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Green Competitive Advantage and SMEs: Is Big Data the Missing Link?

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Abstract

We aim to see the influence of corporate social responsibility (CSR) and green intellectual capital on green competitive advantage with the mediation of green innovation in the manufacturing SMEs of a developing country. Moreover, big data analytics adoption intention (BDAAI) is used as a moderator between green innovation and green competitive advantage. The structural equation modeling (SEM) technique is used. Simple random sampling is used for data collection. The results explain that CSR and green intellectual capital significantly determine green innovation and green competitive advantage. Moreover, green innovation mediates between CSR, green intellectual capital, and green competitive advantage. Green innovation and BDAAI significantly determine green competitive advantage. Finally, BDAAI moderates between green innovation and green competitive advantage. The management can use CSR, green intellectual capital, green innovation, and BDAAI in decision-making to attain a green competitive advantage. This is an initial study that incorporates CSR, green intellectual capital, green innovation, and BDAAI to determine green competitive advantage by using a natural resource-based view (natural RBV). Researchers, managers, and students can all gain from this study.

Keywords: *Green innovation, big data, SMEs, sustainability*
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1. INTRODUCTION

Public awareness about environmental concerns has grown, and corporate environmental policies have dominated worldwide public debate. In today's world, where numerous socio-environmental issues are pushing businesses, CSR is gaining importance in management literature, and its importance is steadily growing (Kraus et al., 2020). Although governments have historically been tasked with ensuring social welfare, it can be challenging for them to satisfy all of the demands and expectations of society. CSR can improve social well-being by covering the gaps left by governments' limited resources and competencies. Many prosperous businesses use CSR as a strategy that goes beyond the conventional idea of economic returns. Businesses start socially responsible initiatives and adhere to environmental standards, creating a win-win situation that improves both their financial and environmental performance. CSR and economic performance in SMEs have recently been the subject of research (Hernández et al., 2020). Businesses, either large or small, should therefore take the broader societal issue into account.

Organizations are increasingly focusing on developing natural resources through initiatives like environmental preservation because they can no longer only rely on intangible assets like networks, information systems, procedures, and know-how. The term green intellectual capital was introduced by (Chen, 2008a; 2008b), who defined it as intangible assets, capabilities, and connections concerning environment protection or green innovation. In addition, green intellectual capital is anticipated to have a beneficial relationship with green innovation and

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environmental performance in businesses (Chen, 2008b). Even while the definition of green intellectual capital implies that it might be related to green innovation, this does not postulate that green intellectual capital contains abstract knowledge stocks that are not used to continuously improve environmental performance. Even though the literature has long acknowledged the significance of intellectual capital and its many implications, little is known about green intellectual capital in the contemporary sustainable environment, where environmental challenges are at the forefront (Wang & Juo, 2021).

Firms are encouraged by environmental strategies to evaluate their environmental impact and address environmental issues. Nowadays, environmental issues are a worldwide concern (Akram et al., 2022; Al Mashkoor, 2022; Bresciani et al., 2023; Bresciani et al., 2022; Karamaşa et al., 2021; Lubis & Pratama, 2022; Ningning & Mengze, 2022). To address environmental challenges, involving a wide range of stakeholders is vital, which improves information flow and stimulates green innovation (Shu et al., 2016). Businesses must modify their strategy in reaction to environmental changes to address green innovation and environmental challenges. According to Chen et al. (2021), fluctuations in the business environment also influence information flows. Big Data Analytics (BDA) has emerged as a development in information technology that provides businesses with a competitive edge (Wamba et al., 2020). Technological innovation plays a vital role in business success (Ahmed et al., 2022; Bhatti et al., 2022; Ferraris et al., 2019; Zainalabideen et al., 2022). BDA is also thought to be crucial for both large and small firms since it broadens organizational potential and promotes innovation. SMEs are essential for economic success worldwide, particularly in emerging countries.

