Cultural Catalysts, Technological Tools, and Economic Factors: An Approach to Adopting Circular Economy Practices in Saudi Arabian SMEs

Houcine Benlaria*

College of Business, Jouf University, Saudi Arabia

hbenlarir@ju.edu.sa

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Abstract:

This inquiry delves into examining the analysis of the incorporation of circular economy practices within small and medium enterprises (SMEs) in Saudi Arabia, concentrating on the influence of technological advancement, cultural dynamics, and economic aspects, along with the moderating function of leadership encouragement. The primary aim is to pinpoint the critical factors shaping the integration of sustainable practices in the SME sector and to comprehend the interplay of these factors within the context of Saudi Arabia's Vision 2030. A structured survey was dispersed among 222 SME leaders to collect information on their encounters and perspectives regarding embracing circular economy practices. The evaluation employed Covariance-Based Structural Equation Modeling (CB-SEM) for data analysis, a technique selected for its efficacy in comprehending intricate variable connections and model validation. The outcomes demonstrate that technological innovation significantly bolsters adopting circular economy practices, while cultural dynamics and economic factors also wield substantial influence. Leadership support emerged as a pivotal mediator, amplifying the beneficial effects of these factors. The study underscores the collaborative impact of leadership and technology as notably potent, proposing that the strategic assimilation of technology into business operations is imperative for surmounting cultural and economic obstacles. Drawing from these observations, the study advocates for SMEs to fortify their leadership capabilities to nurture an environment of innovation and sustainability. It suggests training initiatives centered on sustainability management and strategic decision-making to empower leaders to propel the efficient adoption of circular economy practices.

Keywords: Circular Economy Practices, Small and Medium Enterprises (SMEs), Technological Innovation, Cultural Dynamics, Economic Factors, Leadership Support, CB-SEM Model, Saudi Arabia

Jel Classification Codes:Q55, Q56, M14, Q12.

*Correspondingauthor.

1. Introduction:

Circular economy practices have gained significant attention worldwide as a sustainable approach to economic activities. In the context of Saudi Arabian small and medium enterprises (SMEs), adopting circular economy principles is essential for fostering long-term sustainability. Cultural catalysts, technological advancements, and economic factors play crucial roles in shaping the implementation of circular economy practices within Saudi Arabian SMEs. This essay will explore the impact of cultural catalysts, technology, and the economy on promoting circular economy practices among SMEs in Saudi Arabia. SME development serves as a catalyst for advancing the circular economy agenda in various countries, including Saudi Arabia. Khan and Mihaisi (2023) emphasize the pivotal role of SMEs in driving circular economy practices and sustainable development. By empowering SMEs to adopt circular business models, Saudi Arabia can enhance resource efficiency, reduce waste generation, and contribute to environmental conservation efforts.

The adoption of cleaner production technologies is essential for SMEs to transition towards a circular economy paradigm. Alam et al. (2024) highlight the importance of technological advancements in enabling SMEs to embrace sustainable production practices. By integrating cleaner production technologies, Saudi Arabian SMEs can optimize resource utilization, minimize environmental impact, and enhance their competitiveness in the global market.

Waste-to-energy technologies, such as anaerobic digestion, present a viable solution for promoting circular economy practices within SMEs. Hussain et al. (2020) underscore the significance of implementing waste-to-energy initiatives to convert organic waste into renewable energy sources. By leveraging anaerobic digestion technology, Saudi Arabian SMEs can reduce waste disposal costs, lower carbon emissions, and contribute to a more sustainable energy landscape.

The financial aspect supports SMEs' transition towards circular economy practices. Maspul (2023) discusses the role of Sharia-compliant financing, such as Monsha'at, in providing capital for SMEs to invest in sustainable initiatives. Through tailored financing mechanisms, Saudi Arabian SMEs, such as Buraydah Specialty Coffee, can implement circular economy practices, improve operational efficiency, and drive business growth.

Reducing single-use plastic consumption is a crucial strategy for advancing circular economy practices among SMEs. Choudhary et al. (2022) highlight the detrimental impact of single-use plastics on the environment and the need for SMEs to adopt sustainable alternatives. By implementingmeasures to reduce single-use plastics, Saudi Arabian SMEs can minimize environmental pollution, enhance brand reputation, and contribute to a circular economy ecosystem.

Furthermore, the convergence of cultural catalysts, technology, and economic factors is pivotal in shaping circular economy practices among SMEs in Saudi Arabia. By harnessing these influences, SMEs can drive

sustainable growth, foster innovation, and contribute to the transition towards a more resource-efficient and resilient economy.

Using the PLS-SEM model to measure the impact of the knowledge economy on sustainable development in the Al-Jouf region of Saudi Arabia, Fahad and Benlaria (2023) investigate the role of the knowledge economy in driving sustainable development within Saudi Arabian SMEs. This research illuminates the significance of leveraging knowledge resources and intellectual capital to fuel sustainable practices, emphasizing the crucial link between knowledge-based economies and long-term environmental and economic sustainability. Green entrepreneurship in Saudi Arabia, as explored by Abdelwahed et al. (2023), plays a pivotal role in shaping the landscape of a greener economy. The emergence of green entrepreneurship initiatives fosters circular practices within SMEs, promotes environmentally friendly business models, and contributes to the overall sustainability agenda in the region.

