

The moderating effect of top management environmental awareness on the relationship between circular economy practices and circular economy performance: insights from the Iraqi oil and gas industry

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Abstract

Purpose: This study investigates how circular economy practices (CEPs) influence circular economy performance (CEPf), with a particular focus on the direct and moderating roles of Top Management Environmental Awareness (TMEA) in the Iraqi oil and gas industry. The aim is to understand the mechanisms that enhance sustainability performance through operational and cognitive factors.

Design/methodology/approach: A quantitative approach was employed using a cross-sectional survey of professionals in the Iraqi oil and gas sector. Data from 130 respondents was analyzed through Partial Least Squares Structural Equation Modeling (PLS-SEM) using SmartPLS 4 to examine relationships among variables and test moderation effects.

Findings: The findings reveal that CEPs significantly enhance CEPf, and TMEA not only positively influences CEPf but also strengthens the relationship between CEPs and CEPf. These results underscore the joint importance of circular practices and strategic environmental leadership in advancing sustainability outcomes.

Limitations and Research Implications: The study is limited by its focus on a single sector and geographical context, potentially constraining generalizability. It encourages future research to explore longitudinal designs and examine other contextual moderators such as organizational culture or external stakeholder pressure.

Practical Implications: The results highlight the necessity for managers and policymakers to invest in leadership development programs that foster environmental awareness. Strengthening TMEA can amplify the performance gains derived from CE initiatives, particularly in resource-intensive industries.

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Originality/value: This study contributes to literature by integrating leadership cognition with circular economy implementation, providing novel insights into how managerial awareness enhances the impact of circular practices on performance.

Keywords: Circular Economy Practices, Circular Economy Performance, Environmental Awareness, Top Management, Oil and Gas Sector, Sustainability Leadership.

Introduction

The increasing severity of international environmental problems has prompted the circular economy (CE) to be the most widely reported sustainable development model. CE is a paradigm shift from conventional linear “take-make-dispose” production model towards a more regenerative model emphasizing on waste reduction, resource efficiency, material reuse, and recycling (Rodríguez-Espíndola et al., 2022; Sahoo et al., 2023; Waly et al., 2023). This change is particularly important in heavy industries like oil and gas, which are very resource intensive and are some of the largest environmental offenders.

In resource-rich countries like Iraq, the adoption of CE approaches in the oil and gas industry has been very important recently to reconcile economic stability with environmental responsibility. This despite the rhetoric to expand CE deployment in such industries that still face structural, regulatory, and cultural barriers applying CE (Sharma et al., 2023).

More recent publications have stressed the need for organizational and management related enablers alongside technical CE implementation. More specifically, Top Management Environmental Awareness (TMEA) has been found to be a determinative factor for successful sustainability strategies (Singh et al., 2022). TMEA extends toward the degree of how much top management internalizes environmental issues, and how far the implication takes place in company planning, resource commitment, and corporate culture. Although prior research has demonstrated positive links between CE practices and sustainability performance, few studies have addressed the contingent role of top management awareness in enabling these practices to translate into tangible performance outcomes. This is particularly relevant in transitional economies, where institutional inertia and regulatory ambiguity can dilute the impact of CE initiatives.

This study addresses this knowledge gap by investigating the moderating role of TMEA in the relationship between CE practices and CE performance in Iraq’s oil and gas sector. It aims to answer two research questions: (1) To what extent do CE practices contribute to CE performance in the Iraqi oil and gas industry? and (2) How does TMEA moderate this relationship? Theoretically, this research contributes to CE and sustainability management literature by integrating cognitive leadership factors into performance models. Practically, it provides strategic insights for managers and policymakers aiming to foster CE transitions in environmentally sensitive yet structurally constrained industries.

The remainder of this paper is structured as follows: Section 2 provides a comprehensive literature review covering circular economy practices (CEPs), Circular Economy Performance (CEPf), and Top Management Environmental Awareness (TMEA), supported by recent studies and theoretical insights. Section 3 develops the study’s hypotheses, clarifying the proposed direct and moderating relationships among the variables. Section 4 details the research methodology, including sampling strategy, measurement instruments, and data analysis techniques using PLS-SEM. Section 5 presents the empirical findings from the structural model analysis and discussion of results. Lastly, Section 6 discusses the theoretical and practical implications of the results, followed by the study’s limitations and suggestions for future research directions.

