Remittances Review
April, 2024
Volume: 9, No: 2, pp.3467-3488
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

Received: 05 February 2024, Accepted: 05 April 2024
DOI: https://doi.org/10.33282/rr.vx9i2.178

Role of Financial Conditions: Impact of Green Intellectual Capital on Environmental Sustainability

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Abstract

This study discusses the effect of green intellectual capital on the environmental sustainability of manufacturing firms in Pakistan. Further, it examines the role of financial conditions as a significant mediator between green intellectual capital and environmental sustainability. Questionnaires were used for data collection from 373 respondents who were top-level managers of manufacturing firms, and SPSS and Smart PLS were used for analysis. Partial least square structural equation modelling was performed to test hypotheses. Findings indicate that green human, structural, and relational capital are positively related to environmental sustainability. Similarly, green human, structural, and relational capital are positively related to financial conditions. Financial conditions act as a mediator between green human, structural, relational capital and environmental sustainability. This shows that intangible resources results in competitive advantage, enhancing the firm's goodwill. It also suggests that firms must restructure their business models and strengthen their financial conditions to maximize profits and enhance environmental sustainability. This study contributes to the literature of the intellectual capital view and resource-based view theory by discussing the importance of investment in green intellectual capital. With this investment, firms can attain a competitive advantage, maximize their profits, and contribute to protect society, improving health, and working for welfare. By executing environmental friendly technologies and methods, manufacturing firms can diminish the costs related to resource consumption and regulatory compliance. Maintaining environmental sustainability promotes practices that preserve natural resources and reduce ecological harm.

Keywords: green intellectual capital, green human capital, environmental sustainability, green structural capital, financial conditions, green relational capital.

1. Introduction

In the past few years, problems related to sustainable development and environmental performance have been identified worldwide in firms (Shehzad et al., 2023). For firms, one of the challenging task is to sustain environmental sustainability (ES), especially in developing countries, as they need to transform their operations and activities according to environmental requirements while focusing on economic goals (Gupta et al., 2018; Ilyas et al., 2024). ES is considered as a tool that provides advantages to shareholders, improves the living standards of individuals, and protects the environment (Savitz, 2013). It is necessary in developing countries to focus on ES because of challenging issues regarding the environment. Notably, environmental concerns are faced by manufacturing firms worldwide because this industry plays a major part in environmental issues because of their activities; these issues include carbon emissions, global warming, and damage to the environment (Ali et al., 2021). In the list of populated countries at the global level, Pakistan is at fifth rank, and after agriculture, its manufacturing sector is the 2nd largest sector providing employment (Shehzad et al., 2023). This is why natural resources are used at a vast level in manufacturing firms in countries like Pakistan, leading to global problems and disturbing the performance of the economy (Sharma et al., 2021). Therefore, developing economies must focus on the solutions that can help to solve these environmental and economic problems and improve their ES; this can be attained by rearranging their business models (Chaudhry & Chaudhry, 2022). It is required to provide attention to those aspects of business that help the firm maximize profits, gain a competitive edge, and attain ES. This dual focus on profit and ES helps emerging economies like Pakistan tackle environmental problems by attaining a competitive edge after working on certain factors. The motivation of this study is to recognize those factors.

Among different factors, one significant aspect is green intellectual capital (GIC), which is considered to be a dynamic capability and critical tangible resource helping the firms to achieve a competitive edge and enhance the ES (Rehman et al., 2021). Generally, GIC is identified as a multidimensional notion that defines it as a resource that is non-financial and non-physical for the firms on the basis of their practical capabilities, understanding, and skills to develop a valuable firm (Allameh, 2018). Mainly, three concepts represent GIC: human, structural, and relational. Chen (2008) observed that green human capital (GHC) is valuable because it utilizes the assets built in employees, like their skills, commitments, experiences, and capabilities collectively towards protecting the environment. Wang et al. (2011) found that the firms that make investments in GHC make their performance better. Chen (2008) presents GHC as the "organizational asset which show concerns about environmental protection or green innovation inside the company and those assets named as strategies regarding organizational commitments, capabilities, reward systems, culture, databases, knowledge management system,

information technology, company images, copyrights, and trademarks." Further, green structural capital (GSC) helps firms streamline their procedures and systems, which develops dynamic capabilities in the organization and enhances technological understanding. Therefore, these dynamic capabilities of firms escalate the achievement of sustainable performance because of its GSC (Jadoon et al., 2021). Moreover, existing studies provide an understanding of relational capital. The concept of green relational capital (GRC) was introduced by Chen (2008) as "intangible assets of the company that are based on the relationship between organization and supplier, customers, green innovation, network members, and partners about corporate environmental management to obtain competitive advantages ."The strengths among suppliers' relations with firms contribute to GRC and help attain a competitive advantage.