Highlighting the implementation of advanced technologies as a catalyst for circular economy development in the Middle East, AlSuwaidi (2020) emphasizes the critical role of technology in driving circularity within SMEs. The integration of advanced technologies enables efficient resource utilization, waste reduction, and the adoption of innovative sustainable practices, thereby propelling the transition towards a more circular economy.

This study examines the direct effects of technological innovation, cultural dynamics, and economic factors on adopting circular economy practices within Saudi Arabian SMEs. Furthermore, it explores the mediating role of leadership support in these relationships. The hypotheses proposed that while each factor individually influences the adoption of circular economy practices, leadership support plays a critical mediating role in enhancing the positive impact of these factors.

This study's importance lies not only in its contribution to academic literature but also in its practical implications. By identifying the key factors influencing the adoption of circular economy practices and the role of leadership in mediating these effects, the study provides valuable insights for policymakers, business leaders, and sustainability advocates. It aims to inform strategies to facilitate a smoother transition to circular economy models in Saudi Arabian SMEs, thereby contributing to the country's broader sustainability goals under Vision 2030.

2. Literature Review

❖ Cultural Catalysts and Circular Economy Practices

Adopting circular economy (CE) practices is a collaborative effort significantly influenced by various cultural catalysts. These catalysts, essential for transitioning towards more sustainable and resource-efficient business models and societal behaviors, highlight our shared responsibility in this journey. A critical cultural

catalyst is the shift in organizational culture towards embedding circularity as a core aspect of business operations, which necessitates ambition, prioritization, employee buy-in, and a long-term perspective for successful implementation (Noe, 2015). Additionally, the broader concept of culture, encompassing human interactions within society, plays a pivotal role in the CE transition. This includes a general change in values towards sustainability and the CE, the gradual emergence of a more environmentally conscious attitude, and the importance of stakeholder cooperation and solidarity (Deniz et al., 2021). Government policies and initiatives also serve as a cultural driver by setting the regulatory framework and incentives for CE adoption, as seen in the influence of government policies on cleaner production and urbanization, as well as specific initiatives targeting Indian SMEs (Sai et al., 2022; Peter et al., 2020). The adaptive reuse of cultural heritage by preserving inherent values while stimulating economic growth and reducing material usage exemplifies how cultural and historical values can align with CE principles (Pilar & Yolanda, 2020).

Moreover, it is crucial to highlight the role of knowledge and awareness about CE among organizations and consumers. This understanding is not just important but crucial for driving the adoption of CE practices. It includes understanding the benefits of CE practices, such as resource efficiency, waste reduction, and sustainable production, which are particularly relevant in industries like fashion (Jain, 2023). The systematic review of determinants for adopting circular business models further underscores the importance of culture, regulation, market, and strategy as critical factors influencing CE adoption (Francesco & Sandra, 2023). In summary, the critical cultural catalysts driving the adoption of CE practices encompass a shift in organizational and societal values towards sustainability, government policies and initiatives, the integration of cultural heritage, and increased knowledge and awareness about CE benefits and practices (Castro-Lopez et al., 2023; Sawe et al., 2021; Hakimi et al., 2022).

❖ **Technological Tools and Circular Economy Practices**

Implementing circular economy (CE) practices across various industries is significantly enhanced by adopting advanced technological tools. Among the most effective tools, Industry 4.0 technologies, including artificial intelligence (AI) and blockchain technology (BCT), stand out for their ability to improve circular economy practices and eco-environmental performance, thereby boosting organizational performance, particularly noted in the food processing industry (Neri et al., 2023). The integration of lean manufacturing concepts within a circular context, exemplified by the adaptation of Value Stream Mapping (VSM) with circularity and longevity indicators, demonstrates how traditional productivity tools can be repurposed to support circular systems (Yazan et al., 2022). Innovative decision-support tools, leveraging AI and IT, are pivotal in facilitating the transition to a circular economy, especially in implementing industrial symbiosis (IS) practices.

These tools, which include recommender algorithms, machine learning techniques, and multi-agent systems, aid in identifying opportunities for symbiotic business, assessing business feasibility, and ensuring sustainable operations (Rath et al., 2023). The Internet of Things (IoT) further enables the tracking, monitoring, and analyzing products in real-time, focusing on residual value to motivate circularity decisions (Marquina et al., 2021). Material passports and environmental assessment and accounting tools, such as life cycle analysis (LCA) and material flow analysis (MFA), provide essential quantitative data for evaluating the circular value of products and processes, thereby supporting decision-making in CE (Prieto-Sandoval et al., 2023; Mboli et al., 2022). Additionally, the "Circular Clock" model suggests a structured approach to CE implementation, utilizing a set of tools and techniques across six fields of action, which can guide firms in their strategic adoption of eco-innovation practices (Diéguez-Santana et al., 2021; Mboli et al., 2022; Diéguez-Santana et al., 2021; Saha et al., 2022).