Literature Review

Circular Economy Practices

Specific CEPs refer to various operational practices that focus on achieving environmental impact reduction through resource efficiency, re-use, recycling, and closed looping. In the petroleum sector for instance CEPs include examination of the possibility of water re-injection, recycling of by-products and the use of waste-to-energy (WTE) systems (Waly et al., 2023). These methods are growing in popularity in response to the need to lessen ecological footprints and to meet global sustainability objectives. CEPs drive the shift from linear to regenerative production systems, promoting long-term survival. Another evidence by Rodríguez-Espíndola et al. (2022) suggests that circularity in energy-intensive industries provides competitive advantage and environmental compliance in the long run. Nevertheless, in emerging economies, the systematic application of CEPs is often constrained by structural, financial and regulatory factors, which necessitates integrated approaches overlaying technological readiness with institutional support (Sharma et al., 2023).

Circular Economy Performance

CEPf includes the degree with which organizations in the economy attain circularity objectives such as minimizing resource consumption, waste and emissions (Sharma et al., 2023). CEPf also contains environmental, economic and social performance outcomes. Firms with a high CEPf rate show better environmental management, regulatory compliance and stakeholder satisfaction. Indeed, performance in this realm usually mirrors sustainability in strategic planning and in the operations conduct (Li et al., 2022). Additionally, Rodríguez-Espíndola et al. (2022) highlight the role of innovation and process redesign to achieve CE targets, and the fact that performance is not just a result, but rather a dynamic process of incremental change. These results highlight the strategic significance of CEPf as an end and as a performance measure for evaluating organizational sustainability.

Top Management Environmental Awareness

TMEA is the extent that senior management perceives and takes environmental sustainability into account in the decision-making process (Song et al., 2024). Managers high in environmental awareness are key in terms of sustainability agendas, investment in environmentally friendly innovations and the embedding of a culture of ecological responsibility within their organizations (Singh et al., 2022). TMEA is vital in sectors like O&G where sustainable transitions cannot succeed without strategic dedication and foresight. Because of higher environmental orientation of top managers, organizations can be more agile to adopt to CE disposition, ameliorating the quality of implementation and outcomes. Being aware of leadership helps to be responsive to regulation pressure and market-based sustainability incentives. As a result, TMEA is often put forward as a key driver or mediator in the sustainability performance models, especially when high institutional inertia frustrates environmental innovation.

This study advances the literature on circular economy implementation by integrating TMEA as a moderating variable into the established relationship between CEPs and CEPf. While existing models have extensively documented the direct impact of CEPs on sustainability outcomes (Rodríguez-Espíndola et al., 2022), they often overlook the organizational and cognitive conditions that shape this relationship. By drawing upon Upper Echelons Theory (UET), the study positions TMEA as a strategic enabler that influences how circular initiatives are adopted and translated into measurable outcomes. This theoretical extension is particularly relevant for institutional environments in developing economies like Iraq, where executive leadership often compensates for regulatory or systemic constraints. Thus, this work fills a critical gap by contextualizing circular economy transitions within leadership cognition and environmental



awareness, contributing to a more nuanced understanding of sustainable transformation in the oil and gas sector.

Underpinning Theories and Hypotheses Development

Underpinning Theories

To provide a robust conceptual foundation, this study integrates the Dynamic Capabilities View (DCV) and the UET to explain the relationships among CEPs, CEPf, and TMEA. The DCV posits that firms must continuously reconfigure their operational competencies in response to environmental changes to achieve sustained competitive advantage (Teece, 2007). Within this framework, CEPs are considered dynamic capabilities that enable firms to improve resource efficiency, minimize waste, and adapt to circularity-oriented regulations. As highlighted by Sahoo et al. (2023), circular practices such as recycling, remanufacturing, and product life extension can only contribute to improved environmental performance when firms possess the internal capability to absorb and deploy them strategically. In this context, CEPs are not isolated tools but reflect a firm's strategic agility in transitioning toward sustainable production models.

Complementing this, the UET (Hambrick & Mason, 1984) provides insight into how managerial cognition and values shape strategic choices. UET suggests that top executives' experiences, values, and awareness directly influence organizational outcomes. As recent research by Tang et al. (2024) shows, CEOs with strong environmental awareness tend to prioritize green innovation and performance targets. Applying this logic, TMEA is conceptualized in this study as a critical moderator that amplifies the effectiveness of CEPs on CEPf. When leadership is environmentally conscious, organizations are more likely to align their vision, resource allocation, and culture with circular principles—ultimately resulting in superior sustainability outcomes.