Despite GIC, another significant factor is financial conditions (FIC), which shows where the firm is positioned in the market. FIC is measured through the financial aspects of firms from several financial statements. (Chaudhry & Chaudhry, 2022) discusses that FIC is the firm's capability to make investments and helps increase environmental sustainability. With the existence of GIC, firms can gain ES, and this mechanism is better facilitated in the presence of FIC. Besides this improvement of investment in GIC, it also provides contribution to safeguard society, improves health, and working for welfare.

However, the GIC's importance and its results were acknowledged, but there is requirement to investigate more regarding the integration in firms to produce profit and achieve ES at same time. Moreover, studies explore GIC with other results like sustainable performance (Yusliza et al., 2020), green human resource management (Yong et al., 2019), green competitive advantage (Astuti & Datrini, 2021), and environmental performance (Rehman et al., 2021). However, more studies need to focus on GIC and its contribution to ES, where FIC is a mediator. This leaves many questions that need to be addressed regarding profit generation aspects and environmental concerns. To fill this knowledge gap and offer an in-depth understanding, this study focuses on GIC's impact on ES, where FIC plays a significant part as a mediator. The proposed research questions are below:

RQ1. Does GIC influence ES?

RQ2. Does GIC influence FIC?

RQ3. Does FIC mediate the relationship between GIC and ES?

This study conceptualizes GIC (GHC, GSC, and GRC) and their potential influence by enhancing FIC. It is not an easy job to follow regulations; they are acknowledged as obstacles in the way of firms' future success (Chaudhry & Chaudhry, 2022). Therefore, the primary attention is provided to intangible resources that result in competitive advantage, enhancing the firm's goodwill. It also suggests that firms restructure their business models and strengthen their FIC to maximize profits and enhance ES. This study focuses on the Pakistani manufacturing sector

because of its major contribution to employment. This will help the country's manufacturing firms develop their business models, focus on intangible resources with the rise of GIC, and strengthen their FIC for a profitable entity, leading to ES and contributing to making Pakistan a greener country with their green initiatives.

After the introduction in Section 1, the literature review on variables will be provided in Section 2. Then, Section 3 will show the methods and techniques used for this study in methodology. The other sections present results, a discussion with implications, and a conclusion with limitations and future suggestions.

2. Literature Review

2.1.Theoretical foundation

Intellectual capital (IC) is noted as a major determinant of production, which enables firms to have a competitive advantage. It shows the "intangible or knowledge assets" (Martín-de-Castro et al., 2011), presenting the perspective of the "Knowledge-based view (KBV)" theory (Leonard-Barton, 1992). The extension of this model is "Intellectual capital based view (ICV)" theory introduced by Erik Sveiby (1997). A firm's wealth is improved with the help of skills, knowledge, experience, and intellectual property (Stewart, 2010). Maditinos et al. (2011) discuss that IC is the major determinant that differentiates the market and book value. GIC is built with three dimensions, including GHC, GSC, and GRC (Reed et al., 2006). The model proposed in this study consists of major contributors, i.e., GIC and its role in ES. ICV provides support to this relationship.

Furthermore, the "Resource-based view (RBV)" theory describes that the high performance of firms is because of its resources like strategic tools, capabilities, and resources. Enhancing the firm's value increases its competitive edge, improves its performance, and aligns with the RBV concept (Hsiaoa et al., 2019). The resources can be GHC, GSC, and GRC. Therefore, a strong base is provided by ICV and RBV theory to the current study's model. It is conceptualized on this basis that when investments are made in GIC, an increase in resources and capabilities gives a competitive advantage and increases profitability. These relations are discussed in-depth in the review of the literature.

2.2.GIC and ES

Environmental awareness plays a critical role in maintaining the FIC of manufacturing firms (Chen, 2008). Moreover, focus on environmental protection introduces GIC as a potential factor in firms that address and help tackle ES's challenges. GIC includes three dimensions. Firstly, GHC includes employees' knowledge, attitudes, creativity, experience, abilities, capacity for innovation, and commitment to ES. In the environmental transformation era, the primary purpose is to achieve long-term ES, and firms having GHC smoothly achieve ES. GHC is instrumental in gaining a sustainable competitive edge, and its distinct qualities benefit both the organization and the environment, as Campbell et al. (2012) discussed. Maintaining competitiveness depends

upon having GHC, which is a pivotal strategic method significantly working for firm development (Wright, 1994); GHC provides knowledge and skills of employees that are significant for being adaptive to changes and helpful for the development of today's business environment.

