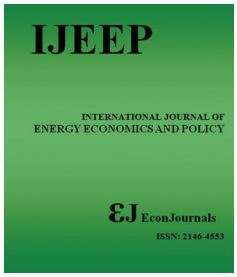

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Leveraging Digital Transformation for Green Competitive Advantage: Synergistic Role of Circular Economy Practices and Environmental Performance

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ABSTRACT

The purpose of the present study is to examine how digital transformation influences the circular economy practices and environmental performance of SMEs so that they can achieve a green competitive advantage. The present study poses the following question of research: (i) What is the influence of digital transformation on green competitive advantage? ii) Do circular economy practices and environmental performance mediate the influence of digital transformation on green competitive advantage? The research retrieves theoretical support from the Practice-Based View. The quantitative method was employed to test the model, and data were collected using a survey questionnaire from SMEs in Lahore. 350 questionnaires were distributed to the employees of SMEs using the convenience sampling technique, and 293 questionnaires were returned and filled. The data was analyzed using SPSS and PLS-SEM. The research study's findings indicated that digital transformation is positively linked with the green competitive advantage of SMEs. The results also highlighted that digital transformation significantly influences circular economy practices and environmental performance. The study's outcomes also showed that circular economic practices and environmental performance mediate the direct relationship between digital transformation and green competitive advantage. The intermediary role of circular economy practices and environmental performance in connecting digital transformation and green competitive advantage is substantial. SMEs can improve the efficiency of resources, reduce wastage, and adopt sustainable practices and models through the integration of digital technologies that ultimately enhance environmental performance. The study offers useful insight into policy implications, underscoring the prerequisite for government support, economic spurs, and governing frameworks for encouraging the adoption of digital technologies to achieve sustainability. The policymakers should expedite access to digital tools, endorse ecological revolution, and create an environment that nurtures circular economy practices, allowing SMEs to achieve competitive advantage, along with fostering sustainability.

Keywords: Digital Transformation, Circular Economy Practices, Environmental Performance, Green Competitive Advantage, SMEs
JEL Classifications: O33, Q56

1. INTRODUCTION

In the dynamic and competitive setting of technology and business, circular economy and digitalization have developed as driving factors. Circular economy practices are swiftly gathering momentum and the attention of industrialists, policymakers, and academics that harmonize economic development without consuming resources to preserve the environment for supporting innovative methods that underpin sustainable development (Rodríguez-González et al., 2023). The circular economy is one

of the major drivers of sustainability (Brglez et al., 2024). The circular economy practices involve regenerating and restoring through reusing, renewing, and recycling processes and methods (Strippoli et al., 2024).

Simultaneously, digitalization in terms of digital advancement, digital technologies, and tools has prompted a paradigm shift in communication, economies, the structure of jobs, and a key skill for individuals' personal and professional lives. It also reshaped industrial production (Guandalini, 2022; Dąbrowska et al., 2022). In the digital era, digital transformation has been seen as a critical contributor to hastening the transition of enterprises from a linear to a circular economy (Arroyabe et al., 2024). The juncture of social and technological revolutions makes a foundation to incorporate green ethos in the circular economy business model with the digital principle of contemporary technology within the structure of the organizations (Song et al., 2024). As compared to small and medium organizations, large organizations are more inclined towards managing sustainability and its practices (Rodríguez-Espíndola et al., 2022).

Considering the white paper on the global digital economy released in 2022 by the Institute of Information and Communications, the digital economy added value was more than 38.1 USD trillion in 47 countries globally, including 45% of worldwide GDP (Song et al., 2024). The competitiveness of enterprises in the digital era is inseparable from the recapitulation of digital advancements and alterations of business models. Digital transformation allows businesses to adjust their models and develop strategies for sustainable development to achieve sustainable competitiveness (Nadkarni and Prügl, 2021). The prominence of sustainable development in an organizational operation framework subliminally encourages an investigation of circular economy, which attempts to reduce wastage and augment the utilization of resources (Subramanian and Suresh, 2022). Circular economic practices backed with digital advancements facilitate organizations to integrate resources effectively, reducing cost, which promotes environmental competitive advantage.

Over the decades, there has been growth in industrialization that often comes at the expense of the environment (Nassar et al., 2025). The empirical studies highlighting digital technologies' environmental opportunities and risks are diverse and frequently provide arguments for indecision concerning environmental influences (Chen and Hao, 2022; Beier et al., 2020). Digital transformation drives sustainable development in the organization by improving responsiveness, making the operations and activities of the business transparent, allocating resources efficiently, and reducing costs (Kyaw et al., 2022). Companies improve their green performance through digital transformation, creating a competitive advantage for the company over its rivals in the marketplace by improving its image and reputation, enhancing the prices of goods, and boosting innovation and differentiation (Zameer et al., 2021).