Together, DCV and UET offer a comprehensive lens for understanding how technical and leadership dimensions interact to shape CEPf. Their integration allows this study to move beyond simplistic linear models by acknowledging the organizational and behavioral enablers necessary for successful CE implementation, particularly in institutional contexts like the Iraqi oil and gas sector.

Circular Economy Practices and Circular Economy Performance

This direct linkage between CEPs and CEPf is validated through significant evidence on empirical grounds that firms that take circular strategies benefit from their practices. These are not only tangible benefits (such as cost savings, resource conservation, etc.) but also the intangibles like your stakeholder faith, and the legal compliances which is again very common. Such practices as waste recovery and materials reuse in oil and gas industry in particular influence directly the environmental performances in terms of a main circular performance indicator (Waly et al., 2023). Accordingly, the following hypothesis is suggested:

H1: Circular economy practices positively affect circular economy performance

Top Management Environmental Awareness and Circular Economy Performance

It has been demonstrated that TMEA is an important driver of a firm's environmental performance. Environmentally sensitive managers are more prone to incorporate circular goals in corporate strategy and promote a culture where long-term environmental effects are preferred over short-term economic benefits (Singh et al., 2022). Firms with environmentally oriented top management are more likely to invest in green technology, train employees in sustainability, and implement comprehensive environmental performance monitoring systems. Such attempts often lead to better scores on circular metrics such as reducing

waste, becoming more resource efficient and lowering emissions. From this perspective, the following hypothesis is advanced:

H2: Top management environmental awareness positively affects circular economy performance

Moderating Role of TMEA

Although the CEPs may have an enabling effect on performance, the latter's success seem to be highly contingent on the contextual aspect of leadership. TMEA acts as a mediator of the relationship between practice and performance outcomes. In organizations with high TMEA, circular practices are more likely to be well-established, consistently utilized, and resource-rich, triggering the positive performance implications of activating them (Song et al., 2024). In contrast, low conscience may impede the institutionalization of CE use, and so sustainability gains will be marginal. Therefore, the third hypothesis is suggested:

H3: Top management environmental awareness positively moderates the relationship between circular economy practices and circular economy performance

Methodology

The collaboration between CEPs and CEPf in TMEA is investigated with the aid of a quantitative empirical research design. A quantitative method is deemed to be suitable since hypothesized relationships can be tested over numerical data and with the help of statistical procedure, hence objectivity and generalization of the study is maintained. The structure is consistent with the aim of the research to comprehend direct and moderating relationships across constructs.

Primary data were collected using a structured survey questionnaire distributed to managers, engineers, and environmental officers working in the Iraqi oil and gas industry. The questionnaire was designed based on validated instruments from prior literature and adapted to the industrial and cultural context of Iraq. This study targets the oil and gas sector in Iraq, focusing on firms involved in upstream and midstream operations. The unit of analysis is the organizational level, wherein perceptions of firm-level practices and performance were captured through responses from individuals occupying strategic leadership roles (e.g., CEOs, general managers). This selection is justified as such roles are best positioned to assess the implementation of circular economy practices and the environmental orientation of top management.

A total of 130 (Central Organization for Statistics, 2025) valid responses were obtained through a structured survey distributed via both online (email-based Google Forms) and onsite (paper-based forms delivered through professional networks) methods. The mixed distribution strategy ensured broader geographic coverage across Iraqi sties, while also facilitating access to firms with limited digital engagement. A purposive sampling technique was adopted to ensure that respondents held decision-making positions relevant to environmental and operational strategies, which align with the objectives of the study.

These methodological choices reflect the need to capture organizational-level data from knowledgeable informants while considering Iraq's infrastructural and institutional context, thereby enhancing the relevance and reliability of the findings. The profile of respondents as shown in Table 1. As presented in Table 1, the demographic profile of the study's sample (n = 130) reflects a workforce primarily situated in mid-sized to large oil and gas companies. Most participants are from organizations with 501 to 2000 full-time employees (71.5%), indicating a prevalence of medium to large firms. In terms of company age, 57.7% of respondents



represent firms established between 5 and 20 years ago, suggesting a mature but operationally active industrial base.

