

CIRCULAR ECONOMY: TOWARDS ENVIRONMENTAL SUSTAINABILITY UNDER THE INFLUENCE OF DIGITAL LEARNING ORIENTATION IN VIET NAM

Pham Thi Huynh Nhu^{*}, Le Thi Truc Mai

Tien Giang University

**Email: phamthihuynhnhu@tgu.edu.vn*

Received: 7 April 2026; Revised: 15 May 2026; Accepted: 22 May 2026

ABSTRACT

In response to growing sustainability pressures, firms in emerging economies such as Viet Nam are increasingly required to move away from conventional linear economic approaches toward circular economy (CE) paradigms. However, the mechanisms through which internal organizational capabilities support CE adoption and environmental performance remain insufficiently understood. Grounded in the resource-based view and associated capability theories, the current research develops and tests a conceptual framework linking digital learning orientation (DLO), digital transformation (DT), CE, and environmental performance (ENP). Specifically, the paper investigates how DLO directly impacts CE, how CE subsequently affects ENP, and how DT moderates the DLO-CE linkage. A quantitative methodology was employed, utilizing data gathered via surveys from Vietnamese enterprises and analyzes the hypothesized framework via partial least squares structural equation modeling (PLS-SEM). The empirical results reveal that DLO exerts a substantial positive influence on CE, DT similarly fosters CE adoption, and CE significantly improves ENP. In addition, DT amplifies the positive association between DLO and CE, suggesting that digital technologies strengthen the capacity of learning-driven firms to succeed in implementing circular practices. These results provide a comprehensive understanding of the synergistic effects of organizational learning and digital competencies on achieving sustainable goals. Furthermore, this work enriches the existing body of knowledge regarding digital transformation, circular economy paradigms, and ecological performance, while also offering practical implications for managers and policymakers in emerging-market contexts.

Keywords: Digital learning orientation, digital transformation, circular economy, environmental performance, Vietnamese enterprises.

1. INTRODUCTION

In the current context, environmental degradation, resource depletion, and climate change have become urgent global challenges, requiring a fundamental transformation of prevailing economic development models [1], [2]. The traditional linear economy, characterized by a take-make-dispose logic, has revealed significant limitations by intensifying pressure on natural ecosystems and undermining long-term sustainability [3]. In response, the circular economy (CE) has emerged as a promising alternative model that emphasizes resource efficiency, waste minimization, product life extension, and regenerative value creation [4]. Rather than treating waste as an unavoidable by-product, CE promotes the continual circulation of materials and the more effective use of natural resources. For developing countries such as Viet Nam, the transition to CE is particularly important because it offers not only a response to environmental problems associated with rapid industrialization, but also an

opportunity to enhance technological capability, strengthen competitiveness, and support sustainable growth.

This study adopts the resource-based view (RBV) as the primary theoretical foundation to explain why some firms are more capable of implementing CE practices successfully. According to RBV, organizations can achieve superior performance when they possess and effectively deploy valuable and difficult-to-imitate internal capabilities [5], [6]. In sustainability-related contexts, this perspective is especially relevant because environmental strategies increasingly depend on firm-specific knowledge, organizational routines, and technological competencies that competitors cannot easily replicate [7]. From this viewpoint, CE adoption is not merely a compliance response to external pressure; it can also be understood as an outcome of how firms mobilize and combine strategic internal capabilities to redesign processes, optimize resource use, and generate environmental value.

Within this theoretical lens, digital learning orientation (DLO) can be viewed as a strategic intangible capability. It reflects an organization's commitment to continuously acquiring, sharing, and applying knowledge through digitally enabled learning processes in order to improve operations and stimulate innovation [8]. Firms with stronger DLO are expected to adapt more effectively to environmental challenges and identify opportunities associated with circular practices. At the same time, digital transformation (DT) can strengthen organizational capability by improving information processing, integrate data, improve traceability, and support more intelligent resource management [9]. Technologies such as the Internet of Things, Big Data, and Artificial Intelligence can facilitate circular practices by improving material flow visibility, enhancing resource efficiency, and enabling more transparent and responsive supply chains [10].

Although prior studies have identified various drivers of CE adoption, important gaps remain. Existing research has often examined organizational learning, digital transformation, or sustainability practices separately, with limited attention to how knowledge-based and technology-based capabilities interact in shaping CE adoption [11]. In addition, the mechanisms through which these capabilities convert into environmental performance remain insufficiently clarified. This limitation is particularly salient in developing economies such as Viet Nam, where both CE and DT are still evolving and where firms face unique institutional and capability constraints. Accordingly, this study differs from previous work by proposing an integrated RBV-based framework in which DLO serves as an internal knowledge-based capability, DT acts as a complementary technological capability, CE adoption functions as the mediating mechanism, and environmental performance is the resulting organizational outcome.

Therefore, this study seeks to investigate the direct impact of DLO on CE adoption, assess the mediating effect of CE adoption in the relationship between DLO and environmental performance (ENP), and examine the moderating role of DT in the relationship between DLO and CE adoption. By doing so, the study makes two primary contributions to the literature. First, it advances CE research by explaining adoption through the joint deployment of internal organizational and technological capabilities. Second, it strengthens the application of RBV in the sustainability context by showing how capability configuration can support CE implementation and environmental performance in an emerging market setting such as Viet Nam.

The remainder of this paper is structured as follows: Section II reviews the relevant literature and develops the research hypotheses. Section III outlines the research methodology, including sampling and measurement. Section IV presents the empirical findings and discussion. Finally, Section V concludes with theoretical and managerial implications, limitations, and future research directions.