Several studies investigated eco-innovation (Zhang et al., 2022) and green innovation (Kraus et al., 2020; Rehman et al., 2022; Rehman et al., 2021). Previous research ignored green innovation while considering SMEs, particularly in developing countries. Moreover, the significance of BDAAI in the context of SMEs in emerging economies has been overlooked. Our research aims to fill this gap in the existing knowledge on CSR, green intellectual capital, green innovation, BDAAI, and green competitive advantage in the manufacturing sector. This study is the first of its kind to examine all these factors in a single study, which has previously been neglected. Our contribution underscores the need for manufacturing SMEs to adopt eco-friendly technologies and leverage big data analytics to gain a competitive edge in green initiatives. It is worth noting that the manufacturing sector holds significant potential for exports, thus making it imperative for Pakistani SMEs to focus on green innovation and BDA to enhance their competitiveness. Following are the research objectives/goals.

1. To study the association between CSR, green intellectual capital, green innovation, and green competitive advantage.
2. To investigate if green innovation significantly mediates between CSR, green intellectual capital, and green competitive advantage.
3. To study if big data analytics adoption intention significantly moderates between green innovation and green competitive advantage.

2. THEORY AND HYPOTHESES DEVELOPMENT

2.1 Natural Resource-Based View (Natural RBV)

Resource-based view postulates that organizational capabilities and resources are vital for achieving competitiveness (Barney, 1991). This view is broadened by Hart (1995) with the help of the natural RBV, which postulates that enterprises can gain competitiveness by answering to natural environmental challenges. Furthermore, they acknowledged that environmental resources, pollution prevention techniques, and firm-level competencies all contribute to long-

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term success (Hart & Dowell, 2011). Furthermore, Lenox and Ehrenfeld (1997) reported that diverse resources are crucial in developing eco-design capability. Moreover, few researchers reveal that green innovation is significantly related to green performance (Kraus et al., 2020; Rehman et al., 2021). BDA enables businesses to generate insight that helps in determining competitive advantage (Jha et al., 2020). In the same fashion, BDA and green innovation are heavily dependent on the ability of a company to quickly adopt changes and implement the necessary environmental management strategy during the innovation process (Sun et al., 2020). Empirical research on environmental innovation and sustainable competitive advantage has been done from dynamic capability perspectives (Mady et al., 2021). The researchers paid less attention to measuring green competitive advantage through CSR, green intellectual capital, green innovation, and BDAAI by using natural RBV. This study used CSR (economic, social, and environmental), green intellectual capital (human, relational, social, and structural), green innovation (process and product), and BDAAI in enhancing green competitive advantage in light of natural RBV.

2.2 Corporate Social Responsibility (CSR) and Green Innovation

CSR is the responsibility of a firm to pursue plans, make choices, and follow lines of action that add value to society. According to Málovics et al. (2008), CSR has become more significant in business life. CSR has gained much concentration in recent years (Sawhney et al., 2022).CSR is the awareness of a firm's capabilities and its self-regulation to achieve them (Duong & Tran, 2022; Phuoc et al., 2022). CSR plays a vital role in a firm's success (Hang, 2022; Poma et al., 2022). In a recent study on SMEs, researchers examined the relationship between CSR and economic performance; for instance, Hernández et al. (2020) discovered a significant relationship between CSR and economic performance. Yuan and Cao (2022) studied Chinese manufacturing companies and reported that CSR is significantly related to green innovation. Our study used the most widely used three CSR dimensions: economic, social, and environmental (Alvarado-Herrera et al., 2017; Kraus et al., 2020). Thus, following is the suggested hypothesis:

H_1. CSR positively determines green innovation.

2.3 Green Intellectual Capital and Green Innovation

Organizations are focusing on intangible assets rather than tangible assets in today's competitive environment to achieve sustainable performance (Agostini et al., 2017), and it is thought that an organization's survival depends on intangible assets (Obeng et al., 2014) through value creation that will enhance performance and competitive advantage (Roos, 2017). Chen (2008b) introduced a novel term, green intellectual capital, and defined it as an investment in environmental protection-related intellectual capital that satisfies environmental management requirements and offers a competitive advantage. As a result of external environmental constraints, organizations have only recently realized the value of having employees who are knowledgeable about the environment to promote green innovation and management (Chang & Chen, 2012). Besides, many organizations are prioritizing environmental knowledge and culture in light of current environmental concerns so they can create and implement environmentally oriented innovative strategies to take advantage of new opportunities and establish long-term competitive advantage (Chang & Chen, 2012). The researchers reported a significant relationship between green intellectual capital and green innovation (Wang & Juo, 2021). Likewise, Rehman et al. (2021) found that green intellectual capital is significantly related to environmental innovation. In light of these arguments, we suggest the following:

H_2. Green intellectual capital is positively determined green innovation.