Secondly, GSC enhances organizational significant performance (Hsu & Wang, 2012; Sharabati et al., 2010). Moreover, to address climate concerns, firms must maintain a strong environmental infrastructure. Inadequate organizational systems and procedures are associated with low performance (Widener, 2006). Competent contextual performance in a manufacturing sector also improves a culture that is favorable to employee skill development (Florin et al., 2003). The implementation of GSC significantly improves ES within manufacturing firms, promoting practices that prioritize ecological protection and resource efficiency. Through strategic investment in green infrastructure and operational context, companies can reduce their environmental impact and participate in a more sustainable future.

Lastly, GRC was established on the notion that firms are acknowledged not to be separate entities except those with good relations to a great extent towards the environment (Hormiga et al., 2011). GRC is the connection of the firms as well as the knowledge according to customers' requirements (Yitmen, 2011). GRC is known for its effective relationship with stakeholders, including consumers, employees, etc., leading to outstanding performance and competitiveness (Bontis et al., 1999; Johnson, 1999). When firms have relationships on the basis of green practices, this reduces the carbon footprint with green activities and ultimately enhances firms' ES. From above discussion, it is hypothesizes that:

H1: GHC positively influences ES

H2: GSC positively influences ES

H3: GRC positively influences ES

2.3.GIC and FIC

GIC is the main component that distinguishes market and book value (Maditinos et al., 2011). Among its dimensions, GHC is “the summation of employees’ knowledge, skills, capabilities, experience, attitude, wisdom, creativities, and commitments, etc. about environmental protection or green innovation, and was embedded in employees, not in organizations" (Chen, 2008). GHC plays a vital role in improving environmental performances in firms that may decrease waste, reduce manufacturing costs, make the environment pollution-free, and raise eco-friendly clients and consumers, resulting in profitability. GHC has achieved significance in addressing environmental problems Gupta et al. (2018) along with green product innovation and sustainability (Chen, 2008; Chen et al., 2006) that improves FIC (Li et al., 2019). GHC's presence produces good-quality products that differentiate firms from their competitors (Chang & Chen, 2014; Lin & Chen, 2016) and ultimately enhances FIC (Liao, 2018).

GHC is a synopsis of "employees' attitudes, capacities, proficiencies, competencies, knowledge, inventiveness, innovation, and commitment to the development and protection of the environment" (Chen, 2008). It means that GHC incorporates the implicit knowledge, skills, and experiences acquired by employees within a manufacturing firm (Ngah & Ibrahim, 2012) and includes the knowledge generated through collaborative efforts or the specialization of workers, as well as information inherently associated with human capabilities (Chaudhry & Chaudhry, 2022). The FIC of an organization indicates its position within the manufacturing firm, typically evaluated through a combination of financial instruments such as statements of cash flow and profit and loss and the balance sheet. The financial performance recognizes the company's position and how effectively its management works in the context of operational activities (Chaudhry & Chaudhry, 2022). These metrics comprehensively evaluate the organization's financial health and operational performance within its operational domain. Chaudhry and Chaudhry (2022) discuss that FIC is the firm's capability to make investments and helps increase environmental sustainability. When skillful and expert employees have capabilities, they will better work to strengthen the firm's FIC. Thus, based on RBV theory, this study proposes that:

H4: GHC positively influences FIC

GSC is described as "the organization's process, patents, copyrights, culture, and procedures" (Chaudhry & Chaudhry, 2022). A powerful GSC facilitates GHC; if it is weak, then it offers opportunities for improvement. GSC is the factor of organization, which is determined as an infrastructure process used for providing products and services (Ivashchenko et al., 2017). (Chaudhry et al., 2016; Chen, 2008; Yahya et al., 2015) define GSC as an organizational capability, commitment, KMS, managerial philosophy, culture, company's image, patent, and trademark towards environmental protection and green innovation. Improving GSC has been identified as a key factor that plays a positive role in improving the FIC of the manufacturing sector (Erinos & Yurniwati, 2018). GSC includes all undertakings aimed at attaining environmental conservation and fostering sustainable results, as Delgado-Verde et al. (2014) discussed. With the understanding from above discussion, it is proposed that:

H5: GSC positively influences FIC

According to Rezaei et al. (2016), GRC is the capability to connect with stakeholders and market in an eco-friendly environment, make interpersonal links, enhance relationships, and build trust. Chen (2008) defined GRC as the relationship of the company with the consumers, suppliers, members of the network as well as partners on ES. GRC offers a combined network among an organization and its stakeholders, including customers, suppliers, partners, competitors, and other related parties, aimed to enhance sustainable environmental management and green initiatives (Chaudhry & Chaudhry, 2022). GRC facilitates increased profitability and a competitive edge for manufacturing firms (Chen, 2008). The organization's relational practices, addressed by Hansen (2014), are instrumental in cultivating environmentally sustainable

performances. GRC and FIC associations highlight their pivotal roles in improving profitability and firms' competitive advantage. GRC means that there is a sharing of knowledge among partners, focusing on the contribution and communication to encourage holistic relationships (Yamin et al., 1997) and work for the betterment of the firm and environment. It is proposed that:

