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ACHIEVING BUSINESS SUSTAINABILITY THROUGH GREEN INTELLECTUAL CAPITAL: MEDIATING ROLE OF VALUE CREATION AND GREEN INNOVATION

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Business Sustainability, Green Intellectual Capital, Green Structural Capital, Green Relational Capital, Value Creation, Green Human Capital, Green Innovation

ABSTRACT

The importance of Green Intellectual Capital (GIC) has been growing internationally in the era of the knowledge economy. Due to rising environmental concerns, it is crucial to investigate the effects of green intellectual capital on organizational sustainability in the present day. Hence this study aims to investigate the linkage between green intellectual capital and business sustainability. By using a resource-based approach, it also addresses the issue that how Value Creation (VC) and Green Innovation (GNIN) can mediate between Green Intellectual Capital and Business Sustainability (BS), in the context of the manufacturing sector of Pakistan. A quantitative approach based on SEM and Smart PLS is used. The primary data collected through a close-ended survey questionnaire from 553 middle and upper management of manufacturing sector in Punjab, Pakistan. The results indicated that the association and influence of GIC on the business sustainability of Pakistani manufacturing firms were statistically significant, however the relationship between GNIN and VC was minimal. Notably, all variables showing GIC, GNIN, and VC had a positive and significant effect on business sustainability. Furthermore, GNIN and VC successfully played a mediating role between GIC and BS. Therefore, Pakistani manufacturing enterprises have been suggested to incorporate GNIN and VC in order to achieve business sustainability. However, this research was limited to the Pakistani manufacturing sector and cannot be generalized to other sectors or countries.

INTRODUCTION

GIC consists of skills, knowledge, intellectual property, and other assets that could be used effectively throughout time to enhance the value of the company (Wang & Ullah, 2021).

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Prior studies had proven a connection between BS and intellectual capital as well as the creation of value (Minoja & Romano, 2021). Russo and Fouts (2020) also emphasized how crucial it is for organizations to understand the concept of sustainability in business. Economic, social, and environmental factors are the three pillars on which the idea of sustainability in business is based (Deleaniz & del Bosque, 2013). The sustainable performance may be reflected in corporate control over profitability, social and market share, and environmental damage. Because of today's intense global competition, businesses must concentrate on their efficiency and demonstrate a sense of social responsibility that contributes to a cleaner, greener world (Erinos & Rahmawati, 2017). Growing environmental concerns worldwide have led companies to embrace environmentally friendly methods, and the notion of going green has been gaining attention among academics and professionals in recent years (El-Kassar & Singh, 2019; Yong et al., 2019). On the other hand, environmental regulations impose extra expenses on businesses to combat pollution, which may have a detrimental effect on performance (Huang et al., 2021). In order to respond to this negative impact, several businesses have turned to GNIN (Achi et al., 2022; Wu et al.,2022). Bai et al. (2019) defined GNIN as "the creation of products, processes, or technologies that reduce emissions. Wang and Jiang (2021) have concluded in their study that GNIN efficiently complements ecological preservation with the economic performance of the business

Green Structural Capital (GSC), Green Human Capital (GHC) and Green Relational Capital (GRC) are the three has three sub-constructs of GIC. GHC is an employee's skill set that strategically increases productivity (Yusoff et al., (2019). The total GHC indicates workers' creativity, effort, experiences, attitudes, and abilities towards environmental sustainability or GNIN (Wang & Juo, 2021), While GRC includes cooperation with all the stakeholders on environmental initiatives (Yusoff et al., 2019). GRC, as stated, depends upon a close connection between partners. (Wang & Juo, 2021). Hence, organizations can achieve sustainable performance by engaging extensively in GIC via their workers' environmental expertise and other collaborations (McDowell et al., 2018). Similarly, in order to maximize the wealth of the company's core stakeholders, such as customers, employees, and shareholders, every firm must focus on creating value for its stakeholders (Windsor, 2017). In a competitive environment, many researchers argue that the process by which an organization's resources are managed, recognized, and utilized in order to transform it from being ordinary to a market leader is primarily based on intellectual capital (Barney, 1991; Bhatti & Zaheer, 2014 and Inkinen, 2015). The resource-based view RBV also revolves

around developing a unique strategy with the firm's present resources that can create value for the customers and stakeholders; this VC can lead the firm to achieve a competitive advantage (Yadiati et al., 2019). According to the resource-based view (RBV), an organization's distinct assets and heterogeneous resources, which are valuable, rare, inimitable, and non-substitutable, create a competitive advantage (Barney, 1991; Asiaei et al., 2022). These characteristics make these assets and resources valuable, rare, inimitable, and non-substitutable.