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2.4 Green Innovation and Green Competitive Advantage

Technological advancements used to lessen environmental impact are referred to as "green innovations" (Li et al., 2020). Green innovation is divided into two categories product/service innovation and process innovation. Improving how goods and services work for consumers and clients is the ultimate goal of product and service innovation. At the same time, process innovation aims at increasing organizational flexibility and achieving cost-effectiveness. Furthermore, green processes and product innovation also lower costs and waste, lessening the adverse environmental impact of firms and improving organizational social performance (Weng et al., 2015). Mady et al. (2021) conducted a study on Egyptian SMEs and reported that positive association between environmental innovation and competitive advantage. Rehman et al. (2021) reported a positive association between green innovation and environmental performance in Malaysian manufacturing firms. Therefore, we suggest the following:

H3. Green innovation positively determines green competitive advantage.

2.5 The mediating role of Green Innovation

It was suggested in the earlier discussion that the relationship between green intellectual capital and green innovation lead to environmental performance (Rehman et al., 2021). Kraus et al. (2020) reported that green innovation significantly mediates CSR and environmental performance relationships in manufacturing firms. Wang and Juo (2021) argued that green innovation significantly explains the relationship between green intellectual capital and green performance. While according to Hart (1995), the relationship between environmental resources and competitive advantage may be further elaborated by green innovation. To balance CSR, intellectual capital, and green competitive advantage, green innovation is integrated as a mediating variable. Figure 1 depicts the research framework. Therefore, the following are the hypotheses of the study:

H_4. Green innovation significantly mediates between CSR and green competitive advantage.

H_5. Green innovation significantly mediates between green innovation and green competitive advantage.

2.6 Big Data Analytics Adoption Intention (BDAAI) as a Moderator

BDA capabilities can analyze data, aid in the exploration of valuable assets and capabilities, add strategic value, promote the development of capabilities, and improve an organization's competitiveness. Additionally, it was asserted that BDA aids businesses in gaining a competitive advantage (Zhang et al., 2022). Similarly, it was argued that BDA encourages innovation and business expansion in SMEs and that SME growth is dependent on innovation strategies (Maroufkhani et al., 2019). BDA also gives SMEs the ability to concentrate on problems, make choices, and gain a competitive edge (Rialti et al., 2019). Additionally, several previous studies investigated the relationship between BDA, green innovation, and competitive advantage (Dong et al., 2022). Thus, following are the hypotheses of the study:

H_6: BDAAI positively determines green competitive advantage.

H_7: BDAAI significantly moderates between green innovation and green competitive advantage.