H6: GRC positively influences FIC

2.4.Mediating role of FIC

ES represents a strategic method that enables the execution of operational strategies aimed at improving manufacturing firm's practices (Benitez-Amado et al., 2015). Effective measures for environmental performance are critical, especially in enhancing environmental operation's costs, market, regulatory, and public pressures, as well as voluntary initiatives and international standards (Initiative, 1997). Financial reporting, with its standardized data sources, plays a pivotal role in assessing the impact of FIC on ES (Montabon et al., 2007). Additionally, such initiatives can improve the firm's reputation, contributing to increased revenues (Montabon et al., 2007). As stated by RBV Barney (2001), when the firm's resources are valuable and non-replaceable, it can increase sustainable competitive advantage. GHC is defined as the environmental competencies of employees Huang and Wang (2008) that are valuable for gaining a competitive advantage (Campbell et al., 2012; Seleim et al., 2007), which increases the performance of the company and ultimately enhances ES (Chaudhry & Chaudhry, 2022).

The GSC represents financial infrastructure and environmental resources built in manufacturing firms, adaptable even during employee turnover. Jadoon et al. (2021) defined it as patents, trademarks, organizational culture, and capabilities contributing to FIC and ES. Sustainability efforts in the manufacturing sector substantially improve GSC and its positive impact on the firm's FIC Agustia et al. (2019). As discussed by Yadiati (2019), it shows that the effectiveness of a firm is enhanced through the utilization of GHC, thus contributing to ES and performance enhancement.

Many studies have discussed the relationship between GIC and firm valuation, considering strategic approaches (Baiburina & Golovko, 2008; Huang & Wang, 2008). There is association among GRC, business practices, and economic sustainability management and aim to develop a structure that manages intangible assets (Chaudhry & Chaudhry, 2022). FIC determines organizational effort towards ES with the encouragement of GRC. It is discussed that the financial health of manufacturing firms shows how effectively investments in environmentally conscious human resources collaborate within the firm's long-term ES (Shrouf et al., 2020). FIC is pivotal between GRC and ES, influencing their connections and investments for the development of firms. ES can be enhanced by increasing GRC (Chaudhry & Chaudhry, 2022). All stakeholders, as well as the environment, obtain benefits from the firms that adopt green strategies. Therefore, firms that invest more in GIC will significantly influence GIC's impact on corporate sustainability (Chaudhry & Chaudhry, 2022). To obtain a more effective and

advanced understanding of the GIC (HC, SC, RC) on ES through FIC, we proposed the following hypotheses.