Pakistan's manufacturing sector has a 10-percent annual growth rate, but most sectors are involved in non-compliance with this environmental standard. This motivates the researcher to investigate the same issue, as that previously suggested by (Yahya & Rahman, 2019), in the context of Pakistani`s manufacturing sector. Hence this study would be an effort to reduce or eliminate the gap in past studies by examining the mediating relationship of VC between GIC and BS. Because of the rise in global temperatures, now is the best time for companies to invest in GIC and develop strategies based on RBV theory to improve their knowledge of developing a green sustainable environment theme on the VRIO (Value, Rare, Imitable, and Organize) framework presented by (Barney, 1991) to evaluate the internal resources of companies. This elaborates on how a business can produce value, build their rare and cannot easily be imitable strategies, and arrange their resources to assist them in attaining sustainable position in a market (Yadiati et al., 2019).

Every organization use its knowledge and experience to improve its processes in today's competitive environment. However, only those organizations can achieve sustainability by differentiating themselves and producing goods and services that are unique, inimitable, and valuable for the stakeholders. According to Zameer et al.'s (2020), the expectations of customers have increased society's and the government's manufacturing companies' understanding of green strategies for decreasing environmental harm and achieving a competitive advantage. In this approach, GNIN entails unique creation, procedure, or management methods and techniques intended to decrease the environmental cost (Singh et al., 2020), while green technologies improve the firm's performance. The same problem has been left unresolved in GIC, BS, and VC, as suggested by (Ullah et al. 2021). Similarly, Asiaei et al. (2022) It was also suggested that the methods by which intellectual capital is transformed into VC are crucial for businesses addressing future sustainability challenges. We suggest GNIN as an unobserved intervening variable via which GIC can be translated to achieve BS in order to address how to convert such organizational practices. Therefore, this

study addressed the two critical gaps. Firstly, the study focuses to investigate the mediation role of VC between GIC and the BS of manufacturing sector firms in Pakistan. Secondly, Secondly, the study tries to reduce the ambiguity in the extant literature by examining how GNIN plays a mediating role between GIC and BS, especially in the context of Pakistani manufacturing firms.

Theoretical background

Resource Based View (RBV) by Barney (1991) and Intellectual Capital-based View (ICBV) theories by Reed et al. (2006) are the two leading theories that would be used in this study. (Barney, 1991) argued that the primary source of gaining competitive advantage is the firm's internal resources. so the organizations should focus on inside resources rather than the external environment. When the resources and capacities are valuable, rare, imitable, and organized (VRIO), the BS can thrive in the long run (Yahya & Rahman, 2019; krishnaswami, 2017 & Barney, 1991). However, RBV, on the other hand, disregards the connections between the organization and the environment. The organization's strategic valued resources and competencies are also intangible assets. However, Bontis (1998) pointed out that estimating the value of these intangible assets is difficult. To overcome the limitations of intangible measurement, they proposed the intellectual capital-based view (ICBV), which uses methods for measuring intellectual capital (Reed et al., 2006). Intangible or intellectual resources were the main emphasis of ICBV. In order to create the intangible resources that contribute to corporate sustainability, this research intends to integrate the "green" into conventional intellectual capital.

LITERATURE REVIEW

Relationship between Green Intellectual Capital and Value Creation

The notion of Intellectual Capital can be summarized as the mixture of intangible assets such as acknowledge, client relationships, skills & expertise of the workforce, information & databases, the organization’s authority structures, innovations capacities and capabilities, social norms, and organization beliefs. (Yaseen et al.,2016 and Yahya & Rahman, 2019). It's been discovered that environmental awareness and Intellectual capital go hand in hand, leading some researchers to coin the term "Green with intellectual capital" (Chen, 2008; Huang & Kung, 2011; and Yahya & Rahman, 2019). GIC includes knowledge of employees, databases, internal relations, external relations, processes, or systems (Bombiak, 2022). GHC, GSC, and GRC are all components of GIC. GHC denotes the commitment, inventiveness, attitude, knowledge, and skills that an organization's workforce demonstrates toward