❖ **Economic Factors and Circular Economy Practices**

Economic factors like inflation, interest rates, and GDP are crucial in influencing the adoption of circular economy practices. Research highlights that cost efficiency considerations are a significant barrier to transitioning to circular economy practices in the food supply chain (Pannila et al., 2022; Assmann et al., 2023). Additionally, the adoption of circular business models is affected by various determinants, including market conditions and business cases, which are closely tied to economic factors like inflation and GDP (Singh et al., 2022; Rehman et al., 2022). Furthermore, organizational factors such as long-term planning, top management participation, and alignment with circular economy goals are essential for successful adoption, indicating the economic impact on strategic decision-making within organizations (Pannila et al., 2022). Therefore, economic stability and conducive financial conditions are vital for promoting the widespread adoption of circular economy practices across industries.

❖ **Leadership Support as a Mediator**

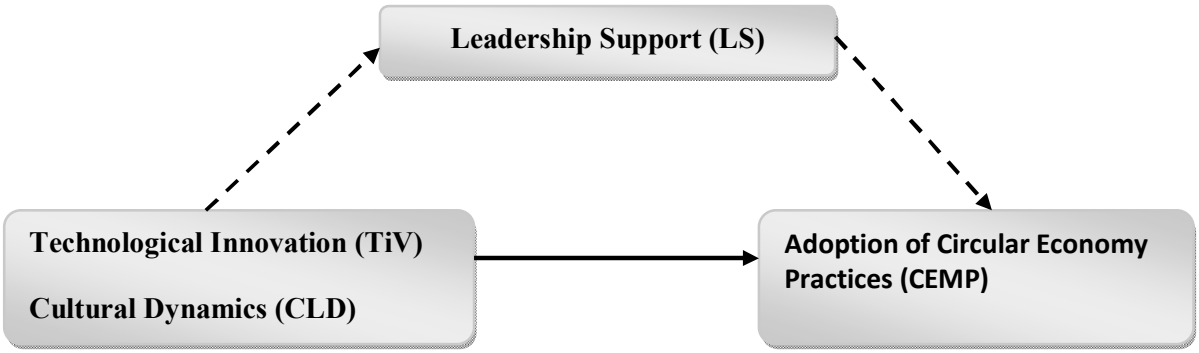
Saudi Arabian SMEs encounter challenges in implementing circular economy (CE) initiatives, such as data utilization barriers, lack of resources, capabilities, and regulatory constraints (Almadhi et al., 2023). Additionally, challenges in the entrepreneurial ecosystem include individual skill shortages, government regulations, societal culture, and economic downturns (Yusuf & Lytras, 2023). Effective leadership can address these hurdles by enhancing educational programs to promote entrepreneurship, streamlining bureaucratic processes for business startups, fostering technological adoption, and coordinating stakeholders for CE integration (Ali et al., 2022; Almuzel & Anderson, 2021). Saudi SMEs can navigate these challenges by leveraging government support, individual empowerment, and educational enhancements to drive successful CE transitions.

3. Research Framework

The research explores the adoption of Circular Economy Practices (CEMP) in Saudi Arabian SMEs, focusing on how Technological Innovation (TiV), Cultural Dynamics (CLD), and Economic Factors (Ecf) directly influence these practices, with Leadership Support (LS) serving as a mediator.

As illustrated in Figure 1, the research framework uses solid arrows to represent the direct influences of Technological Innovation, Cultural Dynamics, and Economic Factors on adopting circular economy practices. Dashed arrows indicate the indirect role of Leadership Support, suggesting its mediating effect on the relationships between the primary factors and the adoption of circular economy practices.

Fig. 1: Research framework. L Legends: Adoption of Circular Economy Practices (CEMP), Cultural Dynamics (CLD), Economic Factors (Ecf), Leadership Support (LS), Technological Innovation (TiV)



Source:Prepared by the researchers.

Based on the research framework and the relationships delineated therein, the following hypotheses are proposed to guide the investigation into the adoption of Circular Economy Practices (CEMP) in Saudi Arabian SMEs:

❖ **Direct Relationships:**

- **H1:** Technological innovation (TiV) positively affects the adoption of circular economy practices (CEMP) within SMEs in KSA.
- **H2:** Cultural dynamics (CLD) positively influence the adoption of circular economy practices (CEMP) within SMEs in KSA.
- **H3:** Economic factors (Ecf) positively affect the adoption of circular economy practices (CEMP) within SMEs in KSA.
- **H4**: Leadership support (LS) positively influences the adoption of circular economy practices (CEMP) by SMEs in KSA.

❖ **Mediated Relationships:**

- **H5:** Leadership support (LS) mediates the relationship between technological innovation (TiV) and the adoption of circular economy practices (CEMP) within SMEs in KSA.

- **H6:** Leadership support (LS) mediates the relationship between cultural dynamics (CLD) and the adoption of circular economy practices (CEMP) within SMEs in KSA.
- **H7:** Leadership support (LS) mediates the relationship between economic factors (Ecf) and the adoption of circular economy practices (CEMP) within SMEs in KSA.