2. LITERATURE REVIEW

The resource-based view (RBV) offers a solid theoretical basis for this study by explaining how firms attain superior outcomes through the possession and deployment of valuable, unique, difficult-to-imitate, and irreplaceable resources [5], [6]. Extending this logic, the natural-resource-based perspective additionally posits that competencies related to environmental management, sustainability, and organizational adaptation can become important sources of long-term advantage [7]. In turbulent environments, this perspective is complemented by the dynamic capabilities framework, which highlights an organization's capacity to synthesize, develop, and realign both internal and external competences in response to shifting conditions [12]. Drawing on these perspectives, this study argues that digital learning orientation (DLO) and digital transformation (DT) represent strategic organizational capabilities that can facilitate circular economy (CE) adoption and, ultimately, improve environmental performance (ENP).

DLO represents an organization's dedication and proficiency in consistently generating, disseminating, and utilizing insights to support innovation and improvement [8]. In this sense, DLO is more than a passive knowledge resource; it functions as a strategic organizational competency empowering companies to sense opportunities, support learning-based adaptation, and foster continuous renewal [8], [12]. This capability is especially important in the transition toward CE, which requires firms to move beyond linear production models and redesign products, processes, and resource flows in ways that minimize waste and extend material use [2], [4]. Because CE implementation involves experimentation, cross-functional learning, and openness to change, companies exhibiting robust DLO are better positioned to develop the cultural and knowledge foundations needed to adopt CE successfully. In light of these arguments, the following hypothesis is formulated:

H1: DLO positively impacts CE adoption.

CE refers to a restorative and regenerative system in which resource input, waste, emissions, and energy leakage are minimized through practices such as reuse, recycling, remanufacturing, and more efficient resource utilization [4]. These practices are increasingly recognized as important pathways toward sustainable production and consumption, particularly in response to climate change, resource depletion, and mounting environmental pressures [1], [2]. From an organizational perspective, CE adoption can improve environmental outcomes by reducing waste generation, lowering pollution, increasing resource efficiency, and supporting more sustainable operating systems [3], [4]. Accordingly, firms that adopt CE practices more extensively are expected to achieve better ENP. Drawing on the aforementioned literature, we propose:

H2: CE has a positive effect on ENP.

RBV also suggests that internal capabilities do not automatically translate into higher performance unless they are deployed through appropriate organizational mechanisms [5], [6]. In this study, DLO is viewed as an important intangible capability that allows firms to acquire and mobilize knowledge for innovation and adaptation [8]. However, the environmental value of this capability is unlikely to be realized directly unless it is converted into concrete sustainability-oriented practices. CE provides such a mechanism. Firms with strong DLO are more likely to identify circular opportunities, support process innovation, and implement practices that reduce waste and improve resource efficiency. Through these practices, the knowledge and learning embedded in DLO can be translated into measurable environmental outcomes [3], [4]. Therefore, CE is expected to act as a strategic bridge through which DLO enhances ENP. Based on the above rationale, the following hypotheses are derived:

H3: CE functions as a mediator between DLO and ENP.

DT refers to the deep integration of digital technologies into organizational processes, structures, and decision-making systems [9]. Beyond its direct value, DT can also strengthen the effectiveness of other organizational capabilities. In the context of CE, digital technologies enable firms to track material flows, monitor resource consumption, improve data visibility, and support more informed environmental decision-making [9], [11]. Prior research also suggests that digitally enabled learning and analytics capabilities can reinforce environmental initiatives and improve performance outcomes [10]. In this study, DT is therefore conceptualized as a complementary capability that amplifies the positive effect of DLO on CE adoption. When firms possess both a strong learning orientation and advanced digital capabilities, they are better positioned to convert knowledge into circular practices. By contrast, firms with strong DLO but limited digital infrastructure may face difficulties in implementing CE effectively, while firms with digital tools but weak learning orientation may fail to use technology strategically for sustainability goals. Based on the above rationale, this study formulates the following hypotheses:

H4: DT strengthens the association between DLO and CE.

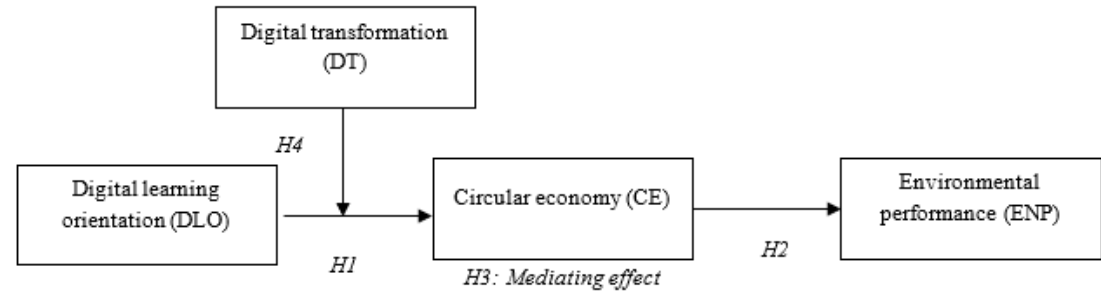


Figure 1. Hypothesized research model

Source: Authors' proposal based on theoretical framework

The rest of this study proceeds as follows. The ensuing section details the research design, covering the conceptual model, hypothesis generation, construct measurements, sampling procedures, and statistical methods. Subsequently, the paper presents the empirical outcomes from the statistical software, illustrating the assessments of both the measurement and structural models. The discussion section then evaluates the results against existing theories and prior studies. Ultimately, the study outlines its core academic advancements and managerial insights, while also addressing inherent limitations and proposing trajectories for subsequent research.