environmental sustainability. A company's ability to ensure environmental sustainability through its production methods is directly proportional to the number of capable personnel it has (Ullah et al., 2021). A firm's stock of relationships with essential stakeholders in environmental management, along with GNIN, is referred to as the company's "Green Relational Capital (GRC). The majority of businesses that are active in an emerging economy place a strong emphasis on GRC, which necessitates the formation of long-term relationships between those businesses and their suppliers (Anwar et al., 2020). These partnerships are necessary for the businesses to continue to be economically viable and to act in a manner that is consistent with sustainability. To be considered "Green Structural Capital," a company must focus intensely on environmental stewardship and GNIN throughout all aspects of its business operations. This includes its trademarks, copyrights, and patents, as well as its brand image, corporate culture, management philosophy, and environmental stewardship and innovation capabilities. As a result, when businesses in developing nations change their logos, it communicates that they are concerned about environmental sustainability, which in turn helps them draw in more customers (Keramitsoglou et al., 2020).

The VC is essential for a company to be successful in the business-to-consumer market (Lindman et al. 2016). The creation of value is a logical way which defines organization expertise and identity which separates one organization from another operating under same market environment and this can be done when organization utilize their resources in a meaningful way (O'Cass & Sok, 2013). Many researchers argues that VC is largely based on intellectual capital which describe the process by which the organization resources are managed, recognized and utilize to change its position from being ordinary to market leader in a competitive environment (Chahal & Bakshi, 2015; Bhatti & Zaheer, 2014; Inkinen, 2015; Barney, 1991; Edvinsson &Sullivan, 1996; Stewart & Ruckdeschel, 1998; López-Gamero, Zaragoza-Sáez, Claver-Cortés, & Molina-Azorín, 2011). Similarly, many researchers argued that the process by which an organization's resources are managed, recognized, and utilized in order to transform it from being ordinary to a market leader is primarily based on intellectual capital (Barney, 1991; Bhatti & Zaheer, 2014 and Inkinen, 2015). Hence in the light of above mentioned literature we deduce that;

H_1: *There is a significant relationship between GIC and VC.*

Relationship between Green Intellectual Capital and Green Innovation

HC is a crucial resource for organizational innovation, according to, Subramaniam and Youndt (2005), because staff knowledge is crucial to maintaining a company in the context of

the present, fast expanding technology. Employees are therefore likely to be more driven to use their knowledge of the environment to GNIN. GNIN exists when a business introduces a new product, service, or process to satisfy the requirements of its stakeholders. In prior research, Cao et al. (2021) and Hilkenmeier et al. (2020) developed the dynamic capabilities perspective as an extension of the resource-based view, stating that a company's unique capabilities and resources are the crucial factors in establishing and sustaining its competitive advantage. Differentiation brought about by the requirement for GHC investment may greatly promote GNIN. A company will experience more substantial success with GNIN if it has a greater degree of GHC (Singh et al., 2020 and Lin et al., 2022). Green structural capital (GSC) is the explicit knowledge that is integrated into an organization's systems, databases, and programs to promote employee performance and productivity (Edvinsson & Malone, 1997). An organization's performance can be improved by having a solid structure and skilled staff who can deliver high-quality services (Amrizah & Nawal, 2013). An innovation that lacks effective mechanisms and an environmental culture will struggle to innovate in a green way. Valuable environmental protection knowledge can be exploited for GNIN when it is codified and then systematically shared and distributed throughout the organization (Machado & Martnez, 2019). It is important to integrate new environmental knowledge, skills, and experience into the business in order to maintain productive working relationships with other collaborators. This can encourage the sharing of innovation knowledge and help GNIN succeed. As a result, businesses with GRC can create new environmental technologies, concepts, and opportunities within a network of cooperation (Dickel et al., 2018).

H_2: *There is significant relationship between GIC and GNIN*

Relationship between Value creation and Business Sustainability

O'Cass and Sok (2013) demonstrated in their study that innovation capability serves as the basis for VC ability, with support from management style, staff behaviour, and marketing. Wu and Choi (2004) investigated the reciprocity function that managerial values have in the enhancement of corporate performance and competition through the establishment of trust and network relationships. According to Guenzi and Troilo (2006), an organization's skill in the marketing activities process can have an effect on the organization's ability to create value. The study concluded that market orientation and the capacity to lead the market increase an organization's chances of achieving and maintaining sustainable performance. To improve the company's competitive performance, greater investigation into its core

competencies is required (Hossain et al., 2020a; Rahman et al., 2020a). Hence The following hypothesis is proposed based on a review of the relevant literature and existing research;