Table 1
Profiles of Companies and Participants (n=130)

Demographic Factors	Frequency	Percentage
Number of full-time employees		
Between 30 to 100	14	10.8
Between 101 to 500	21	16.2
Between 501 to 1000	39	30.0
Between 1001 to 2000	54	41.5
More than 2001	2	1.5
Number of years of company establishment		
Less than 5 years	23	17.7
Between 5 to 10 years	36	27.7
Between 11 to 15 years	28	21.5
Between 16 to 20 years	39	30.0
Between 21 to 25 years	4	3.1
Ownership of company		
Public	34	26.2
Private	94	72.3
Mixed	2	1.5
Current position in the company		
General Manager	31	23.8
CEO	74	56.9
Deputy Director	15	11.5
Others	10	7.7
Work experience in industry		
Less than 5	17	13.1
Between 5 to 10	35	26.9
More than 10	78	60.0

Regarding ownership structure, a significant majority (72.3%) of respondents work in private companies, while public and mixed-ownership firms are underrepresented. In terms of organizational role, 56.9% of participants hold CEO positions, with an additional 23.8% serving as general managers, demonstrating strong representation from top executive leadership. Work experience in the industry is notably high, with 60% of participants reporting more than 10 years of experience, underscoring the seniority and depth of industry knowledge among respondents. Overall, the sample is characterized by experienced executives operating within established, privately owned oil and gas firms.

All variables were assessed using multi-item measures taken from prior research. CEPs was assessed through 8 items with the scale based on Sahoo et al. (2023). Performance on circular economy has 5 items were used to measure CEPf- using indicators by Agyabeng-Mensah et al. (2022) among others such as material efficiency, waste reduction and emissions measures. TMEA was operationalized by 3 items with a scale following Cao and Chen (2019) for managerial perceptions and strategic orientation towards the environment. All the measures were scored based on 5-point Likert scales, ranging from “strongly disagree” to “strongly agree.” Content validity was established by expert review of the survey by 5 academics and 6 industry professionals where some modification had been made.

Data was analyzed by using the Partial Least Squares Structural Equation Modeling (PLS-SEM), which is applicable to predictive models, and for those with moderation, even when it is complex. The examination of both model, formative and reflective, was done using the

SmartPLS 4 software. A boot strapping with 5,000 subsamples was used to examine the significance of the path coefficients and the moderating effects.

Results and Discussion

Assessment of the Measurement Model

Reliability and validity of the measurement model were examined with SmartPLS 4. Internal consistency reliability was tested using the composite reliability (CR), which was above the cut-off value of 0.70 recommended by Bagozzi and Yi (1988). Convergent validity was determined using Average Variance Extracted (AVE), and all constructs obtained values greater than 0.50, thus meeting the criterion prescribed by Hair, Black, Babin, and Anderson (2014). The discriminant validity of the constructs was verified by computing the Heterotrait-Monotrait ratio (HTMT) and was found to be below the conservative cutoff of 0.85 (Henseler et al., 2015). In summary, the results show that all measures obtained adequate validity and reliability. A detail of the results is reported in Table 2 and Table 3.

Table 2
Results of convergent validity

Construct	Item	Measurement	Loading	CR	AVE
CEPs	CEPs.1	Convert waste input	0.828	0.873	0.803
	CEPs.2	Share resources proactively	0.855		
	CEPs.3	Reduce energy use	0.876		
	CEPs.4	Encourage waste recycling	0.818		
	CEPs.5	Source economically sustainably	0.865		
	CEPs.6	Enhance product value	0.837		
	CEPs.7	Support partners proactively	0.888		
	CEPs.8	Adapt circular models	0.845		
CEPf	CEPf.1	Improve product durability	0.901	0.825	0.755
	CEPf.2	Reduce supply risks	0.878		
	CEPf.3	Lower energy costs	0.885		
	CEPf.4	Reduce waste cost	0.837		
	CEPf.5	Decrease environmental fines	0.886		
TMEA	TMEA.1	Aware of environmental laws	0.827	0.810	0.874
	TMEA.2	Aware of environmental harm	0.851		
	TMEA.3	Aware of protection measures	0.811		

Table 3
Results of the discriminant validity (HTMT)

Construct	CEPs	CEPf	TMEA
CEPs			
CEPf	0.521		
TMEA	0.471	0.444	

Assesment of Structural Model

The structural model was evaluated using path analysis and bootstrapping (5,000 samples) in SmartPLS 4. The significance of path coefficients was determined using t-values and p-values,



with thresholds guided by Hair et al. (2017). The results showed the following standardized path coefficients.