4. Methodology

This study adopted a quantitative research methodology to examine the factors influencing the adoption of circular economy practices among small and medium enterprises (SMEs) in the northern region of Saudi Arabia. Specifically, the research targeted 222 officials from SMEs, utilizing purposive sampling to select participants who possessed relevant experience and insights into circular economy practices .

To analyze the collected data, the study employed both regression and correlation techniques, leveraging the capabilities of SmartPLS (Partial Least Squares Structural Equation Modeling) and covariance-based Structural Equation Modeling (CB-SEM) .

In terms of variable analysis, the study focused on several vital constructs:

- Technological Innovation (TiV) - assessing the impact of new and adaptive technologies in promoting circular economy practices.
- Cultural Dynamics (CLD) - evaluating how organizational culture and broader societal values influence the adoption of circular economy strategies.
- Economic Factors (Ecf) - examining the economic incentives and barriers that affect implementing circular practices.
- Leadership Support (LS) - determining the role of top management support in facilitating circular economy initiatives.
- Adoption of Circular Economy Practices (CEMP) - the primary dependent variable, measuring the extent of circular economy adoption within the organizations.

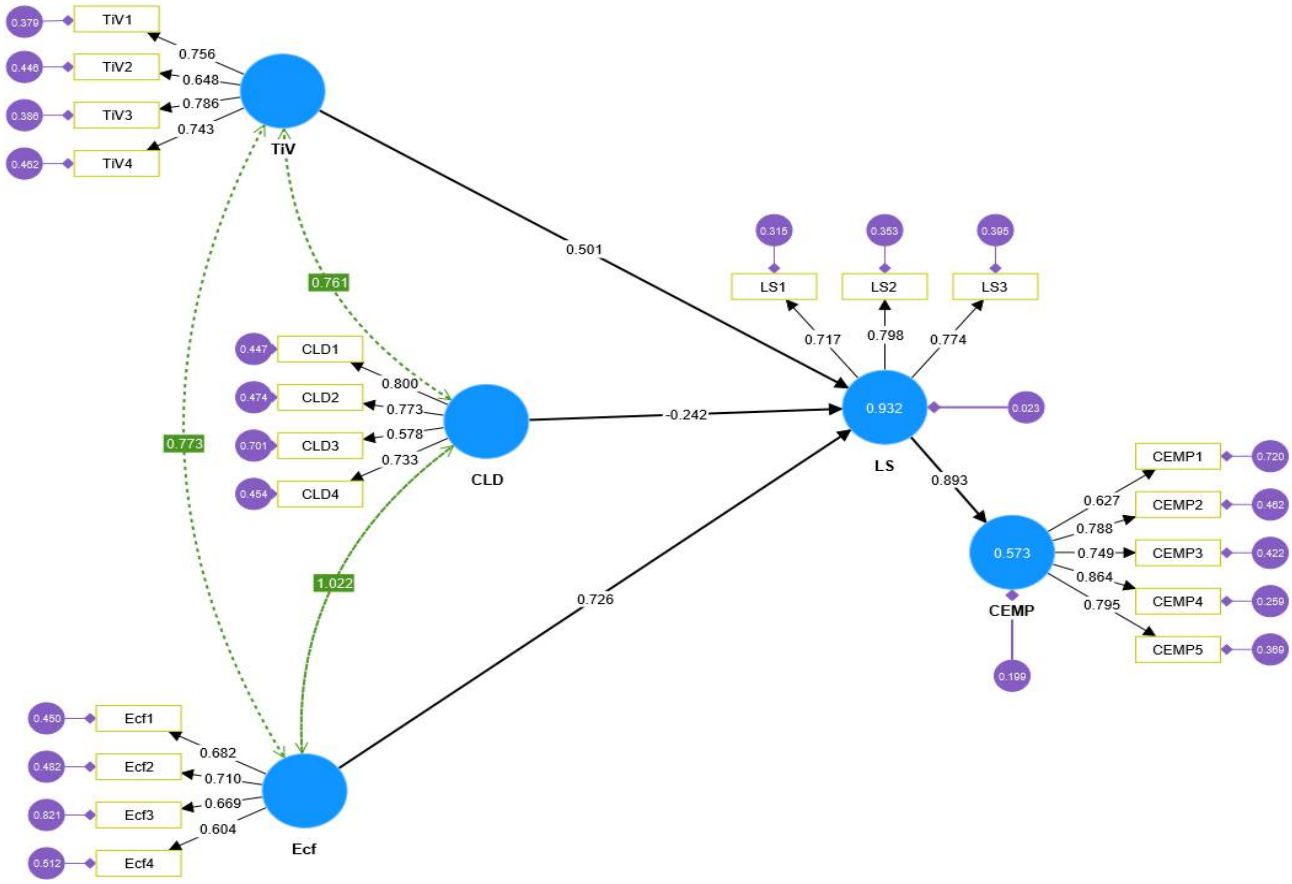
SmartPLS was mainly utilized for its efficacy in path modeling and ability to handle small to medium sample sizes, making it suitable for the study's purposive sample of 222 participants. CB-SEM was employed to confirm the models developed through PLS, providing a robust method for validating and cross-verifying the relationships between constructs.