3. RESEARCH METHODS

To investigate the interrelationships among digital learning orientation (DLO), digital transformation (DT), circular economy (CE), and environmental performance (ENP), this research utilized a cross-sectional quantitative methodology. The empirical context of the study is Viet Nam, an emerging economy in which firms are increasingly under pressure to pursue digital transformation and environmental sustainability simultaneously [13]. Manufacturing firms were selected as the research setting because they are highly resource-intensive, consume substantial amounts of raw materials and energy, and generate considerable waste and emissions, making them especially suitable for examining CE adoption and environmental performance [14]-[19].

The target respondents were middle- and senior-level managers, including department heads, directors, and deputy directors, working in manufacturing enterprises in Viet Nam.

These respondents were selected as key informants because they are expected to possess comprehensive knowledge of their firms' strategic orientations, operational processes, digital initiatives, and environmental practices, and can therefore provide reliable assessments of firm-level activities and performance [13], [16]. The sample was selected using a purposive convenience sampling approach, focusing on respondents with sufficient managerial responsibility and familiarity with organizational practices relevant to the study.

The questionnaire was developed by adapting measurement scales from established prior studies to ensure content validity and reliability. All items were measured using a five-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"). Prior to the formal survey, the instrument was pretested with a panel of five experts, including three academic researchers and two production managers, to assess the appropriateness of the terminology, the clarity of the items, and their suitability for the Vietnamese business context. Based on their feedback, minor revisions were made to improve wording clarity and contextual relevance.

Regarding the measurement of the study constructs, DLO was assessed using four items adapted from prior research on digital learning orientation and organizational learning culture [20]. DT was measured using three items adapted from earlier studies on digitalization and sustainability-oriented transformation [13], [21]. CE was modeled as a higher-order construct comprising three lower-order dimensions: green design, green manufacturing, and recycling and remanufacturing, based on prior CE literature [14]-[17], [21]. ENP was measured using seven items adapted from prior studies on eco-environmental and firm-level environmental performance [13], [22].

Data was collected using both online and face-to-face survey methods. A total of 200 questionnaires were distributed. After excluding invalid responses due to missing information or inconsistent answering patterns, 141 valid questionnaires were retained for the final analysis. This sample size is considered adequate for partial least squares structural equation modeling (PLS-SEM), particularly for prediction-oriented models with relatively complex relationships [23].

Both proactive procedural measures and post-hoc statistical evaluations were utilized to address potential common method bias (CMB) [24], [25]. In terms of procedure, guaranteeing the privacy of respondents served to lessen social desirability bias and respondent anxiety. Furthermore, the survey instruments underwent a pilot phase for refinement, ensuring precise wording and eliminating potential ambiguities for better comprehension [24], [25]. Upon completion of data collection, Harman's single-factor test was applied as a statistical check. The findings indicated that a single underlying factor explained only 38.13% of the variance, remaining safely beneath the 50% threshold and confirming the absence of pervasive CMB within the study [24], [25].

The collected data was analyzed using PLS-SEM with SmartPLS 3. This approach was chosen because it is suitable for prediction-oriented research, performs well with relatively small to medium sample sizes, and is appropriate for models involving higher-order constructs such as CE [23], [26]. The analysis followed two stages. First, the measurement model was assessed in terms of reliability and validity. Second, the structural model was evaluated to test the proposed hypotheses. The bootstrapping procedure with 5,000 resamples was used to determine the statistical significance of the path coefficients [23]. Because CE was conceptualized as a higher-order construct, its estimation and validation followed the hierarchical component modeling approach recommended in prior PLS-SEM research [26].

4. RESULTS AND DISCUSSION

4.1. Results

To ensure the robustness of the measurement model, a comprehensive evaluation was performed based on indicator reliability, internal consistency, convergent validity, and multicollinearity. As presented in Table 1, all outer loadings surpass the recommended 0.708 threshold, thereby validating indicator reliability. The internal consistency of the scales is well-established, with Cronbach's alpha values (0.812–0.902) and composite reliability scores (0.874–0.922) consistently exceeding the 0.70 benchmark. Furthermore, the model satisfies the requirements for convergent validity, as average variance extracted (AVE) scores range between 0.509 and 0.742, comfortably above the 0.50 cutoff [27], [28]. Indicator-level VIF values ranged from 1.648 to 3.316. Using the commonly accepted threshold of 5.0, these results indicate that the indicators do not suffer from problematic collinearity [28], [29].

Table 1. Construct Reliability and Validity

	Cronbach's alpha (CA)	CR	AVE	Factor loading	VIF
Digital Learning Orientation	0.812	0.874	0.635		
DLO - 1				0.769	1.651
DLO - 2				0.862	1.793
DLO - 3				0.778	1.852
DLO - 4				0.776	1.648
Digital Transformation	0.827	0.896	0.742		
DT - 1				0.858	2.029
DT - 2				0.865	2.087
DT - 3				0.861	1.681
Circular Economy	0.878	0.903	0.509		
- <i>Green Design</i>					
GD - 1				0.886	2.199
GD - 2				0.888	2.051
GD - 3				0.860	2.657
- <i>Green Manufacturing</i>					
GM - 1				0.863	1.873
GM - 2				0.819	2.034
GM - 3				0.891	2.564
- <i>Recycling & Remanufacturing</i>					
RR - 1				0.903	2.923
RR - 2				0.865	1.982
RR - 3				0.868	2.041
Environmental Performance	0.902	0.922	0.630		
ENP - 1				0.786	3.316
ENP - 2				0.827	2.493
ENP - 3				0.758	2.092

ENP - 4				0.815	2.801
ENP - 5				0.807	3.212
ENP - 6				0.737	2.729
ENP - 7				0.820	3.108

Note: All outer loadings are significant at $p < 0.001$. Values in brackets for CE dimensions represent the second-order path coefficients.