Table 4
Results of the hypotheses testing

H	Path	β -values	Std. deviation	t-value	p-value	Result
H1	CEPs \rightarrow CEPf	0.502	0.067	7.493	0.000	Significant
H2	TMEA \rightarrow CEPf	0.445	0.066	6.742	0.000	Significant
H3	CEPs \times TMEA \rightarrow CEPf	0.336	0.057	5.895	0.000	Significant

The results of hypothesis testing demonstrate that the empirical support for the study’s conceptual model is very high, as all hypotheses are significant at conventional levels. The direct impact of CEPs on CEPf (H1: $\beta = 0.502$, $t = 7.493$, $p < 0.01$) demonstrates that circular measures (i.e., reusing, recycling, and resource efficiency) have the potential to significantly improve sustainability performance of oil and gas companies. Besides, the TMEA also influences circular performance (H2: $\beta = 0.445$, $t = 6.742$, $p < 0.01$), highlighting that if the top management supports eco-mindedness, organizations are going to embed and implement CE programs efficiently. In particular, the interaction term (H3: CEPs \times TMEA \rightarrow CEPf) showed a positive significant moderating effect ($\beta = 0.336$, $t = 5.895$, $p < 0.01$), which indicates that environmentally aware leadership positively moderates the relationship between CEPs and performance.

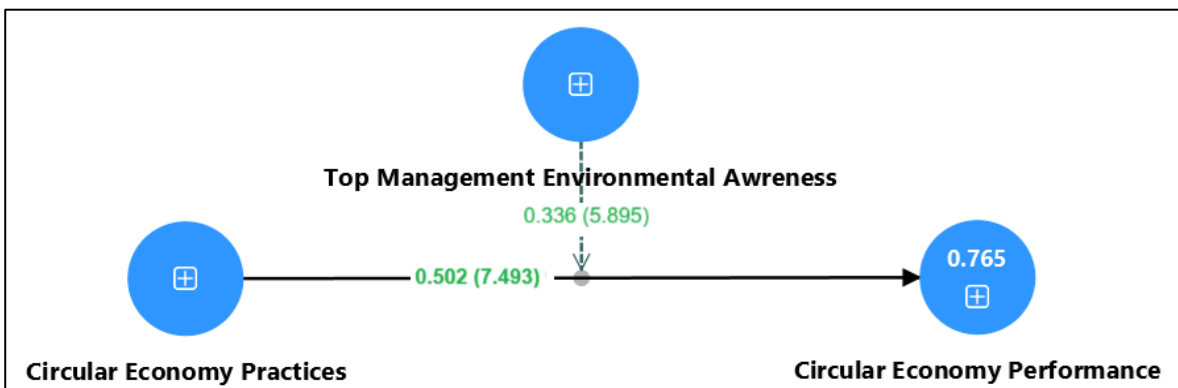


Figure 1
Structural model

This interaction is further illustrated in Figure 2, which shows that firms with high levels of TMEA achieve higher CEPf when implementing CEPs, compared to firms with low levels of TMEA. The slope for the high-TMEA group is markedly steeper, indicating greater performance improvement per unit of CE implementation. These findings align with the propositions of the UET, which posits that managerial cognition influences organizational adaptation to environmental challenges (Tang et al., 2024).