H_3: *There is a significant relation between VC and BS.*

Relationship between Green Innovation and Business Sustainability

Sustainability has become an intrinsic aspect of business across all industries as a result of the increased demand for environmentally friendly goods (Dengelico 2010a, 2015a). Previous research conducted by Wong indicated a significant relationship between GNIN and business competitiveness (Wong 2020). According to Xie et al. (2019) claimed that green process innovation and green product innovation, two parts of GNIN, can boost companies' bottom lines. GNIN has the potential to greatly lower their expenses and improve their social performance, and recycling practices have a positive influence on the performance of businesses (Akbar et al., 2022 and Kushwaha 2016). Moreover, the increasing demand for eco-green products has resulted in sustainability being an intrinsic aspect of all economic sectors (Lin, 2013). The findings showed that green market orientation and environmental and social performance are strongly positively correlated. (Shaukat, 2016 and Hafeez et al., 2023). Hence we may deduce that the GNIN may have a positive influence on sustainable business performance.

H_4: *There is a significant relation between GNIN and BS.*

Relationship between Green Intellectual Capital and Business Sustainability

GHC, being an important component of GIC, refers to a company's employees' dedication to environmental sustainability or GNIN as well as their attitude, creativity, expertise, and competence in this area. DeVos and Vander Heijden (2017) concluded that the competence and aptitude of the organization's personnel are crucial for the sustainability of the business environment. To strengthen the sustainability of their business, firms must assure GHC in the working environment. Similarly, GSC, the second component of GIC, contains all types of trademarks, copyrights, patents, firm reputations, organizational cultures, business commitments, stewardship of the environment, and GNIN skills etc. This concept gives the business a focus on environmentally green manufacturing procedures in addition to sustainable product development. This is how the company uses environmental sustainability to improve business performance (Yusliza et al. 2020; Fernandoetal.2019). GSC is integrated into the corporate green culture value, reflecting the company's external environmental focus as well as future economic growth and regeneration. According to Yong et al. (2019), GSC has a favorable impact on the sustainability of businesses. GRC, the third component of GIC,

denotes cooperation on environmental strategies with outside parties (Chen, 2008a, 2008b; Yong et al., 2019; Yusoff et al., 2019). Most emerging-economy companies place a high priority on GRC, where they establish long-term relationships with suppliers to ensure business sustainability and conduct operations in line with environmental sustainability (Yusliza et al.2020). According to Yu and Huo (2019), GRC significantly impacted the company's success in the industry. Therefore, based on the above mentioned discussion we may deduce the following hypothesis.

H_5: *There is a significant relationship between GIC and BS.*

Value Creation mediates between Green Intellectual Capital and Business Sustainability

VC is crucial for a firm to be successful in the business-to-consumer market (Lindman et al., 2016). According to Grant (1996), a company can create value in two ways; one way is by producing a product by using scarce inputs and transforming it into output that has a greater value, the other way of VC is exploring a completely different market with the same product where the product value is praised high (Moran & Ghoshal, 2017). According to Gurau (2004), the idea of VC for the customers is directly tied to internal activities of the organization's product development process, which involve design, product, market, distribution etc. In today's competitive environment every organization attempts to use their knowledge and past experience to improve their processes but only those organizations are succeed to gain competitive edge on their rivals which differentiate themselves by producing products and services which are rare, imitable and valuable for the stakeholders and the same issue has been left till in the field of GIC, competitive advantage and VC as suggested by (Yahya & Rahman, 2019; Yong *et al*., 2019; Bhatti & Zaheer, 2014; Chahal & Bakshi, 2015). Now a days the focus of the corporations is to invest in GIC, develop a strategies using RBV theory to enhance their knowledge to develop a theme on green sustainable environment on VRIO (Value, Rare, Imitable and Organize) frame work presented by (Barney, 1991) to assess company's internal resources, this include that how can a firm create value, how they develop their strategies which are rare and cannot easily be imitable and how they organized their resources which help them to be in a sustainable position in a market (Yadiati *et al*., 2019). Hence based on the literature review the following hypothesis can be deduced.