H7: FIC mediates the relationship between GHC and ES

H8: FIC mediates the relationship between GSC and ES

H9: FIC mediates the relationship between GRC and ES

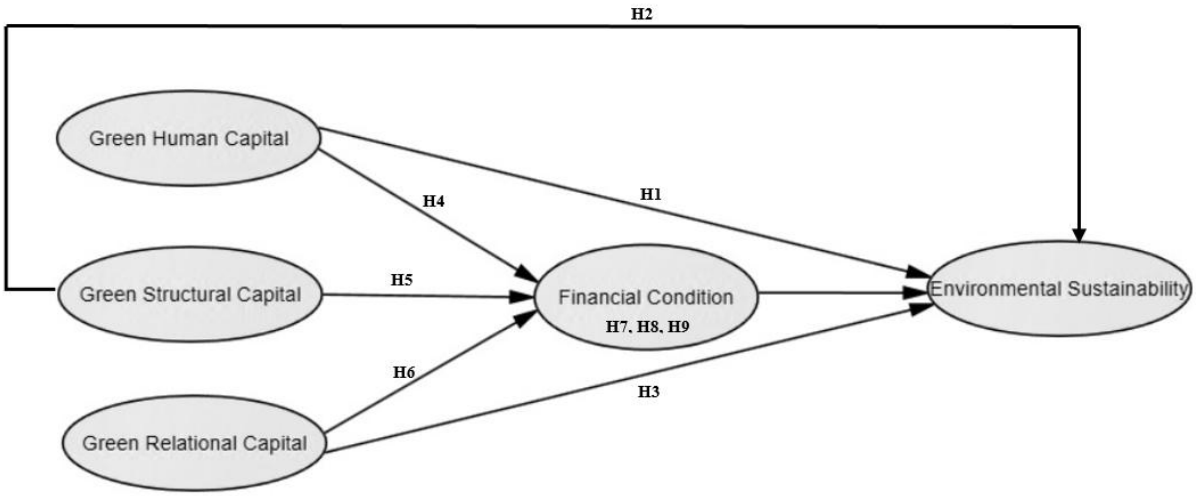

Figure 1: Research Framework

3. Methodology

For data collection, manufacturing firms were selected, where the top-level managers were the unit of analysis. To decide the sample size, Kline (2015) suggestion of "10 times rules" was implemented, and according to this, the current study must have 280 respondents. Therefore, 480 emails containing questionnaires and a cover letter were sent to the companies, and a request was made to the top managers to fill out the mailed questionnaire. After this distribution through the mail, two more emails were sent; the first one described the study's aim and the confidentiality guarantee. After this email, 149 responses were returned. The second mail was a reminder regarding the participants, which did not provide a response; this was sent three weeks after the first mail and resulted in 128 more responses. After waiting for three more weeks, one final mail was decided to send; this also helped and produced 103 responses. In this way, 380 responses were obtained, where 7 had missing values of more than 25%, and they were discarded, leaving 373 valid responses. These 373 responses were utilized for analysis. This analysis was performed on SPSS and Smart PLS. This analysis comprises "Measurement model assessment" and "Structural model evaluation". Hair et al. (2017) discuss these two steps in PLS-SEM, where the first step includes examining the measurement model. If this measurement model fulfills the criteria, then it is necessary for researchers to evaluate the structural model. Researchers can

utilize confidence intervals of bootstrap to analyze that the reliability of the construct is more than the suggested minimum. Likewise, it can also be tested that measure reliability is lower than the suggested maximum criteria (Hair et al., 2019).

3.1.Measures

The measurement of GIC was carried out by utilizing its three dimensions. The construct containing 19 items, which was adopted by Yusliza et al. (2020) and developed by Chen (2008), was used, comprising 5 GHC items, 9 GSC items, and 5 GRC items. For example, "The amount of cooperative teamwork concerning environmental protection in our firm is more than that of our major competitors" (GHC), "The overall operational processes for environmental protection in our firm work smoothly" (GSC), and "Our firm has well cooperative relationships concerning environmental protection with our strategic partners" (GRC). ES was measured by Bangwal et al. (2017) by a 7-item scale, including items such as "We prefer to buy or produce environmentally-friendly products than the others."

FIC measure was adopted from (Chaudhry & Chaudhry, 2022) containing 3 items, which were validated in a study by Le et al. (2019) and introduced by Burritt (2004). One item includes "Enterprise spends much money on environmental management activities." These were measured on a 5-point Likert scale developed by Likert (1932). This was a response scale that measured the viewpoints of individuals regarding a topic. A bipolar structure is used to show the responses containing negative as well as positive responses and facilitate researchers to gather knowledge based on both directions and individual opinion intensity (Hair et al., 2017; Hutchinson, 2021).

1. Results

1.1.Demographics

The demographics of respondents are shown below (Table 1):

Table 1 Demographics

		Frequency	**%**
Gender	Male	245	65.7
	Female	128	34.3
	Total	373	100.0
Education		Frequency	%
	14 Years	7	1.9
	16 Years	107	28.7
	M.Phil.	238	63.8
	PHD	21	5.6
	Total	373	100.0
Age		Frequency	%
	Less than 26	81	21.7
	26-35	78	20.9
	36-45	144	38.6
	46-55	63	16.9
	56 & above	7	1.9
	Total	373	100.0
Experience		Frequency	%
	less than 1	79	21.2
	1-5	170	45.6
	6-10	72	19.3
	11-15	42	11.3
	16-20	7	1.9
	21 & above	3	.8
	Total	373	100.0

The study surveyed 373 respondents, mostly male (65.7%) and M.Phil. educated (63.8%), with a wide range of ages and work experiences, mostly between 1-5 years (45.6%).

1.2.Statistical Analysis

Hair et al. (2017) introduced two methods for evaluating PLS-SEM. Firstly, the measurement model is assessed, and after its satisfactory fit, the next method is the structural model evaluation. These two methods with their steps are presented next:

1.2.1. Measurement Model

In the measurement model, the first step is the evaluation of loading indicators, also known as "Factor loading" (Table 2). It is suggested to have a factor loading of >0.708, as it shows that more than 50% of the indicator's variance is shown by construction (Purwanto, 2021). The loading is >0.7 for each variable, thus showing the reliability of the item, which is acceptable.

The second step is the evaluation of internal consistency's reliability, and most researchers utilize "Composite reliability." A high value shows a great extent of reliability; for instance, if it is between 0.60-0.70, it seems acceptable, but a value between 0.70-0.90 means it is in the "satisfactory to good" range (Purwanto, 2021). The results of CR are greater than 0.7. The reliability of studies like the current study are based on a significant size, must be ≥0.70; therefore, the Cronbach's alpha of each measure is >0.70, further validating reliability.