5. Results

Figure 2 presents the assessment of the measurement model, incorporating validity and reliability tests for the study of the adoption of circular economy practices within Saudi Arabian SMEs. The model visually illustrates the relationships between four primary constructs: Technological Innovation (TiV), Cultural Dynamics (CLD), Economic Factors (Ecf), and Leadership Support (LS), which ultimately influence the Adoption of Circular

Economy Practices (CEMP). Each construct is linked to its respective observed variables with factor loadings displayed beside the arrows, indicating the strength of each variable's contribution to the construct. Leadership Support (LS) is depicted as a central mediator, influencing the adoption of circular economy practices directly and mediating the effects of Cultural Dynamics and Economic Factors on CEMP. The model outlines significant pathways from each construct to CEMP, highlighting the direct and indirect influences that shape the adoption process.

Fig. 2: Assessment of the Measurement Model (Validity and Reliability Test). Legends: Adoption of Circular Economy Practices (CEMP), Cultural Dynamics (CLD), Economic Factors (Ecf), Leadership Support (LS), Technological Innovation (TiV)



Source:Prepared by the researchers.

The reliability and validity of the constructs in the study are demonstrated in Table 2, which summarizes the measurement of the model across various constructs related to the adoption of circular economy practices. Factor loadings for most items surpass the acceptable threshold of 0.6, indicating a strong relationship between them and their corresponding constructs. Notably, all constructs meet the reliability criteria with Cronbach's alpha values well above 0.7, suggesting that the constructs are consistently measured within the survey. Composite Reliability (CR) values also exceed the threshold of 0.7, further validating the reliability of these constructs.

However, the Average Variance Extracted (AVE) values, while generally above the recommended threshold of 0.5, show some variability. The Cultural Dynamics construct has an AVE just above the threshold at 0.527, potentially due to the lower factor loading of item CLD3 (0.578), which is below the recommended 0.6 threshold. Overall, the measurement model in Table 2 presents a solid foundation for analyzing the influences of cultural catalysts, technological tools, and economic factors on adopting circular economy practices in Saudi Arabian SMEs. However, some areas could benefit from further refinement.

Table 2: Summary of the Measurement of the Model

Constructs	Items	Factor Loading (> 0.6)	Cronbach's alpha(> 0.7)	CR (> 0.7)	AVE (> 0.5)
Adoption of Circular Economy Practices (CEMP)	CEMP1	0.627	0.873	0.875	0.591
	CEMP2	0.788			
	CEMP3	0.749			
	CEMP4	0.864			
	CEMP5	0.795			
Cultural Dynamics (CLD)	CLD1	0.800	0.815	0.817	0.527
	CLD2	0.773			
	CLD3	0.578			
	CLD4	0.733			
Economic Factors (Ecf)	Ecf1	0.682	0.765	0.761	0.545
	Ecf2	0.710			
	Ecf3	0.669			
	Ecf4	0.604			
Leadership Support (LS)	LS1	0.717	0.819	0.811	0.584
	LS2	0.798			
	LS3	0.774			
Technological Innovation (TiV)	TiV1	0.756	0.820	0.827	0.540
	TiV2	0.648			
	TiV3	0.786			
	TiV4	0.743			

Source:Prepared by the researchers

Table 3 in the study evaluates discriminant validity using the Heterotrait-Monotrait (HTMT) ratio and the Fornell-Larcker criterion to ensure that the constructs are adequately distinct from one another. This is a crucial component in confirming the measurement model's robustness.

HTMT Ratio Analysis: The threshold for acceptable discriminant validity using HTMT is less than 0.85. The data shows that most construct pairs, such as CEMP and TiV (0.692), CEMP and Ecf (0.731), and LS and Ecf (0.730), have ratios well below this threshold, indicating strong discriminant validity. However, the HTMT ratios for CLD and LS (0.824) and CLD and TiV (0.791) are relatively high, nearing the upper limit. Although these

values still fall below the threshold, indicating valid discriminant validity, they suggest a closer relationship between these constructs, necessitating careful interpretation and further reviewing item definitions or theoretical overlaps.

Fornell-Larcker Criterion Analysis: This criterion confirms discriminant validity when the square root of the Average Variance Extracted (AVE) for each construct (diagonal bold values) exceeds the correlations between that construct and all others. The diagonal entries—0.807 for CEMP, 0.805 for CLD, 0.831 for Ecf, 0.810 for LS, and 0.835 for TiV—surpass all corresponding off-diagonal correlations, affirming discriminant solid validity.

Table 3: Discriminant validity.

Constructs	(HTMT Ratio)**					(Fornell-Larcker criterion) *				
	CEMP	CLD	Ecf	LS	TiV	CEMP	CLD	Ecf	LS	TiV
CEMP						0.807				
CLD	0.841					0.759	0.805			
Ecf	0.731	0.764				0.701	0.679	0.831		
LS	0.809	0.824	0.730			0.734	0.746	0.750	0.810	
TiV	0.692	0.791	0.806	0.813		0.710	0.761	0.773	0.738	0.835

Note:

*Following the Fornell-Larcker criterion, the bold value is accepted when it exceeds its row and column values.