Research on digital transformation and circular economy practices is at its initial stages, as the studies are concentrating on adopting digital technologies to foster productivity and address economic constraints (Tang et al., 2022; Liao et al., 2022). The previous studies identified numerous factors that foster green competitive advantage, such as green innovation, green intellectual capital, and green production (Zameer et al., 2022; Astuti and Datrini, 2021; Zameer et al., 2020). However, limited studies examine the pathway through which circular economy practices integrated with digital transformation lead toward green competitive advantage. The relationship between digital transformation, circular economy, and green competitive advantage is studied separately (Alkhalil et al., 2021). There is scarce research that investigated the relations of the mentioned variables collectively. Still, whether circular economy practices mediate the relationship between digital transformation and green competitive advantage is unidentified. The influence of adoption digital technology on environmental performance has been investigated extensively (Song et al., 2024; Xie et al., 2023; Chen and Hao, 2022). Nonetheless, the mediating role of environmental performance among the direct link of digital transformation and green competitive advantage is still unexplored and requires attention.

Against this backdrop, the present study aims to deepen insight into how digital transformation is linked with green competitive advantage by meditating on circular economic practices and environmental performance. The present study poses the following question of research question: (i) What is the influence of digital transformation on green competitive advantage? (ii) Do circular economy practices and environmental performance mediate the influence of digital transformation on green competitive advantage?

2. THEORETICAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

2.1. Theoretical Framework

The present study retrieved support from the Practice-Based View (PBV), which underlines the influence of practices of the organization that can be available openly and replicable regarding the organization's competitive advantage. Practices are described as activities that can be executed by numerous enterprises (Bromiley, P., and Rau, D. 2014). PBV underscores that the organization can achieve a competitive advantage through activities that are extensively recognized and attainable by the organization. PBV provides a valuable understanding of how enterprises can leverage their organizational resources and activities to navigate competitive landscapes and create a competitive edge by adopting effective organizational practices. In the context of sustainable development, PBV offers a robust framework to analyze green competitive advantages (Jacob et al., 2025). This is specifically relevant when considering the adoption of transferable and imitable resources such as digital transformation and circular economy practices (Rehman et al., 2022). PBV also provides a theoretical basis for enterprises to espouse innovative digital technologies, which sway social and organizational indicators, including increased productivity, sustainable development, green performance, economic thriving, environmental advancements, circularity, and competitiveness (Kannan and Perez-Aleman, 2022). Besides this, PBV asserts that circular economy practices permit companies to drift

between organizations without severe isolation mechanisms to utilize the principle of 3R, which is based on reducing, reusing, and recycling (Tang et al., 2022), which results in achieving competitive advantage (Oliinyk et al., 2021). The adoption of Industry 4.0 technologies, including digital transformation, has been identified as a key enabler to integrate the circular economy in the organizations of developing economies to address the enablers that the companies should consider cultivating capabilities and resources that are crucial for green competitiveness (Despoudi et al., 2023). Additionally, digital transformation has emerged as an organizational resource that amplifies environmental performance (Song et al., 2024), thus augmenting sustainable competitiveness. The PBV, particularly when considering digital transformation, circular economic practices, and environmental performance, becomes substantial in befriending green competitive advantage.

2.2. Hypothesis Development

2.2.1. Digital transformation and green competitive advantage

Numerous organizations are undergoing digital transformation voluntarily and proactively to deal with the growing, severe competition in the market (Wu et al., 2024). Digital technologies are a key strategy for enterprises to compete against their rivals. Digital technologies are necessary for business organizations when they are aiming to achieve a sustainable competitive edge over their competitors (Du et al., 2024). Digital technologies focus on integrating computing information and connectivity technologies, leading to sustainable competitiveness (Martínez-Caro et al., 2020). According to the research by Rehman et al. (2024), the implementation of digital technologies is substantial for the development of organizations since digital transformation is helpful for enterprises to build a green competitive advantage (Muhairat, 2024). The previous studies also highlighted that digital technologies assist the enterprise to improve the quality of data management and improve the company's competitiveness in the market effectively (Shehzad et al., 2024; Okorie et al., 2023). Moreover, the firms are transforming to digital technologies to provide more value to the organization and redefine sustainable transformation and sustainable edge in the marketplace (Verhoef et al., 2021). The organization seeking to create a green competitive edge must focus on transitioning from its existing processes or procedures to digital technologies to meet the changing marketplace, business operations, and structures (Shehadeh et al., 2023). The organizations inclined towards the integration of digital transformation are likely to be more profitable and have a high market valuation compared to their competitors who are not involved in transforming their existing structures (Roy and Vasa, 2025). Consequently, digital technologies act as a crucial driver and tool to create a green competitive advantage by integrating digital transformation. So, the following hypothesis is posited:

H_1: Digital transformation positively influences green competitive advantage.