Source: Authors' calculations based on primary survey data using SmartPLS 3

Regarding the evaluation of the higher-order construct, CE was specified and assessed as a reflective-reflective model following the two-stage approach recommended by Hair et al. [23], [28]. As illustrated in Figure 2, all three lower-order dimensions—Green Design ($\beta = 0.844$, $p < 0.001$), Green Manufacturing ($\beta = 0.770$, $p < 0.001$), Recycling and Remanufacturing ($\beta = 0.840$, $p < 0.001$)—exhibit strong, statistically significant path coefficients onto the second-order CE construct. These results confirm that the three sub-dimensions adequately reflect the overarching construct of CE.

As demonstrated in Table 2, the square root of the AVE for each construct (bolded on the diagonal) exceeds its correlations with all other latent variables, satisfying the Fornell-Larcker criterion for discriminant validity. Furthermore, the Heterotrait-Monotrait (HTMT) ratios for all construct pairs remain below the conservative 0.85 threshold, providing strong evidence of distinctiveness among the constructs. Bootstrapping results with 5,000 resamples further reveal that the 95% confidence intervals for the HTMT ratios do not include 1, confirming the discriminant validity of the measurement model.

Table 2. Discriminant Validity Assessment (Fornell-Larcker Criterion and HTMT Ratios)

Variable	CE	DLO	DT	ENP
CE	0.714			
DLO	0.643	0.797		
DT	0.472	0.211	0.861	
ENP	0.655	0.734	0.251	0.794
Heterotrait-Monotrait Ratio of correlation (HTMT)				
CE				
DLO	0.713			
DT	0.556	0.218		
ENP	0.723	0.817	0.279	

Notes: Bold values on the diagonal represent the square root of AVE. Off-diagonal values in the upper section represent construct correlations (Fornell-Larcker criterion). Values in the lower section represent Heterotrait-Monotrait ratios (HTMT).

Source: Primary survey data analyzed via SmartPLS 3.

Regarding the structural model, the analysis results in Table 3 and Figure 2 demonstrate satisfactory explanatory power and predictive relevance. Specifically, DLO, DT, and their interaction account for 56.4% of the variance in CE ($R^2 = 0.564$), while CE explains 54.6% of the variance in ENP ($R^2 = 0.546$). Additionally, the Q^2 values for CE (0.279) and ENP (0.339) were both above zero, indicating predictive relevance for the endogenous constructs [23].

Table 3. Structural model results and hypothesis testing

Part A					
Variable				R ²	Q ²
CE				0.564	0.279
ENP				0.546	0.339
Part B					
Hypothesis	β	Mean	STDEV	t	Speculation
DLO → CE	0.611 ^a	0.614	0.054	11.395	Supported
CE → ENP	0.502 ^a	0.507	0.074	6.758	Supported
DT → CE	0.328 ^a	0.326	0.064	5.152	Supported
DLO*DT → CE	0.180 ^a	0.182	0.050	3.637	Supported
Part C					
Model	Coefficient	Bootstrap			
		LL CI	UL CI		
DLO → CE	0.611 ^a	0.500		0.708	
DT → CE	0.328 ^a	0.206		0.452	
CE → ENP	0.502 ^a	0.350		0.639	
(*)DLO*DT → CE	0.180 ^a	0.088		0.283	
^a Significant at the 1% level (p < 0.01, two-tailed)					

Source: Authors' calculations based on primary survey data using SmartPLS 3

The hypothesis testing results show that all structural relationships are statistically significant at the 1% level ($p < 0.01$), with DLO exerting the strongest direct effect on CE adoption ($\beta = 0.611$, $t = 11.395$), supporting H1. This finding suggests that learning-oriented organizational capabilities play a fundamental role in promoting CE practices, consistent with prior studies emphasizing the role of organizational capabilities in CE implementation and sustainability innovation [30], [31].

In addition, DT directly and positively impacts CE adoption ($\beta = 0.328$, $t = 5.152$, $p < 0.01$). Furthermore, the positive and statistically significant interaction between DLO and DT ($\beta = 0.180$, $t = 3.637$, $p < 0.01$) supports H4. Simple slope analysis confirms that the positive effect of DLO on CE adoption becomes distinctly pronounced under high levels of digital transformation. From a managerial perspective, this implies that digital transformation acts as a key catalyst, enabling firms to convert learning capabilities into actionable circular practices more effectively [30], [31].

Regarding H2, CE adoption has a highly significant positive impact on ENP ($\beta = 0.502$, $t = 6.758$, $p < 0.01$), confirming that circular practices directly contribute to superior ecological performance [32]. Crucially, bootstrapping results with 5,000 resamples reveal a statistically significant indirect effect of DLO on ENP through CE adoption ($\beta_{\text{indirect}} = 0.307$, $t = 5.721$, $p < 0.01$; 95% CI [0.208, 0.412]). As the 95% bias-corrected confidence interval excludes zero, H3 is fully supported, confirming that CE adoption acts as a vital structural bridge (mediator) through which learning orientation improves environmental outcomes [30], [32].