H_6: *VC significantly mediates between GIC and BS.*

Green Innovation mediates between Green Intellectual Capital and Business Sustainability

To exhibits GNIN, a company needs to create a new product, service, or method to address the demands of its stakeholders while keeping the environment clean. GNIN can drastically

reduce costs and create opportunities to enhance business performance, whereas recycling efforts favorably impact business performance (Khan et al.2021). while companies with more GHC emissions are likely to be more environmentally innovative. Similarly, Jardon and Dasilva (2017), concluded in their study that a firms' environmental actions are not only associated with GHC, but green organizational resources also have a significant influence in increasing environment-related activities. Therefore, GSC enhances also can enhance the green process innovation process. Huang and Kung (2011) were of the view that GRC is the cooperation and commitment of a company to environmental sustainability with its customers, suppliers, and other dealers, which can also expand green practices within the organization with the passage of time. GNIN has the potential to greatly lower their expenses and improve their social performance, and recycling practices have a positive influence on the performance of businesses (Kushwaha 2016). Therefore, a hypothesis concerning the link between GIC and BS has been created and will be tested via the mediation of GNIN.

H7: *GNIN mediates the relationship between GIC and BS*

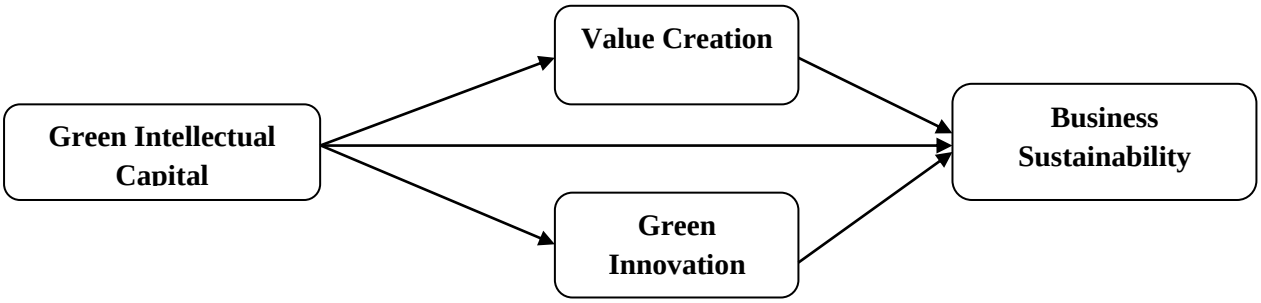

Figure 1. *Proposed Model*

METHODOLOGY

According to Pakistan's Economic Survey for 2021-22, the manufacturing sector's contribution is 9.73% of GDP and accommodates 16.1 percent of the work force of the country. Large Scale Manufacturing, a sub-sector, dominates the overall manufacturing sector, which contributes around 9.73% in GDP while adding 76.1% of the sectoral share. Hence the target audience for this research is a managerial staff of Large scale manufacturing units located in Lahore, Faisalabad, and Sialkot, the three industrial cities of Punjab province. As per the definition of under factories Act 1934, the Large Scale manufacturing covers having ten or more employees and having an annual turnover of more than PKR 800 million. Since these three cities are big industrial cities of Punjab, Pakistan and most of the industries are located in these three cities. The inclusion criteria was set for unit of analysis. The data were obtained from middle and top managers of different departments of LSM units

operating in these cities by using the convenience sampling technique. Lower level management staff was excluded, since they might not be well aware about the concept of "green" due to less exposure and low literacy rate. Sekeran and Bougie (2016, p 247) believe that to get some basic information quickly and efficiently, convenience sampling is the best way. For collection of data, total 770 questionnaires were sent to employees, either by google forms or hard copies of it. Out of which 578 responses were received in all. But it contained many invalid responses and some incomplete responses. So after screening, we left with 553 valid responses which were selected as final sample size for the study. This sample size is sufficient sample size as per Krejcie and Morgan (1970). Data was collected from the company's managerial staff of the companies, like R&D Managers, Marketing Managers, Production Managers, and HR managers etc.

Measurement Instruments

Green intellectual capital (GIC) is comprised of green human capital (GHC), green structural capital (GSC) and green relational capital (GRC). To measure GIC along with its all three sub-constructs, a total number of 19 items are adopted from (Chen 2008). To measure GININ a total of eight items adopted from (Chao &Chen, 2006), while four items for VC from (Guenzi & Troilo 2006) and to measure BS22 items from (Yusoff et al, 2019) are adopted.

Data Collection Method and Analysis.