*A HTMT Ratio < 0.85 is considered valid.

Source:Prepared by the researchers.

Table 4 in the study details the R-square values for the constructs Adoption of Circular Economy Practices (CEMP) and Leadership Support (LS), reflecting the proportion of variance each construct explains within the model. The R-square value for CEMP is reported as 0.573, indicating that 57.3% of the variance in adopting circular economy practices can be explained by the variables considered in the study. This high level of explained variance suggests the model robustly captures the key factors influencing the adoption of these practices among SMEs. For Leadership Support, the R-square value is exceptionally high at 0.932, demonstrating that the model accounts for 93.2% of the variance in leadership support. This indicates a very effective model in explaining leadership behaviors and attitudes toward supporting circular economy practices. These findings underscore the effectiveness of the theoretical framework and the model's components in elucidating significant aspects of circular economy adoption and leadership support within SMEs.

Table 4: R-Square Values

Constructs	R-square	Variance Explained
Adoption of Circular Economy Practices (CEMP)	0.573	High
Leadership Support (LS)	0.932	High

Source:Prepared by the researchers

Table 5 evaluates the goodness-of-fit for an estimated model compared to a null model, demonstrating a significant improvement in model performance. The estimated model shows a substantially reduced chi-square value and a more favorable chi-square/degree of freedom ratio than the null model, indicating a better fit. The RMSEA of the estimated model is at the upper limit of acceptability, but other indices like GFI, AGFI, NFI, TLI, and CFI are high, confirming a solid fit. The SRMR is also very low, further supporting the model's adequacy. Although the estimated model has higher AIC and BIC values, indicating greater complexity, this complexity is justified by the improved fit metrics, suggesting that the model effectively captures the dynamics of the observed data.

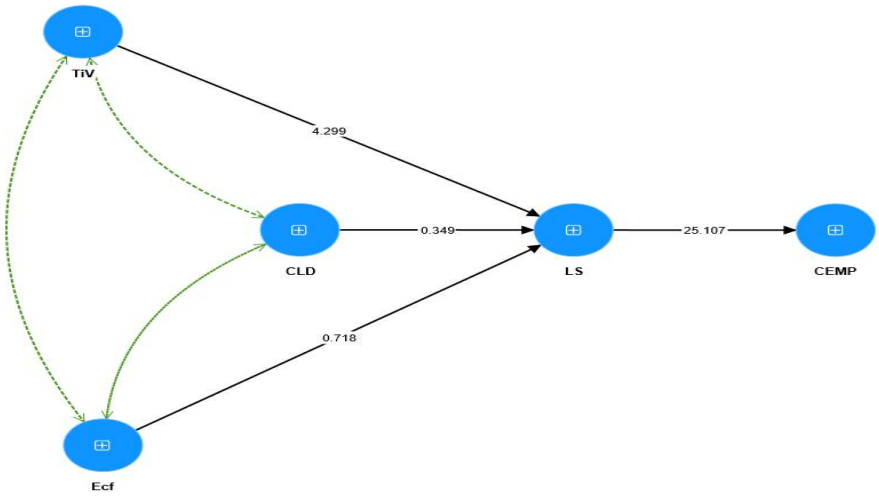
Table 5: Results of GOODNESS-OF-FIT

	Estimated model	Null model
Chi-square	1527.085	5569.377
Number of model parameters	47.000	20.000
Number of observations	383.000	n/a
Degrees of freedom	163.000	190.000
P value	0.000	0.000
ChiSqr/df	9.369	29.313
RMSEA	0.05	0.08
RMSEA LOW 90% CI	0.03	0.05
RMSEA HIGH 90% CI	0.07	0.10
GFI	0.95	n/a
AGFI	0.92	n/a
PGFI	0.50	n/a
SRMR	0.04	n/a
NFI	0.95	n/a
TLI	0.96	n/a
CFI	0.97	n/a
AIC	1151.681	1142.672
BIC	1364.148	1355.252

Source:Prepared by the researchers

Figure 3 illustrates the study's structural model. It employs bootstrapping with 5000 samples to validate the relationships between Sustainable Innovation (SI), Information Technology Capability (ITC), Knowledge Management (KM), and Business Success (BS) in SMEs. This method provides statistical validation for the model's pathways, with standardized beta coefficients and t-values indicating the strength and significance of each relationship.

Fig.3: Structural Model (Bootstrapping @5000)



Source:Prepared by the researchers.

Table 6 summarizes the results of testing direct hypotheses concerning factors influencing the adoption of Circular Economy Practices (CEMP) in Saudi Arabian SMEs. The study reveals mixed results across different influencing factors.