Finally, the stability of all parameter estimates is further substantiated by the 95% confidence intervals, which strictly exclude zero across all structural paths [28].

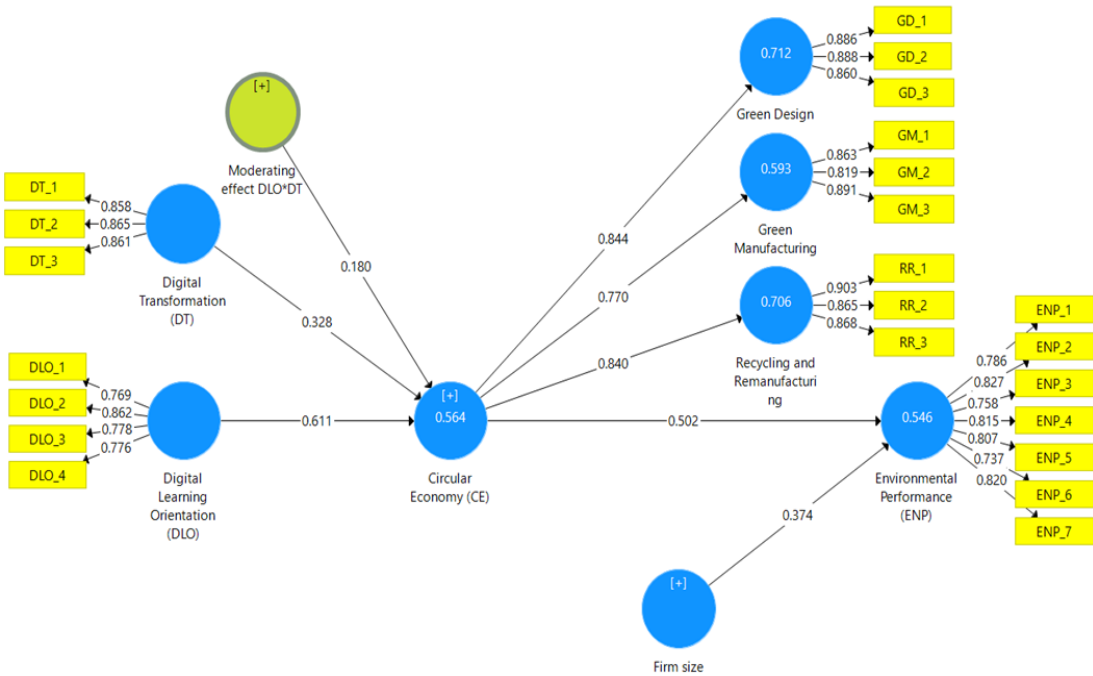


Figure 2. Summary of PLS-SEM Results.

Source: Authors' calculations based on primary survey data using SmartPLS 3

4.2. Discussion

This research contributes empirical insights into the catalysts of circular economy (CE) and environmental performance (ENP) within the Vietnamese corporate landscape. By synthesizing the resource-based view (RBV), the natural-resource-based view (NRBV), and dynamic capabilities theory, the study offers a robust theoretical framework for understanding these relationships. As shown in Figure 2, Digital Learning Orientation (DLO) has the strongest direct effect on CE ($\beta = 0.611$), followed by Digital Transformation (DT) ($\beta = 0.328$), while CE in turn exerts a positive influence on ENP. Figure 2 therefore illustrates a coherent structural pattern in which organizational learning capability serves as the primary internal driver, digital transformation functions as an enabling mechanism, and CE acts as the direct pathway through which these capabilities are translated into superior environmental outcomes.

The strong effect of DLO on CE confirms that a learning-oriented organizational culture is a foundational capability for green transformation. From an RBV perspective, DLO can be understood as a valuable intangible resource that supports knowledge acquisition, knowledge sharing, and the continuous reconfiguration of organizational routines [10]. This finding can be interpreted more deeply through the lens of dynamic capabilities theory, which suggests that firms do not gain advantage merely from possessing resources, but from their ability to integrate, renew, and deploy them effectively in changing environments [12]. In this sense, DLO helps firms sense new sustainability opportunities, absorb knowledge on circular practices, and adapt internal processes to support CE implementation. This is especially relevant in the Vietnamese context, where firms often face resource constraints and therefore rely heavily on organizational learning to support strategic change [33].

More specifically, the contribution of DLO to CE should be understood through its implications for core circular practices such as green design, green manufacturing, recycling, and remanufacturing. A strong learning orientation can encourage firms to redesign products for durability, disassembly, and reuse, which is central to green design. It also supports green

manufacturing by promoting process innovation, resource efficiency, and waste minimization during production. In addition, firms with higher learning capability are more likely to develop routines for recycling materials and recovering value from used components through remanufacturing. These practices are not isolated technical activities; rather, they reflect the organization's capacity to absorb environmental knowledge and convert it into operational improvements. This interpretation is consistent with prior studies showing that CE practices improve sustainability performance through systematic redesign, material recovery, and closed-loop production thinking [14], [32], [34].

The positive relationship between CE and ENP suggests that CE practices are not merely symbolic sustainability activities, but mechanisms that generate measurable environmental improvements. These findings are highly consistent with the tenets of the NRBV, which posits that organizational competencies in pollution mitigation, product stewardship, and sustainable practices serve as strategic pillars for competitive advantage [7]. In this study, CE can be viewed as the operational expression of this logic. Through green design, firms reduce material intensity at the product development stage; through green manufacturing, they lower energy use, emissions, and waste generation; through recycling, they reduce dependence on virgin resources; and through remanufacturing, they extend product life cycles and preserve embedded material value. These pathways explain why CE contributes positively to ENP and why firms that invest in circular practices can achieve both ecological and strategic gains [16], [30], [35].