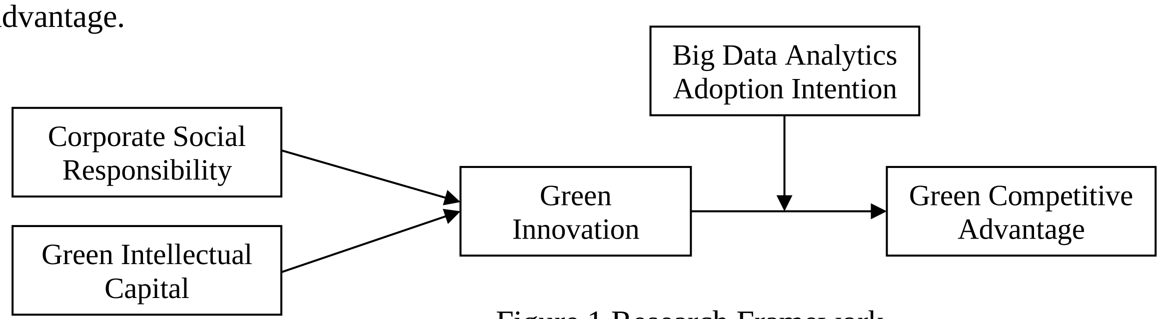

Figure 1 Research Framework

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3 METHODOLOGY

3.1 Questionnaire development

This study is based on five constructs CSR, green intellectual, green innovation, BDAAI, and green competitive advantage. All variables are used wholly in the study. CSR has three dimensions: environmental, economic, and social CSR. Environmental CSR includes seven items, economic CSR includes eight items, and social CSR includes nine items adapted from Rehman et al. (2022). Furthermore, green intellectual capital has four dimensions. Green human capital included five items, green structural capital included nine items, and green relational capital included four items adapted from (Chen, 2008a, 2008b). Similarly, green social capital includes four items from Delgado-Verde et al. (2014). Moreover, green innovation includes two dimensions. Green product innovation and green process innovation have four items, each adapted from Chen et al. (2006). Additionally, BDAAI includes three items from Sun et al. (2020). Lastly, green competitive advantage was measured with the help of four items adapted from Chen and Chang (2013). All measurement items were based on a 5-point Likert scale to get a better response (Almoussawi et al., 2022; Chidambaram et al., 2021; Prabowo & Sinaga, 2021). Moreover, Data collection for this cross-sectional, quantitative study involves questionnaires.

3.2 The study population & sample

The data was gathered from manufacturing SMEs working in Pakistan in the textile, leather and fashion, chemical, and auto industries. The data was gathered from the capital cities of Punjab province, the province with 61% of the manufacturing SMEs. The lists of manufacturing SMEs were obtained from the chamber of commerce and industries, and data were gathered through simple random sampling. Each manager/owner of an SME was a unit of analysis. Comrey and Lee (1992) argued that a sample size of 1,000 is regarded as excellent. Based on these recommendations, 1000 questionnaires were distributed, and due to a lack of time, some respondents did not respond. Only 496 questionnaires were ultimately examined for analysis.

Table 1: Demographic Information

Demographics	**Category**	**Frequency**	**%**
Gender	Male	469	94.56
	Female	27	5.44
Hierarchy Level	Senior Manager	461	92.94
	Junior Manager	35	7.06
Firm Type	Textile	253	51.01
	Leather & Fashion	119	23.99
	Chemical	81	16.33
	Automobile	43	8.67
Education Level	Bachelors	56	11.29
	Masters	391	78.83
	M.Phil/MS	8	1.61
	Others	41	8.27
No. of Employees	20-100	11	2.22
	101-150	266	53.63
	151-250	219	44.15

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The data may have been influenced by Common Method Bias (CMB) because it was collected through self-reported questionnaires (Podsakoff & Organ, 1986). To lessen the impact of CMB, procedural and statistical methods are used. Herman's single-factor test has a 50% cutoff, but in our study, it is much lower at 30.260%. As a result, this study shows no signs of CMB (Podsakoff & Organ, 1986). The demographic information of owners of SMEs is shown in Table 1. Out of 496 respondents, 94.56% were male, and 5.44% were female. According to the hierarchy, there were 92.94% senior managers and 7.06% junior managers. Additionally, SMEs related to the textile sector were 51.05%, the leather and fashion sector includes 23.99% SMEs, the chemical sector includes 16.33%, and the automobiles sector includes 8.67% SMEs. Most of the respondents (78.83%) have a master's degree. In addition, 11.29% of managers have a bachelor's degree, 1.16% have an M.Phil./MS, and 8.27% have another (in Pakistan, M.Phil/MS is a degree after master's and before a Ph.D.). Furthermore, 2.22% of SMEs have between 20 and 100 employees, 53.63% have between 101 and 150 employees, and 44.15% have between 151 and 250 employees.

4 RESULTS

4.1 The Measurement Model

To test the hypotheses, we used the PLS-SEM technique through SmartPLS. When the normality assumptions are violated, partial least square (PLS) is thought to be an appropriate strategy. Additionally, when the sample is small, multicollinearity issues are present (Hair et al., 2014). The study is based on first- and second-order constructs. PLS-SEM incorporates structural models and measurements.