The questionnaire was designed in google form and the link of the form was shared through emails. The emails were also sent to executive members and other administrative staff of Lahore chamber of commerce, Sialkot chamber of commerce and Faisalabad chamber of commerce as well for assistance in data collection. Furthermore, hard copies of questionnaire were also distributed to different firms to get more responses. The PLS being the most preferred method of testing the dimensions' measurement and structural model, structural equation modeling (SEM) was performed on the data using Smart PLS 4 Software. (Ringle et al., 2015) implemented the PLS algorithms with bootstrapping set to 5000 subordinate samples (Hair et al., 2011b). This was done in order to analyze the data. By calculating Cronbach's alpha (CA), rho (RHO), AVE (Chin, 1998), and confirmatory factor analysis, the SEM measurement model also takes data validity and reliability into account (CFA). Measurement model was evaluated through convergent, discriminant validity and construct reliability. The average variance and factor loading recovered were used to test the convergent validity. Additionally, the Heterotrait-Monotrait (HTMT) ratio was applied to

examine discriminant validity. R^2(coefficient of determination) was calculated to evaluate the overall impact of the model.

RESULTS

Table 1 Demographic Statistics

Demographics	Frequency	Percentage
Gender		
Female	407	74%
Male	146	26%
Age		
Under 30 yrs.	38	07%
31 to 40 yrs.	187	34%
41 to 50 yrs.	203	37%
51 & above	125	23%
Working Experience		
Less than 10 yrs.	224	44%
11 to 20yrs.	199	36%
More than 20yrs.	110	20%
Education		
Undergraduate	75	14%
Graduate	254	46%
Post Graduate	153	28%
Others	71	13%
Department		
Production & Operations	175	30%
Marketing & Sales	138	27%
Human Resource	102	19%
Finance	84	15%
Others	54	10%

Table 1 describes the respondents' demographics; 407 (74%) were males, and 146 (26%) were females. According to age, 38 (7%) were having the age less than 30 years; 187 (34%) was at the age of 31 to 40; 203 (37%) were in the age group between 41 to 50. and 125 (23%) were having the age of above 51. 224 (44%) were having less than 10 years of work experience, 199 (36%) had10-20 years' experience, and 110 (20%) over 20 years of experience. Similarly, 75 (14%) were undergraduate; 254 (46%) graduate in different fields; 153 (28) Post graduate and 71 (13%) had other qualifications. Furthermore, 175 (30%) were from the production and operations department; 138 (27%) were from marketing and sales; 102 (19%) Human resource; 84 (15%) and 54 (10%) were from other departments(Table1)

Measurement Model

To ensure that the measurement items were valid and reliable, the loadings from the results, the average variance extracted, and the composite reliability were examined. In addition, convergent validity describes the extent to which an item from an explicit factor is merged and loaded to a nearby aspect where they are regarded as being loaded (Mehmood & Najmi,

2017; Sharif & Bukhari, 2014). The results of rest of all the loadings are shown in Table 2. All the loadings are higher than 0.70. In Table 3 Convergent validity (CV)is shown by using an average variance extracted (AVE) for each component (Fornell & Larcker, 1981; Afshan & Sharif, 2016). It is clearly evident that all values of AVEs are above than 0.5, and the all CRs are all more than 0.7 means that the measurement are valid and reliable (Ramayah et al., 2018, Hair et al., 2019). Similarly, the cronbach alpha value for all variables are also above 0.70. Hence there is no issue of reliability.

Table 2: Factor Loadings

	BS	GIC	GNIN	VC
BS1	0.788			
BS10	0.798			
BS11	0.819			
BS12	0.811			
BS13	0.812			
BS14	0.792			
BS15	0.821			
BS16	0.797			
BS17	0.795			
BS18	0.804			
BS19	0.807			
BS2	0.802			
BS20	0.812			
BS21	0.804			
BS22	0.828			
BS3	0.821			
BS4	0.801			
BS5	0.797			
BS6	0.828			
BS7	0.785			
BS8	0.822			
BS9	0.813			
GIC1		0.794		
GIC10		0.819		
GIC11		0.794		
GIC12		0.809		
GIC13		0.804		
GIC14		0.801		
GIC15		0.796		
GIC16		0.807		
GIC17		0.806		
GIC18		0.811		
GIC19		0.801		
GIC2		0.799		

GIC3	0.801			
GIC4	0.804			
GIC5	0.808			
GIC6	0.795			
GIC7	0.801			
GIC8	0.791			
GIC9	0.821			
GNIN1		0.755		
GNIN2		0.763		
GNIN3		0.703		
GNIN4		0.711		
GNIN5		0.737		
GNIN6		0.703		
GNIN7		0.731		
GNIN8		0.721		
VC1			0.828	
VC2			0.826	
VC3			0.851	
VC4			0.844	