The mediating role of CE also deserves stronger theoretical emphasis. The findings suggest that DLO alone is not sufficient to improve environmental performance unless it is translated into concrete circular actions. In other words, DLO represents an important organizational resource, but CE is the mechanism that converts this resource into environmental value. This extends RBV by showing that intangible resources must be operationalized through context-specific capabilities before they can produce sustainable outcomes [10]. It also complements dynamic capabilities theory, because CE reflects the firm's ability to reconfigure products, processes, and resource flows in response to sustainability pressures [12], [30]. Thus, the pathway from DLO to ENP through CE highlights that competitive advantage in the sustainability domain depends not only on what the firm knows, but also on how effectively it embeds that knowledge into green design, green manufacturing, recycling, and remanufacturing routines.

Furthermore, the empirical findings highlight the moderating influence of DT on the link between DLO and CE. This suggests a synergistic effect where digital technologies act as a catalyst, amplifying the benefits of organizational learning. Consequently, firms with a robust learning orientation can more effectively leverage digital assets to expedite their circular economy transitions. Viewed through the lens of dynamic capabilities, DT bolsters an organization's proficiency in sensing, seizing, and reconfiguring resources to capitalize on circular opportunities [12]. Technologies such as IoT, big data, and AI can support green design through improved product lifecycle data, enhance green manufacturing through real-time resource optimization, strengthen recycling through better material tracking, and improve remanufacturing through predictive diagnostics and reverse logistics coordination [31], [35]. Therefore, DT should not be viewed merely as a technological investment, but as a capability-enhancing mechanism that helps firms transform learning into actionable circular practices. This finding is also consistent with prior studies emphasizing that digital transformation and digital knowledge capabilities are important enablers of sustainability innovation and environmental improvement [31], [36].

Overall, the results shown in Figure 2 support a theoretically integrated explanation of environmental improvement in firms. DLO provides the knowledge-based foundation, DT enhances the firm's ability to deploy that knowledge, CE functions as the practical

implementation route, and ENP represents the ultimate outcome. This framework is particularly meaningful in Viet Nam, where enterprises are under increasing pressure to pursue both digital transformation and sustainable development simultaneously. The findings therefore suggest that firms will be more environmentally successful when they do not treat learning, digitalization, and circularity as separate initiatives, but as mutually reinforcing components of a broader strategic transformation [7], [12], [31], [36].

5. CONCLUSION

This study was conducted to clarify the relationships among digital learning orientation (DLO), digital transformation (DT), circular economy (CE), and environmental performance (ENP) in the context of Vietnamese enterprises. The empirical results support the proposed hypotheses and provide a more integrated understanding of the drivers of sustainability in contemporary business settings. In particular, the findings show that DLO is a key organizational capability that strongly promotes CE adoption, while DT not only directly supports CE but also strengthens the effect of DLO on CE. In turn, CE positively influences ENP, confirming its role as an important mechanism through which firms translate internal capabilities into environmental outcomes.

The study also offers important theoretical implications. It extends the resource-based view by showing that DLO and DT should not be seen merely as isolated resources, but as complementary capabilities that help firms build environmental advantage. At the same time, the findings are consistent with the logic of the natural-resource-based view and dynamic capabilities theory, as they suggest that firms can improve environmental performance by integrating learning orientation, digital capabilities, and circular practices such as green design, green manufacturing, recycling, and remanufacturing. In this regard, the study provides a more comprehensive explanation of how organizational learning and digital transformation interact to support sustainability-oriented strategic change.

Regarding managerial implications, the results underscore that organizational learning, digital transformation, and circular economy strategies should not be managed in silos. Rather, a holistic integration of these pillars is essential to bolster environmental performance and secure long-lasting sustainability. Leaders are encouraged to look beyond mere investment in digital tools; they must simultaneously cultivate organizational learning cultures, prioritize talent development, and establish robust knowledge-sharing systems that streamline the execution of circular initiatives. For policymakers, the results imply that support programs should go beyond digital infrastructure investment and also promote training, innovation capability, and circular economy awareness among enterprises.

Despite its contributions, this research has certain limitations. Primarily, the empirical scope is limited to the Vietnamese manufacturing sector, which may restrict the results' applicability to other industries or geographic regions. Furthermore, while the resource-based view (RBV) serves as the primary theoretical foundation, alternative scholarly perspectives could add depth to the relationships examined. Consequently, future inquiries should consider broadening the sample to include varied sectors and international contexts to enhance the findings' external validity. Future studies may also extend the research model by incorporating other relevant factors, such as organizational pressure, leadership style, or supply chain structure. In addition, further research could draw more explicitly on complementary theories to provide a deeper theoretical explanation for the relationships in the model. Finally, while this study focuses primarily on organizational capabilities (DLO and DT) and circular practices, future research could incorporate the Environmental Management Accounting (EMA) perspective as an operational and measurement framework to better quantify how internal accounting systems track and facilitate sustainability-oriented initiatives.