2.2.2. Mediation of circular economy practices

The idea of circular economy focuses on a system of economy to minimize waste and maximize utilization of resources (Pizzi et al., 2021). The integration of the circular economy interrupts the traditional practices of business and offers prominent challenges. Adopting innovative and novel technologies reinforces the competitive ability of the organizations (Mikhaylov et al., 2023). Innovation derived through technological advancement steers implementation a circular economy in the enterprise (Banihashemi et al., 2023). Digitalization is one of the driving factors of the circular economy (Arroyabe et al., 2024). Furthermore, Industry 4.0 technologies, such as digital transformation, improve the utilization of resources and productivity, thus impelling the practices of the circular economy (Kristoffersen et al., 2020). Digital transformation provides modification by incorporating digital technologies in business procedures and processes, which emerges as an enabler that can facilitate a shift from linear to circular economy models (Trushkina and Prokopyshyn, 2021). According to the study by Whenish and Ramakrishna (2022), BigTech has facilitated the adoption of circular economy practices, and organizations shifted to a circular business model from a linear model, which amplifies the competitiveness of firms. Considering Industry 4.0 and digital technologies adoption, the circular economy is identified as a key contributor to sustainable development by concentrating on reducing emissions, inputs, and waste (Banihashemi et al., 2023). The practices of circular practices focus on novel models of business that demand innovative tactics and perceptions of business operations, facilitating the enterprise to build a sustainable competitive edge (Lopes and Farinha, 2019). The adoption of circular economy practices is related to the circulation of resources, utilization of natural assets, minimizing the wastage, and durability of the product to fortify sustainable operations of the enterprise's operations (Siddik et al., 2023) that ultimately improves the competitiveness of the business in the marketplace over its rivals (Brogi and Menichini, 2024). Keeping in view the results of past studies, the implementation of digital technologies assists the ecological outcomes by facilitating enterprises to create capabilities that are sustainability-oriented for adopting circularity to reduce wastage (Rodríguez-González et al., 2022; Santoalha et al., 2021; Bag et al., 2020), offering significant advantages by augmenting operational effectiveness and sustainable competitive edge (Marrucci et al., 2021). Therefore, digital transformation is an antecedent of circular economy practices that gives the firm the green edge over its rivals. Hence, the following hypotheses are postulated:

H_2: Digital transformation influences circular economy practices.

H_3: Circular economy practices influence green competitive advantage.

H_4: Circular economy practices mediate the positive influence of digital transformation influences green competitive advantage.

2.2.3. Mediation of environmental performance

Digital transformation enables business organizations to drive sustainable development and focus on the organization's and society's benefits (Jin et al., 2023). Organizations focus on improving society, economy, politics, and the environment to advance their profitability, which is required by the company's key stakeholders (Waheed et al., 2020). Numerous scholars highlighted that the adoption of digital technologies enhances the efficiency and effectiveness of organizations to accomplish sustainable growth (Xu et al., 2023; Bendig et al., 2023; Li et al., 2020), which is a crucial element for the stakeholders to drive enterprises to transform their traditional processes. Moreover, the stakeholders are also pressurizing the companies to consider environmental challenges;

with this, the organizations are advised to focus on ecological strategies that focus on proactive governance of the environment (Noja et al., 2022). The responsiveness of the organizations is improved by digital technology adoption, making the operations and business management of the company transparent, which is helpful for the stakeholders to recognize the inclination of the organization to conservational governance (Trujillo-Gallego et al., 2022; Kyaw et al., 2022) that lead towards the competitiveness of the company (Singh et al., 2019). From the point of view of Chen and Hao (2022), implementing digital technologies in the business's operations and processes augments the business's green performance for achieving environmental and economic sustainability (Chen and Hao, 2022). Enterprises add value to their basic programs through the implementation of ecological programs effectively, which helps the organization achieve competitiveness (Fatoki, 2021). Organizations focus on enhancing their ecological productivity by adopting digital technologies, which in turn support opening new business prospects and augmenting competitive advantage (Zameer et al., 2021). When the company achieves environmental performance, it reduces costs, limits input usage, improves social reputation, boosts differentiation, and enhances the high prices of goods and services, increasing the company's competitiveness. Contrary to this, when the company does not focus on achieving environmental performance, it reduces reputation, profitability, and rate of returns, ultimately lowering its competitiveness (Pratono et al., 2019). As a result, digital transformation is considered the precursor of environmental performance, creating a competitive edge for the company. Therefore, the following hypotheses are proposed:

H_5: Digital transformation influences environmental performance.

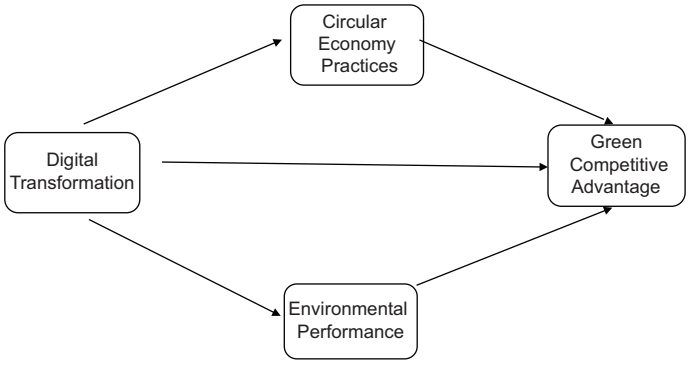
H_6: Environmental performance influences green competitive advantage.