Table 2 Convergent Validity

First Order Constructs	**Second Order**	**Items**	**Loadings**	**AVE**	**CR**	**α**	**VIF**
Environmental CSR		ENV1	0.773	0.644	0.927	0.908	1.557
		ENV2	0.856				
		ENV3	0.728				
		ENV4	0.808				
		ENV5	0.832				
		ENV6	0.796				
		ENV7	0.818				
Economic CSR		ECO1	0.753	0.597	0.922	0.904	2.084
		ECO2	0.746				
		ECO3	0.783				
		ECO4	0.786				
		ECO5	0.771				
		ECO6	0.776				
		ECO7	0.780				
		ECO8	0.786				
Social CSR		SOC1	0.777	0.630	0.939	0.926	1.932
		SOC2	0.813				
		SOC3	0.704				
		SOC4	0.837				
		SOC5	0.827				
		SOC6	0.785				
		SOC7	0.784				
		SOC8	0.845				
		SOC9	0.761				
		ENV	0.787	0.693	0.871	0.778	1.558

	Corporate Social Responsibility	ECO	0.846				
		SOC	0.862				
Green Human Capital		GHC1	0.842	0.703	0.922	0.894	2.115
		GHC2	0.802				
		GHC3	0.825				
		GHC4	0.850				
		GHC5	0.873				
Green Relational Capital		GRC1	0.841	0.657	0.905	0.870	1.657
		GRC2	0.804				
		GRC3	0.816				
		GRC4	0.777				
		GRC5	0.812				
Green Social Capital		GSOC1	0.888	0.760	0.927	0.895	1.920
		GSOC2	0.824				
		GSOC3	0.897				
		GSOC4	0.876				
Green Structural Capital		GSC1	0.787	0.602	0.931	0.918	3.330
		GSC2	0.775				
		GSC3	0.785				
		GSC4	0.800				
		GSC5	0.805				
		GSC6	0.781				
		GSC7	0.698				
		GSC8	0.775				
		GSC9	0.769				
	Green Intellectual Capital	GHC	0.799	0.663	0.887	0.833	1.558
		GRC	0.806				
		GSOC	0.755				
		GSTC	0.891				
Green Product Innovation		GPDI1	0.830	0.707	0.906	0.862	1.791
		GPDI2	0.859				
		GPDI3	0.842				
		GPDI4	0.832				
Green Process Innovation		GPRI1	0.768	0.717	0.910	0.868	1.804
		GPRI2	0.880				
		GPRI3	0.872				
		GPRI4	0.862				
	Green Innovation	Green Product	0.927	0.830	0.907	0.797	1.059
		Green Process	0.895				
Big Data Analytics Adoption Intention		BDAAI1	0.840	0.710	0.880	0.798	1.050
		BDAAI2	0.825				
		BDAAI3	0.863				
Green Competitive Advantage		GCA1	0.822	0.694	0.901	0.853	
		GCA2	0.827				
		GCA3	0.847				
		GCA4	0.836				

The measurement model is supported by numerous reliability and validity tests (Hair et al., 2014). Table 2 highlights that the highest and lowest loading values in this study, at 0.927 and 0.698, respectively, are above the required value of 0.50 (Hair et al., 2014). Furthermore, the

CR & alpha values are above the required threshold (Hair et al., 2014). Similarly, the AVE values of all the constructs are higher than the required benchmark value of 0.50. Moreover, all the VIF values are below the cutoff of 5, indicating no sign of multicollinearity (Hair et al., 2014).

Discriminant validity was historically measured through the method developed by Fornell and Larcker in 1981. Since traditional metrics, according to Henseler et al. (2015), had significant drawbacks, a novel method, such as the heterotrait-monotrait ratio (HTMT), was introduced. Table 3 highlights the first-order HTMT values for constructs, and the maximum value of HTMT is 0.793, which is below the required threshold of 0.85. Similarly, Table 4 shows the second-order discriminant validity values, which indicates that the maximum HTMT value for second-order constructs is 0.732, which is less than the required value of 0.85, and the discriminant validity assumption is fulfilled.

Table 3: Heterotrait-monotrait ratio (HTMT) for first-order

	BDAAI	ECO-CSR	ENV-CSR	GCA	GHC	GPR IN	GPDIN	GRC	GSC	GSTC	SOC-CSR
BDAAI											
ECO-CSR	0.267										
ENV-SCR	0.121	0.563									
GCA	0.548	0.181	0.183								
GHC	0.107	0.503	0.237	0.156							
GPRIN	0.243	0.328	0.311	0.470	0.327						
GPDIN	0.223	0.449	0.414	0.517	0.265	0.764					
GRC	0.382	0.507	0.274	0.404	0.549	0.461	0.519				
GSC	0.044	0.516	0.408	0.172	0.570	0.323	0.355	0.426			
GSTC	0.236	0.609	0.277	0.260	0.793	0.294	0.354	0.643	0.719		
SOC-CSR	0.271	0.665	0.546	0.240	0.430	0.323	0.538	0.531	0.466	0.536	