The hypothesis that Technological Innovation (TiV) significantly influences CEMP is strongly supported, evidenced by a standard beta of 0.615 and a statistically significant t-value of 4.299, leading to the acceptance of this hypothesis. Similarly, Leadership Support (LS) is a crucial factor, with a standard beta of 0.757 and an exceptionally high t-value of 25.107, confirming its significant positive impact on CEMP.

Conversely, the hypotheses involving Cultural Dynamics (CLD) and Economic Factors (Ecf) are rejected. For CLD, despite a reasonable beta of 0.372, the t-value of 0.349 does not reach significance, indicating that cultural dynamics do not directly impact CEMP adoption in this context. Economic Factors also do not show a significant direct effect, as indicated by a t-value of 0.718, despite a high beta of 0.784.

These outcomes highlight the importance of technological innovation and leadership support in promoting circular economy practices while suggesting that cultural and economic factors, as measured in this study, may not directly influence such adoption in the sample of Saudi SMEs.

Table 6: Summary of direct Hypotheses testing

	Std beta	Sample mean (M)	t value	P values	Decision
H1: TiV -> CEMP	0.615	0.620	4.299	0.000	accept**
H2: CLD -> CEMP	0.372	0.008	0.349	0.727	reject*
H3: Ecf -> CEMP	0.784	0.402	0.718	0.473	reject*
H4: LS -> CEMP	0.757	0.757	25.107	0.000	accept**
Note(s): *p < 0.05, **p < 0.01					

Source:Prepared by the researchers

Table 7 presents the results of indirect hypothesis testing, analyzing the mediation effect of Leadership Support (LS) on the relationship between various factors and the Adoption of Circular Economy Practices (CEMP) in Saudi Arabian SMEs. The table summarizes the mediation roles across three different relationships.

The first hypothesis tested, H5, examines the indirect effect of Technological Innovation (TiV) on CEMP through Leadership Support. The results indicate a partial mediation with a path coefficient of 0.447 and a t-value of 4.149, confirmed by a significant p-value of 0.000. The bootstrapped confidence interval ranges from 0.412 to 1.056, suggesting that while Leadership Support significantly mediates the relationship, Technological Innovation also directly impacts CEMP.

In the case of Cultural Dynamics (CLD), as detailed in hypothesis H6, the analysis shows a full mediation effect. The path coefficient is 0.216 with a marginal t-value of 0.346 and a p-value of 0.049, with the confidence interval ranging from 0.704 to 1.123. This indicates that the effect of Cultural Dynamics on CEMP is entirely mediated through Leadership Support, emphasizing the role of leadership in aligning cultural dynamics with circular economy adoption.

Similarly, hypothesis H7 suggests a full mediation effect of Economic Factors (Ecf) on CEMP through Leadership Support. The path coefficient of 0.648, along with a t-value of 0.718 and a p-value of 0.043, supported by a confidence interval of 0.070 to 0.236, highlights that Leadership Support fully mediates the influence of Economic Factors on the adoption of circular economy practices.

These findings emphasize the central role of Leadership Support in mediating the impacts of technological, cultural, and economic factors on the adoption of circular economy practices in SMEs. This highlights the importance of effective leadership in facilitating the integration and effectiveness of circular economy strategies within organizations.

Table 7: Summary of indirect Hypotheses testing

Relationship	Indirect Effect			Bootstrapped Confidence Interval		Decision
	Path Coeff	t-Value	Significance level P	2.5%	97.5%	
H5: TiV -> LS -> CEMP	0.447	4.149	0.000	0.412	1.056	Partial mediation
H6: CLD -> LS -> CEMP	0.216	0.346	0.049	0.704	1.123	Full mediation
H7: Ecf -> LS -> CEMP	0.648	0.718	0.043	0.070	0.236	Full mediation
Significant at P** =< 0.01, p*<0.05						

Source:Prepared by the researchers.

6. Discussion

Cultural catalysts in the acceptance of CE practices affirm one significant dimension in society, which is the organizational culture, and the said culture has a significant impact on how businesses operate and are environmentally related. As Noe (2015) argues, the fashion industry depends to a great extent on transitioning towards a more sustainable and resource-efficient approach coupled with circular economy concepts, and the latter should be an integral part of business strategies. Such a change requires a shift in the organizational culture focus and broader social support for sustainability development. This angle is complemented by Deniz et al. (2021), who underlined how cooperation between stakeholders is essential in helping create eco-friendly ideas. Furthermore government, many approaches are mentioned by Sai et al. (2022) and Peter et al. (2020), among them are frameworks for regulation and taxation that govern the introduction of new CE standards. Pilar et al. (2020) focused on the creative integration of cultural heritage into cradle-to-cradle (C2C), which results in the conservation of values and material wastage while creating opportunities for economic growth. It is an all-encompassing cultural factor that is a prerequisite to ease down the whole process, as more support comes from various researchers Castro-Lopez et al. (2023), Sawe et al. (2021), and Hakimi et al. (2022) who advocate for the importance of the alteration in the social values to sustainability.