H_7: Environmental performance mediates the positive influence of digital transformation influences green competitive advantage.

2.3. Conceptual Framework

The conceptual framework of the present study is based on sustainability-related practices of business by integrating digital transformation with circular economy practices and environmental performance to achieve a green competitive advantage. The relationship among the variables of the research study is depicted in Figures 1 and 2. Digital transformation is the independent variable, whereas circular economy practices and environmental performance serve as mediators and green competitive advantage is the dependent variable.

Figure 1: Research model



3. METHODOLOGY

3.1. Research Design, Data Collection Procedures, and Sample

The present study utilized a quantitative research design and a deductive approach. The cross-sectional research strategy was employed with the survey questionnaire as a method to collect data. The study's targeted population was the individuals working in the SMEs of Lahore. Keeping in view the report of the Small and Medium Enterprise Development Agency (SMEDA), the operational SMEs in Pakistan are almost 37 million, and is contribution to the GDP of the country is almost 40% (Hidayat-ur-Rehman and Alsolamy, 2023). Furthermore, approximately 21 million individuals are employed in SMEs in Pakistan (State Bank of Pakistan, 2022). SMEs were selected because they produce a huge portion of conservational effects compared to large enterprises and are prone to environmental challenges. Considering the continuous deterioration of the economic and environmental eminences of SMEs in Pakistan, it is important to consider why the pace of digital transformation and circular economy practices are deficient in this context. Lahore was selected because it is one of the economic hubs of Pakistan and its significant contribution to the country's GDP. SMEs of Lahore are playing a crucial role in economic growth, digitalization, market shifts, technological advancements, and innovation (State Bank of Pakistan, 2023). A non-probability sampling convenience sampling technique was used to ensure that the sample represented the targeted population. 350 questionnaires were distributed from May 2024 to August 2024 to the employees of SMEs, and 293 questionnaires were returned and filled.

The privacy of the participant's responses was ensured to ensure that the data has no issue of common method bias (CMB). Herman's single-factor analysis was also utilized. The results showed that no single factor has emerged and the maximum variance explained by a single component was <50%, depicting no CMB issue in the data. Social desirability bias was by informing the respondents about confidentiality and anonymity of the respondents. The data collected from the respondents were analyzed using SPSS and Smart PLS.

3.2. Measures

The scales used in the present study to measure the variable were taken from the previous studies. Respondents' responses were ranked on a 5-point Likert scale (1 = strongly disagree-5 = strongly agree). The scale Nasiri et al. (2020) developed was used to measure digital transformation. Circular economy practices were measured using the scale Cheng et al. adopted (2023). The scale of Large and Thomsen (2011), that have five items, was used to measure environmental performance. Green competitive advantage was measured by a 4-item scale by (Lin and Chen (2017).

4. ANALYSIS AND RESULTS

4.1. Demographic Analysis

The study participants' profile was tested with SPSS descriptive statistics. The demographics depicted that the percentage of female and male participants was 39% (115) and 61% (178), respectively.

164 (56%) participants were married, and 129 (44%) respondents were single. 119 (40%) participants were doing government jobs, 99 (34%) respondents were private job holders, and 75 (26%) belonged to semi-government institutions. The average experience of participants was 5.21, with 33 average age.

4.2. PLS Measurement Model

Considering the nature and scope of the existing research study, the Partial Least Squares Structural Equation Modeling (PLS-SEM) technique using version 3.0 (VB) was utilized to test and analyze the model. Smart PLS is widely used in the field of social sciences and business research (Matthews et al., 2018). PLS is preferred when the data is collected from a small size of population (Hair Jr. et al., 2017). PLS provides robustness in the analysis and results. It also offers reliability and validity of the scale used to measure constructs by providing comprehensive information about Cronbach Alpha, average variance extracted (AVE), and composite reliability. Additionally, it offers discriminant validity, path coefficient, P-value, and confidence interval (Rasoolimanesh, 2022).

4.3. Construct Reliability and Validity

The reliability of the items of a particular variable is measured by internal consistency (Tang et al., 2014). It is assessed using Cronbach's Alpha and composite reliability rho-a and rho-c, and the threshold value for all three should be >0.70 (Hair Jr. et al., 2017). The results of the PLS- Algorithm identified that Cronbach's Alpha CEP, DT, EP, and GCA were 0.830, 0.749, 0.756, and 0.777, respectively. It presents a high level of internal consistency as the variable's values surpass the threshold value of 0.70. Moreover, the composite reliability rho-a and rho-c of CEP is (0.832, 0.876), DT is (0.754, 0.833), EP is (0.761, 0.837), and GCA is (0.779, 0.856). These values also show that composite reliability is higher than the cut-off value of 0.70, leading to internal consistency in the measures (Table 1).