In the third step, convergent validity is discussed for each measure by Hair et al. (2019). Convergent validity is “the extent to which the construct converges to explain the variance of the items” (Purwanto, 2021). The metrics include AVE, where the loadings are squared, and their mean value is computed. The AVE ≥0.50 is acceptable, showing the 50% variance in each measure's items. The values of AVE in Table 2 are >0.50.

Table 2 CFA

Rotated component matrix						Reliability and convergent validity			
Items	1	2	3	4	5	α	CR	AVE	
GHC1	0.90					0.95	0.95	0.83	
GHC2	0.90								
GHC3	0.90								
GHC4	0.93								
GHC5	0.91								
GSC1		0.89				0.97	0.97	0.80	
GSC2		0.92							
GSC3		0.93							
GSC4		0.88							
GSC5		0.88							
GSC6		0.83							
GSC7		0.93							
GSC8		0.93							
GSC9		0.87							
GRC1			0.89			0.92	0.92	0.77	
GRC2			0.90						
GRC3			0.88						
GRC4			0.87						
GRC5			0.84						
FIC1				0.89		0.88	0.88	0.81	
FIC2				0.89					
FIC3				0.91					
ES1					0.81	0.94	0.95	0.75	
ES2					0.89				
ES3					0.85				
ES4					0.88				
ES5					0.85				
ES6					0.88				
ES7					0.87				

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Table 3 HTMT values

	ES	FIC	GHC	GRC	GSC
ES					
FIC	0.69				
GHC	0.58	0.63			
GRC	0.70	0.69	0.64		
GSC	0.64	0.69	0.68	0.70	

Table 4 Fornell-Larcker criterion

	ES	FIC	GHC	GRC	GSC
ES	0.86				
FIC	0.64	0.90			
GHC	0.55	0.58	0.91		
GRC	0.66	0.62	0.60	0.88	
GSC	0.61	0.64	0.65	0.67	0.89

The fourth step evaluates discriminant validity, showing that the construction level is distinct from other model constructs (Hair et al., 2019). It is recommended by Fornell and Larcker (1981) that there must be a comparison of the AVE construct with correlation among "quadratic constructs" of similar constructs and the other measures in the model. The combined variance should not be >AVE, and values in Table 4 are not greater than AVE. However, the literature discusses the requirement of other metrics than this criterion. It is evaluated by Henseler et al. (2015) that when there is a slight difference in the loading of the indicator, then FornellLarcker criteria do not work soundly. Despite this, (Henseler et al., 2015) present a "heterotrait-monotrait ratio (HTMT)". The HTMT value in Table 3 shows that the values are <0.85, confirming the validity.

For model fitness, SRMR was computed, whose value must be <0.08, and the value of SRMR of this model is 0.047, showing a satisfactory fit. Further, the NFI value is 0.806, which is nearest to the threshold value. This shows that model is fit for further exploration.

1.2.2. Structural model assessment

The study consists of seven direct and three mediating hypothesis. To confirm the hypotheses, the path coefficient and significance of statistics were utilized. The hypothesis' results are shown in Figure 3.

Table 5 SEM

	Effects	Estimate	S.D	P	T Statistics	Decision
H1	GHC -> ES	0.13	0.03	.001	3.37	Supported
H2	GSC -> ES	0.19	0.04	.000	4.46	Supported
H3	GRC -> ES	0.19	0.05	.000	3.81	Supported
H4	GHC -> FIC	0.20	0.05	.001	3.43	Supported
H5	GSC -> FIC	0.30	0.06	.000	4.64	Supported
H6	GRC -> FIC	0.30	0.07	.000	3.94	Supported
Indirect Effects						
H7	GHC -> FIC -> ES	0.13	0.03	.001	3.37	Supported
H8	GSC -> FIC -> ES	0.19	0.04	.000	4.46	Supported
H9	GRC -> FIC -> ES	0.19	0.05	.000	3.81	Supported

Firstly, the direct relationship was evaluated. Table 5 presents the positive influence of GHC on ES (β 0.130, p=0.001), GSC on ES (β 0.197, $p < 0.001$), and GRC on ES (β 0.193, $p < 0.001$) supporting H1, H2 and H3. Moreover, H4, H5, and H6 are supported by the results showing a positive impact of GHC on FIC (β 0.202, p =0.001), GSC on FIC (β 0.307, $p < 0.001$), and GRC on FIC (β 0.300, $p < 0.001$).