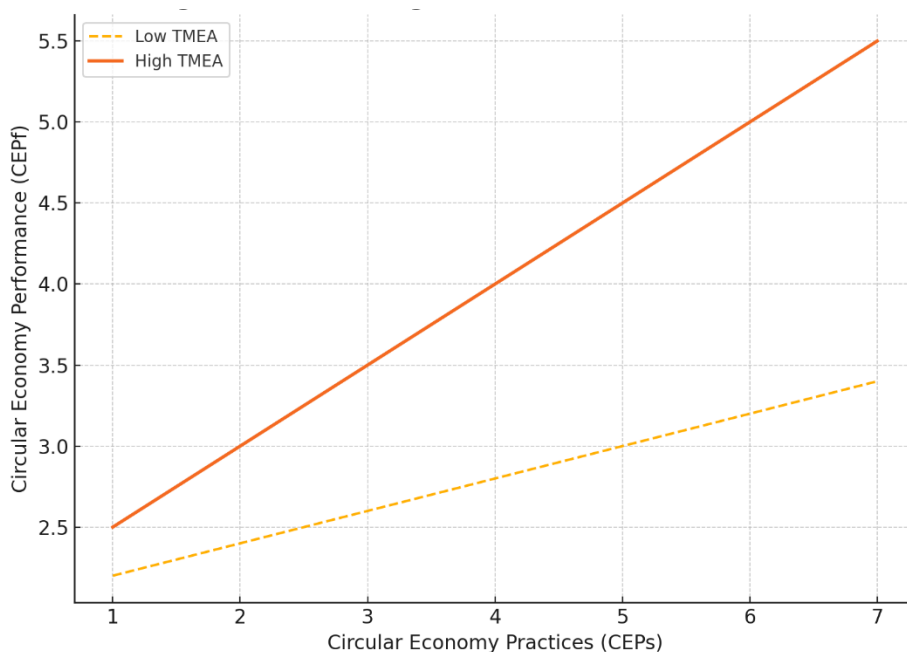


Figure 2
Interaction graph

Discussion

The findings of this study make significant theoretical and empirical contributions by affirming and extending existing knowledge on CEPs and the strategic role of leadership in sustainability. The positive association observed between CEPs and CEPf aligns with earlier work by Waly et al. (2023), who emphasized the environmental and operational advantages of CE adoption. The current study has implications in suggesting that TMEA is not simply a contextual factor but a strategic driver of the success of sustainability. This is consistent with the findings of Singh et al. (2022), environmentally friendly leadership facilitates strategic consistency, employee dedication, and exploitation of the resources in the development of green innovations.

Importantly, the moderating effect of TMEA found in this study offers a fresh perspective on how leadership cognition influences the effectiveness of circular initiatives. This is consistent with the claims of Sharma et al. (2023), who claimed that leaders' involvement develops responsibility in relation to institutional pressures and market signals. The findings suggest that in settings such as Iraq's oil and gas, infamous for regulatory ossification and intricacy, TMEA serves a 'measurable' catalyst for transitioning CE initiatives into tangible results. High levels of leadership environmental awareness in organizations led to better CE performance by means of better vision execution, strategic coherence, and inside collaboration.

From a strategic perspective, this suggests that environmental awareness at the executive level acts as a catalytic capability that enhances the operational effectiveness of circular strategies. It allows firms to better align their resources, policies, and culture with CE goals—leading to superior environmental and operational outcomes. This moderation is particularly relevant in institutional environments like Iraq's oil and gas sector, where top-down leadership remains a decisive factor in driving sustainable transitions (Sahoo et al., 2023).

This discussion generally points out that technical solutions cannot succeed without managerial commitment and knowledge. The value added to the study is in a leadership-focused framework to comprehend the success of CE, and it extends an appeal for more focus on the role of leadership in developing the skills necessary for traditional, high-impact sectors to transition into sustainability.



Conclusion

The paper aims to investigate the associations between CEPs, CEPf, and TMEA in the Iraqi oil and gas industry. Main results indicate that CEPs make an unfilled contribution to circular performance, and TMEA has not only the direct and positive effect on CEPf but also the moderating effect to enhance the influence of CEPs. This result confirms the relevance of both operational and cognitive logic for sustainability effects. This study contributes to theoretical research by combining the CE frameworks with leadership awareness and arguing that successful CE implementation is achieved by strategic intent and organizational capability. In practical terms, the results underline the need to create environmental consciousness at the top management with a view to obtaining the greatest rewards from CE implementations. Second, the study offers implications for policymakers seeking to encourage the development of environmentally sustainable practices through leader development and organizational support processes.

However, the study has limitations that should be noted. The study was carried out in one sector, and it was geographically determined; the results might not be generally generalized. In addition, the cross-sectional nature limits inferences about causality. Longitudinal studies and other relevant moderator variables (e.g., organizational culture, stakeholder pressure, regulatory context) may be useful in future research. Finally, the study underscored the importance of the interrelationship between manager awareness and operational practices for driving CE performance. It calls for further investigation of the byplay between leadership cognition and corporate strategy in enabling sustainability in high-impact industries.

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