4.4. Convergent Validity

The convergence of the items in their respective construct indicates the convergent validity of the scale (Zhu, 2000). It is measured by AVE and outer loadings of the indicators having a value >0.50 (Peterson and Kim, 2013) and 0.40 (Hulland, 1999) respectively. AVE values presented in Table 1 indicate that the AVE of constructs meets the threshold value, highlighting the convergent validity of CEP (0.541), DT (0.500), EP (0.507), and GCA (0.599). The outer loadings of items shown in Table 2 also depict that the criteria of convergent validity have been met as the values are within a range which is 0.40 (Hulland, 1999).

4.5. Discriminant Validity

To measure that the items of different variables are different, measuring specific variables and items of different constructs are not converging (Ab Hamid et al., 2017). The HTMT ratio can measure it, and it should not be close to 1 (Rasoolimanesh, 2022). The Cornell-Larcker Criterion is also used to measure discriminant validity, and the acceptance criteria are that the square root of AVE must be greater than the correlation among different constructs. Table 3 depicts values of the HTMT ratio, and the values of variables are not close to 1, highlighting the discriminate validity of the constructs. In Table 4, the outcome of the Fornell-Larcker Criterion shows that the square root of CEP, DT, EP, and GCA is (0.735, 0.707, 0.712, 0.774), respectively, which is greater than the correlation among the constructs of the study.

According to Ringle et al. (2023), a model is said to be a good fit when the Standardized Root Means Square Residual (SRMR) is <0.08. The current study's SRMR value is 0.070, indicating that the model is a good fit.

4.6. Structural Model

The structural model of PLS-SEM is shown in Table 5. H_1 hypothesized that DT is positively related to GCA, and the

Table 1: Internal consistency

Variables	Cronbach's Alpha	Composite reliability (rho-a)	Composite reliability (rho-c)	Average variance extracted (AVE)
CEP	0.830	0.832	0.876	0.541
DT	0.749	0.754	0.833	0.500
EP	0.756	0.761	0.837	0.507
GCA	0.777	0.779	0.856	0.599

DT: Digital transformation, CEP: Circular economy practices, EP: Environmental performance, GCA: Green competitive advantage

Table 2: Outer loadings of indicator

Factor loading	CEP	DT	EP	GCA
CEP1	0.721			
CEP2	0.706			
CEP3	0.771			
CEP4	0.748			
CEP5	0.753			
CEP6	0.709			
DT1		0.749		
DT2		0.759		
DT3		0.678		
DT4		0.707		
DT5		0.633		
EP1			0.729	
EP2			0.608	
EP3			0.739	
EP4			0.742	
EP5			0.734	
GCA1				0.757
GCA2				0.755
GCA3				0.807
GCA4				0.776

Table 3: Heterotrait-monotrait ratio (HTMT)

