability and competitiveness.

Data Availability:

The datasets used in this study are available from the corresponding authors upon reasonable request.

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