As for the mainstream development of CE, IT is an unchallenged area reflecting the post-industrial world. 0 tech developments coming along with AI and blockchain improve eco-spheres` performance and corporate efficiency. In food processing, the effect has been authoritatively shown by Neri et al. (2023). Technology's pivotal role in CE practices, favored by the utilization of VSM for circular systems, as shown by Yazan et al. (2022), and the application of decision-support tools implementing AI and IT for industrial symbiosis, as described by Rath et al. (2023), demonstrates that technology is a vital tool for the conservation of the environment. This is where IoT is leveraged to monitor and analyze product life cycles. It can also be applied to material passporting and LCA systems. Prieto-Sandoval et al. (2023) and Mboli et al. (2022) state that such information is essential to CE. The "Circular Clock" model proposed by Diéguez-Santana et al. (2021) is quite a remarkable system as it makes applying such tools for strategic eco-innovation within firms easier.

Economic considerations highlight CE practices as one of the main determinants in people's adoption. Research by Pannila et al. (2022) and Assmann et al. (2023) reveals that the Affordability and economic barriers within the Food Supply Chain are significant impediments to CE. Thus, economic stability should be built into the financial provision for these conditions. Moreover, the thoughts of (Singh et al., 2022) and (Rehman et al., 2022) go on to describe that market conditions and other economic factors like inflation and GDP also have an effect on the flow of circular business models and hence, the organizational strategy should be directed in a manner that complies with CE goals to gain full benefits from the implementation of a circular economy.

The inspiring leadership trait in building up the CE adoption process definitely cannot be underappreciated. Difficulties associated with space limitations, regulatory breaks, and cultural restrictions, which were mentioned by Almadi et al. (2023) and Yusuf & Lytra (2023), should, in return, be well-coped with leadership skills. The strategies of leadership that result from the works of Ali et al. (2022) and Almuzel & Anderson (2021), such as improvement of educational systems, optimizing the bureaucracy, and adoption of technology, are the ones that are paramount to the overcoming of the abovementioned challenges and the integration of CE in the economy.

This summary portrays the essential insights from previous studies that show the difficulties that arise during implementing CE practices and which are beyond the reach of technical or economic solutions. Instead, the cultural and strategic aspects are seen in the whole enterprise and the systemic change requirements. The inclusiveness of different perspectives makes it possible to identify the factors that affect the adoption of CE and the method of implementing these changes, providing a practical framework for addressing sustainability challenges in SMEs of Saudi Arabia.

7. Conclusion

This study demonstrates the intricate and integrating patterns of normative factors, technology, and economy that influence SMEs' adoption of circular economy principles in Saudi Arabia. The research documentation indicates that while every aspect of these factors of CE independently influences CE adoption, integrating these through effective leadership is an essential component of a successful transition. Technological developments provide an indispensable means for efficiency, sustainability, and Affordability, while cultural dynamics remain a critical factor in shaping organizational receptiveness and societal acceptance of new practices. Economic challenges tend to determine whether the practices are feasible and scalable.

The leadership's role is to be decisive, guide and motivate all the main questions for CE, and moderate the effect of the different external and internal matters that affect acceptance. The overall commitment to the Saudi 2030 goal put sustainability at the forefront of reform and development.

❖ **Recommendations**

- ✓ Strengthen Leadership Capacities: Upgrade the existing skill training program for SME owners to develop the ability to think strategically and strategically in sustainability and engagement of stakeholders. The primary set of goals of leadership development aims to build an innovative, sustainable, and long-term vision-oriented environment.
- ✓ Promote Technological Integration: Promote the widespread use of industry 4. 0. 0. technology by partnering with organizations, consultancies, and specialists and providing financial assistance. Create

collaboration scenarios between technological providers and SMEs to accelerate knowledge transfer and supply tailored solutions to solving the respective industrial issues.

- ✓ Cultural Adaptation and Awareness: Launch awareness campaigns that are comprehensive in order for the cultural behavior of both the social and organizational setting to be geared towards sustainability. These, for example, could be some special events (like educational programs, workshops, and public engagements) in which the advantages of CE performances and the matters of individuals' and organizations' participation will be highlighted as a part of sustainability.
- ✓ Economic Incentives and Support: Draft a structure of incentives, including tax reductions, grants, subsidies, etc., that can reduce the financial obstacles associated with the shift toward circular economy practices for industries and end users. Moreover, it brings economic eyes into the perspective of the SME through tools that help them gauge the long-term advantages and potential savings in the future after the adoption of CE.
- ✓ Regulatory Framework and Policy Making: Emphasize regulations to develop circular initiatives. This may include setting up more stringent regulations on waste disposal, establishing compulsory recycling laws, and setting standards for green production. Policies can help create opportunities for green loans and vendors that offer circular business functions.
- ✓ Facilitate Stakeholder Collaboration: Encourage coordinated work between government agencies, school institutions, the private sector, and the community to achieve a unified purpose of applying the Circular Economy principle. Such dialogue might represent a distinct process for the government to establish platforms to synchronize collaboration and cooperation.
- ✓ Continuous Research and Development: Build research funds that allow periodic comparative studies of the cultural, technological, and economic influences of CE users. This will help provide a picture of the unfolding new barriers and openings to adaptation in real-time so as to achieve sustainability.

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