	CEP	DT	EP	GCA
CEP				
DT	0.713			
EP	0.820	0.731		
GCA	0.857	0.787	0.812	

Table 4: Fornell-Larcker criterion

	CEP	DT	EP	GCA
CEP	0.735			
DT	0.571	0.707		
EP	0.652	0.555	0.712	
GCA	0.700	0.603	0.624	0.774

Figure 2: PLS algorithm

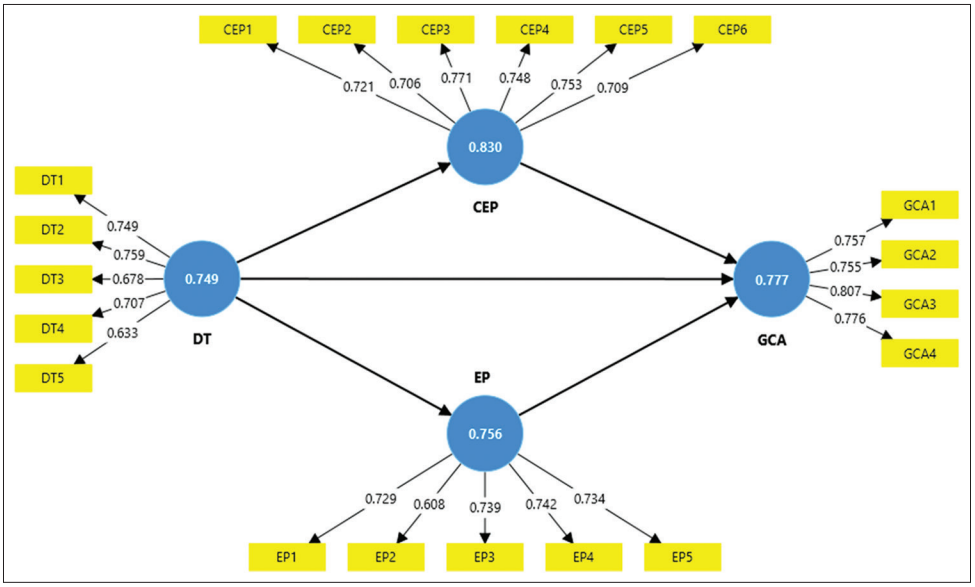
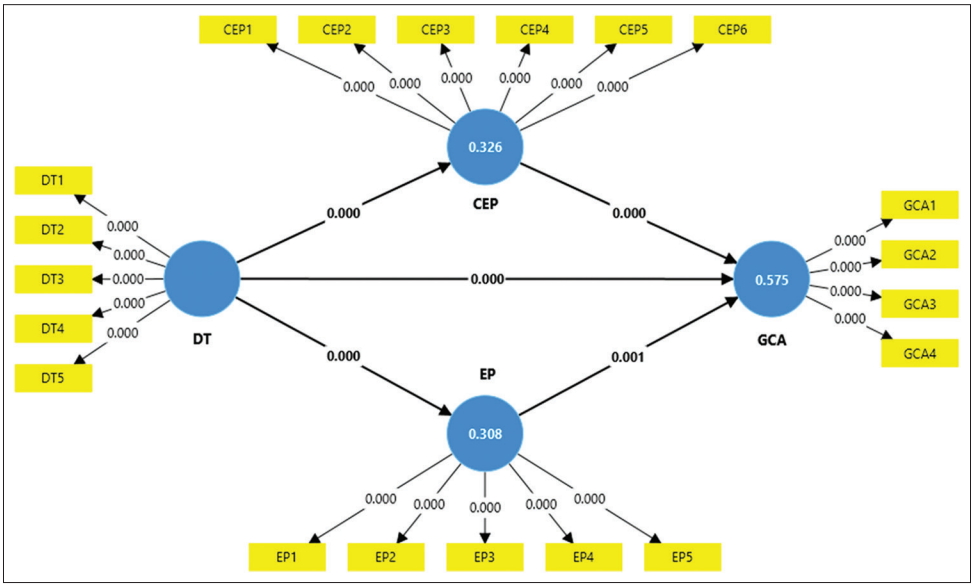


Figure 3: PLS structural model



study's findings also indicated a positive relation as the value of ($\beta = 0.245$, $P < 0.000$), and H_1 is accepted. H_2 posited that DT positively influences CEP, and the results of the present study also supported H2 ($\beta = 0.576$, $P < 0.000$). H_3 hypothesized that the relation between CEP and GCA is positive; findings of the study also depicted that ($\beta = 0.422$, $P < 0.000$). H_4 proposed that DT is significantly associated with EP, and findings also highlighted that ($\beta = 0.560$, $P < 0.000$), indicating a positive association of GPV and GPI. H_6 suggested that EP is linked with GCA, and results presented that GT is linked with GPI positively and significantly ($\beta = 0.213$, $P < 0.001$).

Mediation was tested using bootstrapping of 1000, with a 95-confidence interval and 0.05 significance level. The current research proposed two mediating hypotheses, H_4 and H_7, to determine whether CEP and EP act as mediators in the relationship between DT and GCA as shown in Figure 3. The indirect paths

Table 5: Direct path coefficient

Hypotheses	Paths	Estimates	T-value	P-value
H_1	DT->GCA	0.245	4.105	0.000
H_2	DT->CEP	0.576	13.226	0.000
H_3	CEP->GCA	0.422	6.819	0.000
H_5	DT->EP	0.560	12.295	0.000
H_6	EP->GCA	0.213	3.271	0.001

Table 6: Mediation path coefficient

Hypotheses	Paths	Estimates	T-value	P-value	95% BC CI
H_4	DT->CEP->GCA	0.243	6.336	0.000	0.173-0.322
H_7	DT->EP->GCA	0.119	3.101	0.002	0.046-0.196

are given in Table 6. The results revealed that DT influences GCA indirectly via CEP ($\beta = 0.243$, $P > 0.000$, BC-CI 0.173-0.322),

supporting H_4. The findings also revealed that DT influences GCA indirectly through the mediation of EP ($\beta = 0.119$, $P < 0.002$, BC- CI 0.046-0.196), accepting H_7.