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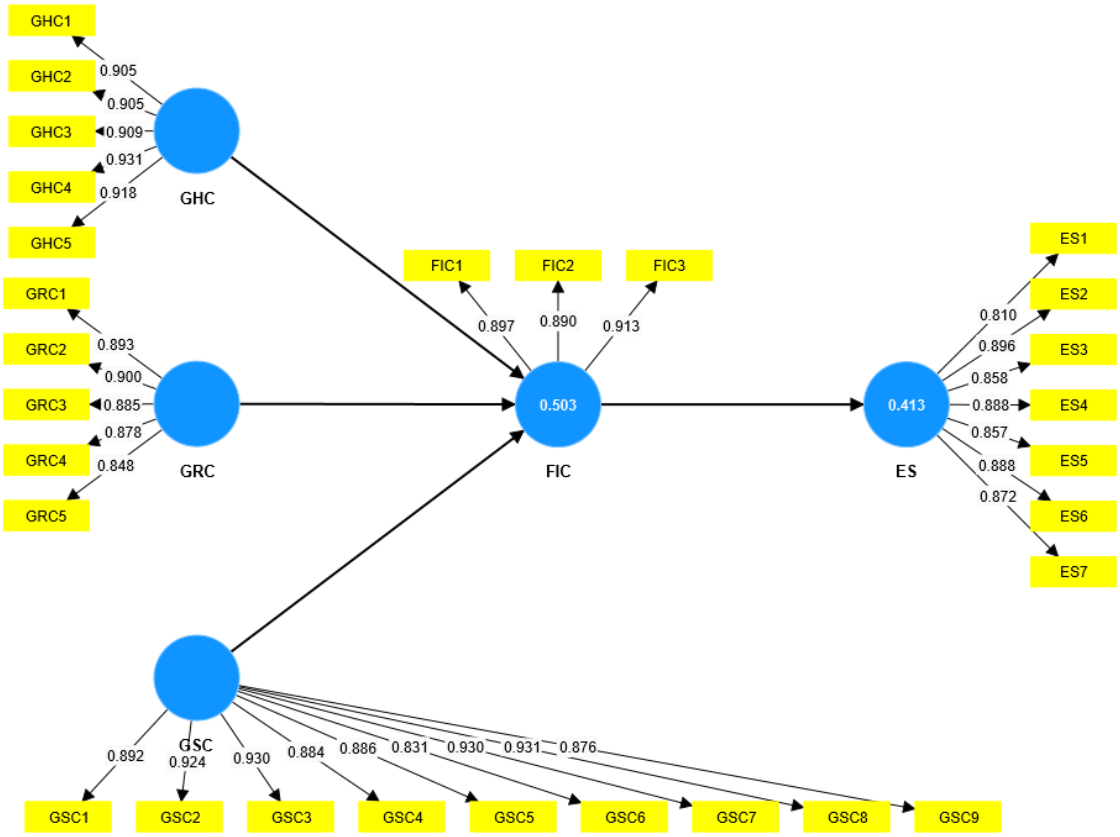

Figure 2: PLS algorithm

Next to evaluate mediating hypotheses, bootstrapping was performed regarding the indirect effects. For H7, H8, and H9, results show that GHC→FIC→ES (β 0.130, p=0.001), GSC→FIC→ES (β 0.197, p < 0.001), and GRC→FIC→ES (β 0.193, p < 0.001) and supporting hypotheses.

2. Discussion

The findings of the study provide strong support for the hypotheses proposed in the theoretical framework (Figure 2). The first set of hypotheses (H1, H2, and H3) focuses on the direct influence of GHC, GSC, and GRC on ES. The study affirms that GHC, consisting of employees' knowledge, creativity, and commitment to environmental sustainability, indeed positively influences ES. This aligns with studies highlighting the instrumental role of knowledgeable and committed employees in achieving long-term environmental goals (Campbell et al., 2012). Further, GSC and GRC positively impact ES and are, according to literature, where importance has been provided to organizational infrastructure and connections with stakeholders to encourage the conservation of the environment and efficiency of resources (Bontis et al., 1999; Mention & Bontis, 2013). The second set of hypotheses (H4, H5, and H6) explores the relationship between GIC and FIC. The study confirms that GHC positively

influences FIC, emphasizing the importance of employees' knowledge, skills, and commitment to enhance financial performance and sustainability (Chang & Chen, 2014; Liao, 2018). Additionally, the role of GSC and GRC in enhancing FIC further supports the idea that a robust green infrastructure and positive stakeholder relationships contribute significantly to financial outcomes within the manufacturing sector (Chen, 2008; Delgado-Verde et al., 2014).