Table 3: Reliability and validity Analysis

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
BS	0.975	0.975	0.976	0.651
GIC	0.969	0.970	0.972	0.645
GNIN	0.864	0.866	0.894	0.512
VC	0.857	0.858	0.903	0.700

Table no 4 shows the results of discriminant validity. The discriminant validity was assessed using the HTMT criterion, which was suggested by Henseler et al. (2015). If the ratios were less than HTMT 0.85, it might be assumed that all measures were discriminatory. Furthermore, Franke and Sarstedt (2019) suggested that the measures are discriminant if the HTMT bootstrapping value's upper limit does not contain. The ratios were all below a cut-off value of 0.85, as indicated in Table 4, indicating that the measure are distinct.

Table 4: HTMT ratio

	BS	GIC	GNIN	VC
BS				
GIC	0.501			
GNIN	0.806	0.549		
VC	0.841	0.431	0.78	

Structural Model

Table 5: Path Coefficients, t values and P values

	Original sample	Sample mean	Standard deviation	T statistics	P values
GIC -> GNIN	0.504	0.505	0.044	11.512	0.000
GIC -> VC	0.395	0.396	0.050	7.973	0.000
GNIN -> BS	0.410	0.411	0.044	9.409	0.000
VC -> BS	0.494	0.494	0.041	11.902	0.000
GIC -> BS	0.402	0.404	0.041	9.807	0.000

Table no 5 displays the beta coefficients values as well as the probability values that correlate to each one**.** Using a 5,000-sample re-sample bootstrapping approach, the path coefficient, t-values, p-values, and standard errors were provided for the structural model, as suggested by Hair et al (2019). The results indicate that a green intellectual capital (GIC) has a positive effect on GNIN (β= 0.504, p<0.000); VC (β= 0.395, p<0.000) and BS (β= 0.402, p<0.000). Since the P-values for all these three relationship are less than 0.05 hence indicates that our hypotheses H1, H2, and H5 are significant. In other words, it can be concluded that GIC significantly impacts VC, GNIN and BS. In addition, the findings of the PLS-SEM also confirms that GNIN (β= 0.410, p<0.000) has a positive and substantial effect on (BS) of these manufacturing firms. VC with (β= 0.494, p<0.000) shows that it has significant effect on BS. In short these results confirm Hypotheses 3 and 4. In other words, the PLS-SEM findings support Hypotheses 3 and 4. Hence, in the light of all above mentioned results, H1, H2 H3, H4 & H5, all hypotheses are supported.

Table 6: Mediation analysis.

	Original sample	Sample mean	S.D	T statistics	P values
GIC -> VC -> BS	0.195	0.196	0.032	6.166	0.000
GIC -> GNIN -> BS	0.207	0.208	0.032	6.384	0.000

To examine the mediation relationship, we performed the bootstrapping method as suggested by Preacher and Hayes (2008). Table 6 showed that GIC → VC → BS has (β =0.195, p <0.05) while GIC → GNIN → BS with (β =0.207, p <0.05) results. As it is evident that the P-values for both mediation relationships were less than 0.05 which means it is significant. Hence, Hypotheses H6 and H7 were also supported. In other words, we can conclude that VC and GNIN significantly mediates between GIC and BS.

Table 7: R-square

	R-square	R-square adjusted
BS	0.685	0.683
GNIN	0.254	0.253
VC	0.156	0.154

As suggested by Hair et al. (2017), R-Square, beta and t-value are used to access structural model via bootstrapping procedure with 5000 resample (Mahmud et al., 2017 and Jahangir et al., 2022). The study examined the R-Square value, which represents the amount of variance in the endogenous constructs explained by exogenous constructs (Hair et al., 2017 and Zhao et al., 2021). R-square indicates the overall change in the Dependent variables due to predictors. It is evident from Table no 8 that the R-square BS value is 0.685 which means around 68.5% change in BS is explained by explanatory variables of the model.