5. DISCUSSION AND CONCLUSION

5.1. Discussion

The industries are overburdened by digitalization (Cozzolino et al., 2021), and SMEs are struggling with the question of whether and how to undertake digital technologies to achieve sustainable competitiveness. Nonetheless, SMEs drive the economy globally, depicting a substantive contribution to innovation and economic and sustainable development (Awonuga et al., 2024). SME agility permits the required adjustment quickly to change according to the contemporary and dynamic needs of the market and adapt the digitalization backed with sustainable practices (Parra-Sánchez and Talero-Sarmiento, 2024). Thereby, drawing on PBV, the study developed a conceptual framework to investigate the influence of digital transformation on green competitive advantage with the mediation of circular economy practices and the environmental performance of SMEs in Pakistan. PBV theory provides a framework to investigate how organizations can focus on transforming their existing processes and procedures through digital technologies and adopt adjustments in the business model to compete with the firms in the marketplace and achieve sustainable development in the contemporary business era (Hidayat-ur-Rehman and Alsolamy, 2023). The study's findings showed that digital transformation undertaken by SMEs positively influences the green competitive advantage (i.e., H_1). The findings are consistent with the previous studies conducted by researchers examining the antecedents of green competitive advantage, such as Du et al. (2024), Rehman et al. (2024), and Shehzad et al. (2024) highlighted that it is influenced by the adoption of digital technologies, digitalization, and transiting existing procedures and systems to digital processes. Digital stratagems are becoming one of the key factors of organizational strategies so that the enterprise can achieve a competitive advantage over its rivals in the market. The study results showed that circular economy practices (i.e., H_2, H_3, and H_4) mediated the digital transformation and green competitive advantage relationship. Unswerving with the previous studies that indicated that Industry 4.0 and technological advancement are crucial enablers of the implementation of practices of circular economy in the organization (Arroyabe et al., 2024; Banihashemi et al., 2023) that ultimately improves the sustainable competitiveness of the enterprise in the market over its competitors (Brogi and Menichini, 2024; Marrucci et al., 2021). When the enterprise focuses on integrating digital technologies and the circular economy, it transitions from traditional to digital and linear to circular practices. It reduces waste, improves resource utilization, and enhances the efficiency and effectiveness of the enterprise, offering augmentation in the sustainable competitive edge. The research outcomes highlighted that environmental performance mediates the influence of digital transformation and green competitive advantage (i.e., H_5, H_6, and H_7). Previous studies concluded that Industry 4.0 and the integration of digital technologies in enterprises help firms to accomplish sustainable development by improving their environmental performance (Xu et al., 2023; Bendig et al., 2023; Li et al., 2020) and improving the environmental performance of the corporate lead towards the competitiveness of the company (Singh et al., 2019). When digital technologies are implemented in the organization, traditional processes and structure can be transitioned to digitalization, which improves the environmental performance of the enterprise so that sustainability can be reached. When the company can achieve environmental performance resultantly, its costs are reduced, input usage is restricted, social repute is bolstered, differentiation is boosted, and prices for goods and services are augmented, which helps the company compete fairly in the dynamic market. At odds with this, if the company cannot achieve green performance with the adoption of technological development, the social reputation, profitability, and rate of returns of the company are affected negatively, eventually depressing the enterprise's competitiveness. The present study investigates the influence of digital transformation on green competitive advantage with the mediation of circular economy practices and environmental performance, retrieving theoretical support from the theory practice-based view (PBV).

5.2. Theoretical Implications

The prevailing study is augmenting the present body of knowledge by providing multifaceted theoretical inferences. This offers valuable insight into understanding the link among the study variables, such as digital transformation, circular economy practices, environmental performance, and green competitive advantage. The study is contributing to the literature on digital transformation. The present study takes up digital transformation as a process instead of an outcome, which is considered to be a remarkable shift conceptually. The literature has hardly investigated the influence of digital technologies on the sustainable competitiveness of organizations. The study results are significant, providing a logical flow of digital transformation in establishing a green competitive advantage in SMEs. When the SMEs transform digitally, they undergo certain changes and advancements, thus creating green competitiveness. The study offers a significant contribution to the field of circular economy practices by incorporating how circular economy practices play a key role in the interaction of the adoption of digital technologies and green competitive advantage. Circular economy practices support SMEs in using digitalization to transform and adjust their business model from linearity to circularity (Kondala et al., 2024). Nevertheless, the integration of digital transformation, circular economy practices, and the advantages of green competition are relatively unexplored. The present study will address the gap in the literature by comprehensively examining the circular economy practices mediation in the positive relationship of digital transformation and green competitive advantage in SMEs of the developing country. In this context, the study will expand the knowledge by stressing the tendency of SMEs to prioritize digital technology adoption and circularity to achieve a sustainable edge in the market. The SME's circular economy practices catalyze to amplify the organization's forward movement of sustainable transformation and development (Yosep et al., 2024). Moreover, the study emphasizes that while digital advancements and circularity are integrated into the organization there should emerge complementarities and synergies that allow SMEs to compete in the marketplace. The past studies focused on large enterprises without focusing on the influences of

digital transformation, circularity, and environmental performance on SMEs (Bouncken et al., 2021). So, the study's findings offer a theoretical foundation for how digital technologies assist SMEs in improving their processes and procedures, reducing cost, optimizing supply chains, and improving the efficiency of resources so that environmental performance can be augmented to achieve sustainable development and competitive advantage.