REFERENCES

- [1] R. Swart, J. Robinson, and S. Cohen, "Climate change and sustainable development: expanding the options," *Climate Policy*, vol. 3, no. 1, pp. 19–40, 2003, doi: <https://doi.org/10.1016/j.clipol.2003.10.010>
- [2] S. N. Sharma, K. Dehalwar, and J. Singh, "Emerging techniques of solid waste management for sustainable and safe living environment," in *Solid Waste Management: Advances and Trends to Tackle the SDGs*, Springer, 2024, pp. 29–51, doi: https://doi.org/10.1007/978-3-031-60684-7_3
- [3] S. U. Rehman, S. Bresciani, D. Yahiaoui, and E. Giacosa, "Environmental sustainability orientation and corporate social responsibility influence on environmental performance of small and medium enterprises: The mediating effect of green capability," *Corporate Social Responsibility and Environmental Management*, vol. 29, no. 6, pp. 1954–1967, 2022, doi: <https://doi.org/10.1002/csr.2293>
- [4] J. Li, G. Song, M. Cai, J. Bian, and B. S. Mohammed, "Green environment and circular economy: A state-of-the-art analysis," *Sustainable Energy Technologies and Assessments*, vol. 52, p. 102106, 2022, doi: <https://doi.org/10.1016/j.seta.2022.102106>
- [5] J. Barney, "Firm resources and sustained competitive advantage," *Journal of Management*, vol. 17, no. 1, pp. 99–120, 1991, doi: <https://doi.org/10.1177/014920639101700108>
- [6] B. Wernerfelt, "A resource-based view of the firm," *Strategic Management Journal*, vol. 5, no. 2, pp. 171–180, 1984, doi: <https://doi.org/10.1002/smj.4250050207>
- [7] S. L. Hart, "A natural-resource-based view of the firm," *Academy of Management Review*, vol. 20, no. 4, pp. 986–1014, 1995, doi: <https://doi.org/10.5465/AMR.1995.9512280033>
- [8] K. N. Iyer, P. Srivastava, and M. Srinivasan, "Performance implications of lean in supply chains: Exploring the role of learning orientation and relational resources," *International Journal of Production Economics*, vol. 216, pp. 94–104, 2019, doi: <https://doi.org/10.1016/j.ijpe.2019.04.012>
- [9] S. Bresciani, K. H. Huarng, A. Malhotra, and A. Ferraris, "Digital transformation as a springboard for product, process and business model innovation," *Journal of Business Research*, vol. 128, pp. 204–210, 2021, doi: <https://doi.org/10.1016/j.jbusres.2021.02.003>
- [10] M. M. Abu Afifa and N. M. Nguyen, "Nexus among big data analytics, environmental process integration and environmental performance: Moderating role of digital learning orientation and environmental strategy," *VINE Journal of Information and Knowledge Management Systems*, vol. 54, no. 6, pp. 1404–1427, 2024, doi: <https://doi.org/10.1108/VJIKMS-05-2022-0186>
- [11] K. Wang, X. Xu, P. Mao, X. Deng, and D. Cao, "Digital transformation and organizational readiness: Evidence from Chinese construction SMEs with a dynamic managerial capabilities lens," *Engineering, Construction and Architectural Management*, 2025, doi: <https://doi.org/10.1108/ECAM-01-2025-0069>
- [12] D. J. Teece, G. Pisano, and A. Shuen, "Dynamic capabilities and strategic management," *Strategic Management Journal*, vol. 18, no. 7, pp. 509–533, 1997, doi: [https://doi.org/10.1002/\(SICI\)1097-0266\(199708\)18:7<509::AID-SMJ882>3.0.CO;2-Z](https://doi.org/10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z)

- [13] N. M. Nguyen, T. T. Hoai, H. V. Vo, and N. P. Nguyen, "Digital approach toward environmental sustainability in supply chains: Evidence from Vietnamese firms," *Sustainable Development*, vol. 31, no. 5, pp. 3303–3317, 2023, doi: <https://doi.org/10.1002/sd.2586>
- [14] S. Yin, F. Jia, L. Chen, and Q. Wang, "Circular economy practices and sustainable performance: A meta-analysis," *Resources, Conservation and Recycling*, vol. 190, p. 106838, 2023, doi: <https://doi.org/10.1016/j.resconrec.2022.106838>
- [15] E. Onukwulu, I. Dienagha, W. Digitemie, P. Egbumokei, and O. Oladipo, "Enhancing sustainability through stakeholder engagement: Strategies for effective circular economy practices," *South Asian Journal of Social Studies and Economics*, vol. 22, no. 1, pp. 135–150, 2025, doi: <https://doi.org/10.9734/sajsse/2025/v22i1950>
- [16] P. K. Dey, C. Malesios, S. Chowdhury, K. Saha, P. Budhwar, and D. De, "Adoption of circular economy practices in small and medium-sized enterprises: Evidence from Europe," *International Journal of Production Economics*, vol. 248, p. 108496, 2022, doi: <https://doi.org/10.1016/j.ijpe.2022.108496>
- [17] N. Eyo-Udo, M. Agho, E. Onukwulu, A. Sule, and C. Azubuike, "Advances in circular economy models for sustainable energy supply chains," *Global Journal of Advanced Engineering and Business Research*, vol. 2, no. 6, pp. 300–337, 2024, doi: <https://doi.org/10.51594/gjabr.v2i6.52>
- [18] Q. Zhu, J. Sarkis, J. J. Cordeiro, and K. H. Lai, "Firm-level correlates of emergent green supply chain management practices in the Chinese context," *Omega*, vol. 36, no. 4, pp. 577–591, 2008, doi: <https://doi.org/10.1016/j.omega.2006.11.009>
- [19] S. A. R. Khan and D. Qianli, "Impact of green supply chain management practices on firms' performance: An empirical study from the perspective of Pakistan," *Environmental Science and Pollution Research*, vol. 24, no. 20, pp. 16829–16844, 2017, doi: <https://doi.org/10.1007/s11356-017-9172-5>
- [20] N. Aboobaker and Z. Ka, "Digital learning orientation and innovative behavior in the higher education sector: Effects of organizational learning culture and readiness for change," *International Journal of Educational Management*, vol. 35, no. 5, pp. 1030–1047, 2021, doi: <https://doi.org/10.1108/IJEM-09-2019-0345>
- [21] S. A. Rehman Khan, Z. Yu, S. Sarwat, D. I. Godil, S. Amin, and S. Shujaat, "The role of block chain technology in circular economy practices to improve organisational performance," *International Journal of Logistics Research and Applications*, vol. 25, no. 4–5, pp. 605–622, 2021, doi: <https://doi.org/10.1080/13675567.2021.1872512>
- [22] S. A. Rehman Khan and Z. Yu, "Assessing the eco-environmental performance: An PLS-SEM approach with practice-based view," *International Journal of Logistics Research and Applications*, vol. 24, no. 3, pp. 303–321, 2021, doi: <https://doi.org/10.1080/13675567.2020.1754773>
- [23] J. F. Hair, J. J. Risher, M. Sarstedt, and C. M. Ringle, "When to use and how to report the results of PLS-SEM," *European Business Review*, vol. 31, no. 1, pp. 2–24, 2019, doi: <https://doi.org/10.1108/EBR-11-2018-0203>
- [24] P. M. Podsakoff, S. B. MacKenzie, J. Y. Lee, and N. P. Podsakoff, "Common method biases in behavioral research: A critical review of the literature and recommended remedies," *Journal of Applied Psychology*, vol. 88, no. 5, pp. 879–903, 2003, doi: <https://doi.org/10.1037/0021-9010.88.5.879>
- [25] B. Cooper, N. Eva, F. Z. Fazlelahi, A. Newman, A. Lee, and M. Obschonka, "Addressing common method variance and endogeneity in vocational behavior