Table 4: Heterotrait-monotrait ratio (HTMT) for second-order

	BDAAI	CSR	GCA	GIN	GIC
BDAAI					
CSR	0.287				
GCA	0.548	0.265			
GIN	0.267	0.589	0.567		
GIC	0.239	0.732	0.318	0.531	

4.2 Structural Model

A total of seven hypotheses are included in our study: four direct, two mediating, and one moderating. Analysis was conducted with the help of SmartPLS using bootstrapping runs of 5,000 subsamples. Table 5 highlights that CSR is significantly related to green innovation (β= 0.314, p=0.000 and t=6.419) and supported H_1. Green intellectual capital is significantly related to green innovation (β=0.265, p=0.000 and t=4.952) and H_2 are supported. Green innovation is significantly related to green competitive advantage (β=0.372, p=0.000 and t=8.270), and H_3 is supported. Furthermore, BDAAI is significantly related to green competitive advantage (β=0.421, p=0.000 and t=9.069); similarly, BDAAI significantly moderates between green innovation and green competitive advantage (β= 0.165, p=0.000 and t=3.584); therefore, H_4 and H_5 are supported. Moreover, green innovation significantly mediates CSR and green competitive advantage relationship (β= 0.117, p=0.000 and t=5.827); similarly, green innovation significantly mediates green intellectual capital and green competitive advantage relationship (β=0.099, p=0.000 and t=3.827); therefore, H_6, H_7 are supported respectively.

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According to Cohen (1988), the f^2 value can be divided into three categories: small effect size (f^2 = 0.02), medium effect (f^2 = 0.15), and high effect (f^2 = 0.35). Table 5 shows that all the values of f^2 are above 0.35. R^2 and Q^2 were calculated to determine the research model's predictive ability. According to the literature and the R^2 using SmartPLS had to be at least 10% (Falk & Miller, 1992). This study reveals that the R^2 value of green innovation is 0.269 and the green competitive advantage is 0.358. All the values of R^2 are above the required threshold. Similarly, Q^2 tells about the predictive relevance of the model, and its value should be greater than zero. All the values of the model are above the required threshold.

Table 5: Hypotheses testing

Hypotheses	Paths	B-Value	t-values	p-values	f^2	Remarks
H1	CSR → GIN	0.314	6.419	0.000	0.086	Yes
H2	GIC → GIN	0.265	4.952	0.000	0.062	Yes
H3	GIN → GCA	0.372	8.270	0.000	0.212	Yes
H4	CSR → GIN → GCA	0.117	5.827	0.000	-	Yes
H5	GIC → GIN → GCA	0.099	3.827	0.000	-	Yes
H6	BDAAI → GCA	0.421	9.069	0.000	0.257	Yes
H7	GI*BDAAI → GCA	0.165	3.584	0.000	0.042	Yes

5 DISCUSSION

The results explain that CSR, green intellectual capital, green innovation, and BDAAI are used to determine green competitive advantage. These days, organizations' involvement in enhancing their competitive position is compulsory to guarantee their survival in the market (Ong et al., 2022). The detailed results report that CSR is positively related to green innovation; therefore, H_1 is supported. Kraus et al. (2020) reported that CSR and green innovation are significantly related. Likewise, green intellectual capital is significantly related to green innovation, and H_2 is supported. This outcome is supported by (Wang & Juo, 2021). Rehman et al. (2021) studied that green intellectual capital is significantly related to green innovation. The results are in favor of natural RBV that environmental resources significantly determine green innovation (Hart, 1995; Hart & Dowell, 2011). Moreover, results reported that green innovation is significantly related to green competitive advantage and H_3 is supported. Mady et al. (2021) conducted a study on Egyptian SMEs and reported that environmental innovation is significantly related to competitive advantage. Riaz and Ali (2023), while studying Pakistani SMEs, argued that environmental innovation leads to the competitiveness of SMEs.Natural RBV supported this argument that green capabilities lead to green competitive advantage (Hart, 1995; Hart & Dowell, 2011).