5.3. Practical Implications

The study also provides practical inferences that are particularly remarkable. The research offers managerial insights for practitioners and experts, particularly employed in the SME industry. First, the study underscores the importance of integrating digital transformation into their enterprise's strategic operations and framework. The firms should harness their investment in research and development, focusing on innovative research on dynamic technologies to protect the environment while transforming and incorporating digitalization and commitment to augment the quality and quantity of ecological transformation (Madaan et al., 2024). The findings of the study are helpful for organizations to exploit their resources of digital technology to reduce wastage and maximize resource utilization through transitioning from linear business models to circularity. The SMEs should adopt the trend of adopting digital technologies for the development of enterprise, grasp the chance of novel platforms and transformations of digitalization integrated with environmental protection, dynamically promote transiting to digital systems, completely exploit the prospect of economies of scale, contribute to the long-term growth and expansion of the enterprise that also improves productivity and reduce the cost of doing business resulting in competitiveness (Muzamwese et al., 2024). The findings provide valuable insight into the organizations, practitioners, entrepreneurs, SMEs, and experts to achieve a green competitive advantage that can be strengthened by their standing in the digital and circular environment. Aligning the digital transformation with the strategies of the organization to protect the environment and achieve green performance by opening up novel opportunities for progress, sustainable development, and innovation in SMEs. The mediation of circular economy practices and environmental performance in the association of digital transformation and green competitive advantage provides a roadmap to SMEs in navigating the intricacies to enhance competitiveness sustainably through digital transformation. Industrialists, practitioners, and scholars should identify that the benefits gained from digital transformation can be exaggerated when combined with sustainable performance and circular practices that magnify green competitiveness. The strategic integration of digital transformation must be reinforced through a vigorous context that also depicts a green and circular strategy to reach a sustainable competitive advantage. It guarantees that technological advancements are not only conservational but these are also offer competitiveness to SMEs. The study provides significant understanding for the research scholars and academics to redefine the role played by digital transformation, circularity, and sustainability to achieve a high level of competitiveness in the sector of SMEs.

5.4. Significance and Justification of the Study

The study is significant as it uses a practice-based view (PBV) as a theoretical basis to examine how the interplay of digital transformation, circular economy practices, and environmental performance boosts green competitive advantage. PBV assists in understanding how the activities specifically, that can be adopted by the enterprise to transform its business resources influence its competitiveness (Bromiley and Rau, 2014). The study is helpful for enterprises aiming to improve their environmental sustainability and achieve competitive advantage by integrating digital advancements and adjustments in business models. The study provides valuable insight into the fact that technological approaches are crucial for firms to achieve superior environmental outcomes linked with sustainable business competitiveness. Digital transformation plays a crucial role in adopting circular economic practices and facilitates companies striving to achieve competitiveness in the marketplace through improving environmental performance. The research facilitates entrepreneurs, industrialists, businesses, and policymakers to exploit Industry 4.0 technologies and digital transformation to achieve sustainable development. The study is significant since it addresses the crucial role of digital transformation in enhancing the competitiveness and sustainable development of SMEs. In the realm where technological transformation and sustainable development concerns are redesigning the landscape of business, it is important to understand that digital tools can drive green performance and circular economy practices, providing a roadmap to SMEs to be competitive and sustainable. The study is justified since there is a growing need for SMEs to combine digital and green practices to be resilient and relevant in the market. Digital transformation is not only considered as a digital update, but it is also a strategic inevitability for the SME, focusing on reducing wastage, optimizing resources, and fostering efficiency. Furthermore, the integration of circular economy practices in the business is helpful for SMEs to comply with contemporary environmental rules and regulations to gain a competitive advantage.

5.5. Limitations and Future Directions

There are numerous inferences and suggestions of the research; besides this, the study has a few limitations that can be taken as a future direction by future researchers. The researcher has only obtained the data from the SME sector of Pakistan, limiting its generalization to other sectors and industries. However, in the future, other sectors, industries, and large enterprises can be taken as research populations, and findings can be compared. The study used a cross-sectional strategy to obtain data from the participants. The future researcher can employ other strategies to investigate the possible variation in the results. The research was quantitative and overlooked the underlying patterns hidden in the study's findings, so a mixed-method study can be utilized in the future to triangulate the qualitative and quantitative results. The study considered the future intervention of circular economy practices and environmental performance. The conceptual model can also use the moderating mechanisms of leadership, competitive climate, and digital strategy. PBV theoretically supported the research, whereas in the future, stakeholder and dynamic capability theories can be used to support conceptual relations.

5.6. Conclusion

The research underlines the role of digital transformation to foster environmental performance and circular economy practices that

eventually promote green competitive advantage for small and medium-sized enterprises. The integration of digital and green technologies in the operations of SMEs optimizes the efficiency of resources, waste reduction, and aligns the strategies of business with the Sustainable Development Goals. The research examined the divided effect of circular economy practices and environmental performance through which the advantages of green competition can be achieved by adopting digital transformation. The research underscores the crucial role of integrating digital transformation in SMEs to promote sustainable practices and achieve environmental performance to gain and sustain green competitiveness. SMEs should focus on embracing proactive digital innovation, exploiting it as a strategic instrument for driving competitiveness and sustainability. The study offers useful insight for SMEs, stakeholders, and managers who are focusing on bolstering their competitiveness to survive in the dynamic and competitive business environment.

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