- research: A review of the literature and suggestions for future research,” *Journal of Vocational Behavior*, vol. 121, p. 103472, 2020, doi: <https://doi.org/10.1016/j.jvb.2020.103472>
- [26] M. Sarstedt, C. M. Ringle, and J. F. Hair, “How to specify, estimate, and validate higher-order constructs in PLS-SEM,” *Australasian Marketing Journal*, vol. 27, no. 3, pp. 197–211, 2019, doi: <https://doi.org/10.1016/j.ausmj.2019.05.003>
- [27] C. Fornell and D. F. Larcker, “Evaluating structural equation models with unobservable variables and measurement error,” *Journal of Marketing Research*, vol. 18, no. 1, pp. 39–50, 1981, doi: <https://doi.org/10.1177/002224378101800104>
- [28] J. F. Hair Jr., G. T. M. Hult, C. M. Ringle, M. Sarstedt, N. P. Danks, and S. Ray, “Evaluation of reflective measurement models,” in *Partial Least Squares Structural Equation Modeling (PLS-SEM) Using R*, Springer, 2021, pp. 75–90, doi: https://doi.org/10.1007/978-3-030-80519-7_4
- [29] N. Kock, “Common method bias in PLS-SEM: A full collinearity assessment approach,” *International Journal of e-Collaboration*, vol. 11, no. 4, pp. 1–10, 2015, doi: <https://doi.org/10.4018/IJEC.2015100101>
- [30] O. Khan, T. Daddi, and F. Iraldo, “Sensing, seizing, and reconfiguring: Key capabilities and organizational routines for circular economy implementation,” *Journal of Cleaner Production*, vol. 287, p. 125565, 2021, doi: <https://doi.org/10.1016/j.jclepro.2020.125565>
- [31] H. T. Lu, X. Li, and K. F. Yuen, “Digital transformation as an enabler of sustainability innovation and performance: Information processing and innovation ambidexterity perspectives,” *Technological Forecasting and Social Change*, vol. 196, p. 122860, 2023, doi: <https://doi.org/10.1016/j.techfore.2023.122860>
- [32] R. Mora-Contreras, L. E. Torres-Guevara, A. Mejia-Villa, M. Ormazabal, and V. Prieto-Sandoval, “Unraveling the effect of circular economy practices on companies' sustainability performance: Evidence from a literature review,” *Sustainable Production and Consumption*, vol. 35, pp. 95–115, 2023, doi: <https://doi.org/10.1016/j.spc.2022.10.022>
- [33] S. Singh, M. Sharma, and S. Dhir, “Modeling the effects of digital transformation in Indian manufacturing industry,” *Technology in Society*, vol. 67, p. 101763, 2021, doi: <https://doi.org/10.1016/j.techsoc.2021.101763>
- [34] L. F. Dumée, “Circular materials and circular design—review on challenges towards sustainable manufacturing and recycling,” *Circular Economy and Sustainability*, vol. 2, no. 1, pp. 9–23, 2022, doi: <https://doi.org/10.1007/s43615-021-00085-2>
- [35] A. W. Al-Khatib, “Enabling the circular economy in the digital transformation era: Evidence from an emerging country,” *Kybernetes*, vol. 53, no. 2, pp. 779–802, 2024, doi: <https://doi.org/10.1108/K-02-2023-0297>
- [36] A. N. El-Kassar and S. K. Singh, “Green innovation and organizational performance: The influence of big data and the moderating role of management commitment and HR practices,” *Technological Forecasting and Social Change*, vol. 144, pp. 483–498, 2019, doi: <https://doi.org/10.1016/j.techfore.2017.12.016>