Green innovation significantly mediated CSR, green intellectual capital, and green competitive advantage and supported H_4 and H_5. The natural RBV postulated that green capabilities strengthen the association between environmental resources (i.e., CSR and green intellectual capital) and sustainable competitive advantage (Hart, 1995; Hart & Dowell, 2011).

Additionally, the study found that BDAAI is significantly related to green competitive advantage and supported H_6. Prior research reveals that big data analytics is significant in measuring green performance (Waqas et al., 2021) and competitive advantage (Jha et al., 2020). The results align with natural RBV that organizational technologies assist in attaining sustained competitive advantage (Hart, 1995; Hart & Dowell, 2011). Finally, BDAAI significantly moderates the relationship between green innovation and competitive advantage; therefore, H_7 is supported. Prior researchers supported this relationship (Dong et al., 2022; Zhang et al., 2022). Innovation is heavily emphasized in the literature on manufacturing SMEs, but it cannot,

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by itself, keep up with shifting consumer demands. The demand for environmentally friendly products, services, and processes has increased along with environmental concerns. The study determines how CSR, green intellectual capital, green innovation, and BDAAI affect GCA based on data from manufacturing SMEs.

5.1 Conclusion

Due to the increasing importance of environmental issues and the depletion of natural resources, green factors are highly discussed. The natural environment is being harmed by the majority of innovation activities. Manufacturing SMEs have a significant ecological footprint because these companies are concerned with producing, processing, and consuming environmental resources. However, these footprints and environmental risks can be reduced with the aid of environmental strategies, giving attention to CSR activities, green intellectual capital, and through the adoption of BDA. Furthermore, by addressing environmental issues, SMEs can increase their customer base and gain a green competitive advantage. Therefore, this study found that CSR, green intellectual capital, green innovation, and BDAAI significantly determine green competitive advantage. Furthermore, the study also aims to advance the theory of natural RBV. While according to Hart (1995), the relationship between environmental resources and green competitive advantage can be explained by green innovation.

5.2Research Implications

Numerous theoretical and practical implications stem from this study. According to the best researchers' knowledge, this is initial research that integrates CSR, green intellectual capital, green innovation, BDAAI, and green competitive advantage in one framework. Prior researchers overlooked determining green competitive advantage through CSR, green intellectual capital, green innovation, and BDAAI (Kraus et al., 2020; Rehman et al., 2021; Waqas et al., 2021). This study further calls for research on CSR, green intellectual capital, green innovation, and BDAAI to determine green competitive advantage and sustainable performance. Our study is a preliminary investigation into green innovation that applies the theory of the natural RBV to manufacturing SMEs in developing countries using CSR, green intellectual capital, BDAAI, and green competitive advantage. Second, from the perspective of green innovation, earlier researchers overlooked how manufacturing SMEs in developing countries might impact the environment. Overall, this study adds to green innovation and BDAAI by providing an integrative framework based on the natural RBV.

Practically, this empirical study deepens our existing understanding of which digital tools and environmental resources can be used by organizations to attain organizational sustainability and competitive advantage (Broccardo et al., 2023; Rehman et al., 2023). Besides, researchers reveal that innovation and sustainability can be attained through technological factors and green factors (Lardo et al., 2020). This study suggests that manufacturing SMEs can concentrate on environmental resources like CSR and green intellectual capital and green innovation if they want to attain a competitive edge over competitors. Furthermore, legislators should acknowledge the seriousness of the situation and develop laws and regulations that could oversee and control the environmental impact of manufacturing.Finally, this study suggests that BDAAI strengthens the relationship between green innovation and green competitive advantage. Hence, manufacturing SMEs cannot ignore BDAAI if they want to attain a competitive advantage.

5.3 Limitations and Recommendations

Like other studies, this study also has some limitations. A cross-sectional approach is used. The data is collected from manufacturing SMEs and figure researchers can collect data from large

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manufacturing organizations to see if the results vary or not. Prior researchers used the internet-of-things and green HRM to determine green competitive advantage (Rehman et al., 2023). In future research, internet-of-things can be used to determine sustainability. In future research, top management support can be used as a moderator. Future research could be done in developed countries or other developing economies to confirm the results. Future research may also compare developed and developing countries or may perform a cross-country analysis.

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