Discussion and Conclusion

This study's results contribute to the first-of-its-kind literature by illuminating the factors that contribute to GNIN in LSMs in developing economies like Pakistan. Firstly, the result showed that GHC and BS had a significant relationship. This finding conforms with past studies such as Chen and Chang (2013), Chen (2008), Huang and Kung (2011), and Yong et al. (2019). The findings above portray that GIC has strong association with VC, GNINs and BS, hence, this means that we found that VC and GNIN successfully mediated the relationship between GIC and BS. This demonstrates that manufacturing companies are more receptive to GNIN and VC to achieve BS in the contemporary business environment. It asserts that when competition intensifies, businesses must provide more unique goods and services and improve their procedures in order to operate as efficiently as possible (Ullah et al. 2021a). It is clear that there is a connection between GIC (GIC), GNIN, and BS. Consequently, the knowledge and experiences of the employees were accessed in relation to GIC, including necessary skill sets, creative potential, and pertinent experience. The results also showed that GIC and BS had a positive relationship, proving that a balance between human, structural, and relational capital promotes BS. This result is consistent with that of an earlier study by Yusoff et al. (2020), which shown that GIC predicts sustainability. The results also support the claims made by the RBV hypothesis, which states that intangible resources are related to organizational success.

Additionally, it can be inferred that staff creativity is a significant element of a business's GNIN process. As a result, there is now a score on the evaluation scale that indicates the development of new concepts and knowledge. A possible explanation is that elements like

employees' talent, creativity, skills, and prior experience help GNIN rather than pose obstacles and give companies the diversity they need to change their behavior and take a more active role in innovation (Shahzad et al., 2021b). Building a distinct position in the industry has become increasingly crucial due to increased competition and workplace complexity, and it has been found that innovation can help achieve this goal. Intangible assets are currently the biggest and most productive assets for businesses (Waseem et al. 2018; Abbas et al. 2021b).

In a nutshell, resource limitations, technology improvements, rising markets, environmental degradation, and the challenges posed by new businesses to established companies have changed the business landscape more than any other time in history. The idea of "going green" has become more and more of a focus for organizations due to rising environmental awareness. The achievement of BS depends on green drivers like GIC and GNIN. On the other hand, focusing on generating value for all stakeholders can also play a big part in connecting these green drives to industrial BS.

Theoretical Implications and Future Directions.

The study makes several contributions to the body of literature. First, the study significantly advances RBV theory. Relatively little is known about the RBV outside of this setting because a large portion of empirical study on it concentrated on industrialized nations (Kamasak, 2017). This study examined the effects of intangible resources, particularly GIC on BS when mediated through GNIN and VC among employees of large-scale manufacturing firms in Pakistan, drawing on RBV theory in this context. Second, the results of the study help to integrate the intellectual capital based view (Reed et al., 2010) and RBV (Barney, 2001) theoretical lenses to explain sustainability-related problems of large-scale manufacturing in connection with the causes and effects of GNIN and VC. Intangible or intellectual resource measurement is the main focus of intellectual capital theory, which outlines what resources and competencies are needed to gain a competitive advantage in the present and the future, ultimately assisting in the achievement of BS. RBV requires the company to have strategic resources that are priceless, uncommon, unique, and non-replaceable (Barney, 2001). The results of this study imply that intellectual capital might indirectly affect the BS in LSMs through GNIN and VC, which is relevant to sustainability and firm performance that is related to sustainability.

The researchers stated that in order to attain BS, one must employ a green strategy like GNIN and VC. Previous research like Ullah et al. (2021b) and Huang et al. (2021) have praised the

improvement of the GIC implementation. Therefore, the relationship between GIC and BS is yet unknown, particularly in the context of Pakistan's manufacturing industry. Even though this study fills in this vacuum by examining how GIC affects BS, more variables might be added as mediators to determine how it affects BS.

Practical implications

The experts and decision-makers involved in the manufacturing sectors will notably benefit from this study's various implications. It suggests a conceptual framework that will serve as a guide for the Pakistani large-scale manufacturing sector in order to improve the results from the use of GNIN and VC as well as GIC. The results of this study's literature assessment demonstrate that using green intellectual models in the manufacturing industries of developing nations can lead to long-term corporate sustainability. In order to fully promote sustainability in the workplace, company management must priorities GNIN by fostering an atmosphere for intangible resources like GIC. In order to create sustainability in manufacturing organizations, management might also connect GIC and VC. Additionally, the company needs to give its staff enough training, especially in environmental protection. As a result, the workers will be able to provide goods or services that satisfy the environmental requirements set forth by clients. Additionally, the knowledge, abilities, morals, and experiences of staff members contribute to the social and environmental sustainability of LMEs and the advancement of novel social and environmental practices (Loucks et al., 2010).

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