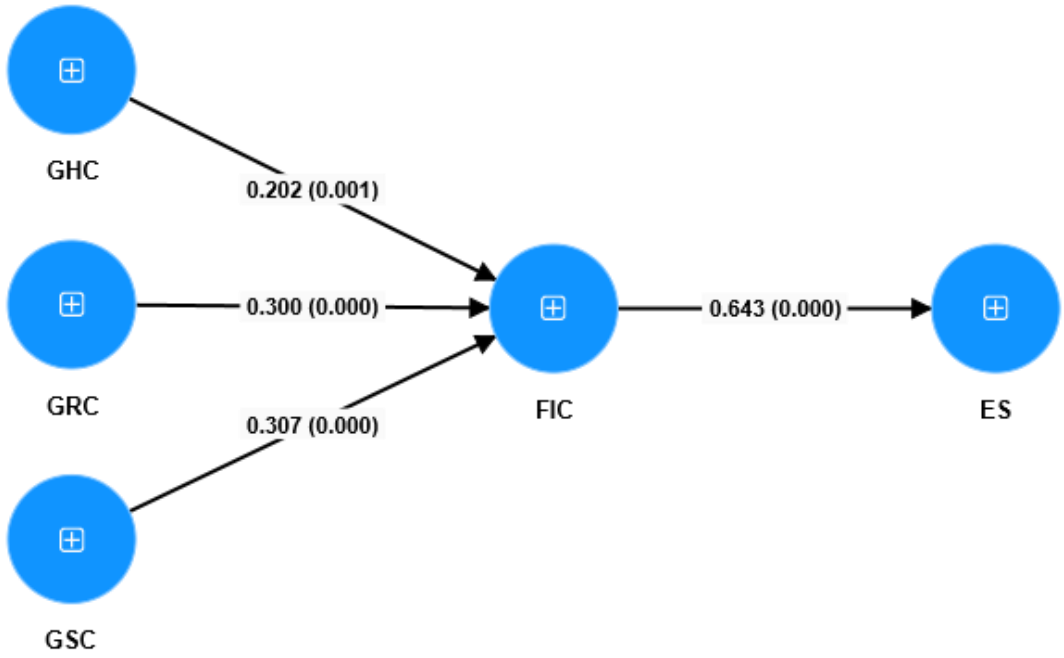

Figure 3: Structural Model

In the third set of hypotheses (H7, H8, H9), It is validated that FIC mediates the association between GHC, GSC, GRC and ES, like perspectives of RBV theory, which emphasizes that investments in resources that are valuable and not replaceable result in the achievement of competitive advantages (Barney, 2001)

The study validates the mediating role of FIC, showing the efforts of organizations and investments for solid integration of green initiatives and accomplishment of ES. The associations in this study are supported by ICV and RBV theory. ICV highlights the intangible asset’s values, such as skills and understanding, while RBV focuses on strategic resources and capabilities' role to improve a firm's performance.

2.1.Implications

The theoretical implications of this study are significantly advanced from the theoretical point of view. The RBV theory contributes to this study by focusing on GIC as a valuable resource for manufacturing industries. This study enriches RBV by highlighting the strategic management of green IC, which can lead to sustainable competitive advantages and outstanding business practices. This study improves the understanding of RBV theory by incorporating

sustainability dimensions into the strategic allocation method. ICV theory enhances its scope by demonstrating how GHC, SC, and RC are within the context of integral components of GIC in manufacturing firms.

This research outlines the relationship between environmental performance and organizational awareness and provides valuable insight into how firms strategically leverage and create IC in organizations. GIC helps to achieve competitive advantage and sustainable development. Investment in green practices can potentially enhance their fiscal health. By executing environmentally friendly technologies and methods, these firms can diminish the costs related to resource consumption and regulatory compliance. Maintaining ES promotes practices that preserve natural resources and reduce ecological harm.

3. Conclusion

The basic aim of the study is to evaluate the GIC influence on ES in Pakistani manufacturing firms. The three dimensions of GIC, including GHC, GSC, and GRC, were individually explored, and their relationship with ES was tested with the mediating effect of FIC on GIC and ES. Data was collected from 373 top-level managers currently serving manufacturing firms in Pakistan. PLS-SEM was used for a structured and robust analysis of data. GIC (GHC, GSC, and GRC) positively impacts FIC and ES, where FIC positively mediates the relationship between GIC and ES. These results provide answers to the proposed research questions.

3.1.Limitations and future suggestions

As mentioned in the preceding contributions, this study also has few limitations that could be addressed in future studies. Firstly, a cross-sectional approach was adopted to collect data that may be needed to correctly examine causal relationships in the model. Secondly, the sample size was comparatively small and limited to developing countries, which restricts the generalizability of the findings to developed countries.

So, future researchers can consider these limitations by adapting a longitudinal approach, which provides deep insight into the causal relationship between GIC and ES. In this model, sustainable business performance can be considered a dependent variable.

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