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From Knowledge to Growth: How Intellectual Capital Drives Technological Innovation and Firm Performance in Pakistan's Manufacturing Sector

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ABSTRACT

The research study aims to evaluate the impact of Intellectual Capital (comprising Human, Relational, and Structural Capital) on firm performance in the textile industry of Pakistan, with Technological Innovation acting as a mediator. Data was collected from 308 mid and top-management employees across 36 textile companies in all four provinces of Pakistan. Using Partial Structural Equation Modeling, the study finds that Intellectual Capital positively affects firm performance both directly and indirectly. Additionally, Technological Innovation enhances the relationship between Intellectual Capital components and firm performance. The research emphasizes the need for organizations to invest in Intellectual Capital to improve performance and growth, while also suggesting future studies in other sectors and using different research methodologies.

INTRODUCTION

Intellectual capital (IC) is an essential intangible resource that significantly enhances a firm's value and competitive advantage, especially in today's rapidly changing information-based economy. In this environment, technological innovations serve as critical drivers for increasing productivity in manufacturing organizations. Countries worldwide, particularly China with its ambitious "Made in China 2025" initiative, are actively pursuing innovation and strategic adaptation to address rising operational costs and improve efficiency.

(Xu, J., et al, 2019). At the same time, Malaysia is focusing on developing human capital as a key step in its transition to a more sophisticated knowledge-based economy, as outlined in its national planning documents (Kamaluddin, A., & Rahman, R. A., 2013). Recent studies indicate that innovation plays a crucial role in connecting a firm's people skills, systems, and external networks, ultimately enhancing performance. Despite the importance of IC and its significant impact on firm performance, very few studies have been undertaken to find the effects of various dimensions of IC (human capital, structural capital, relational capital, and technology capital) on organizational performance (Bontis et al., 2000; Xu, J., & Wang, B. 2018). According to Mubarik, M. S. (2016), a research gap exists in terms of examining the effects of multiple dimensions of IC on organizational performance in developing countries. Furthermore, Edvinsson, L. (1997) states that Intellectual capital and innovation capacity have a disintegrated correlation. Although innovation has a significant economic impact, there is little literature on how a company's IC contributes to innovation Bontis et al., (2000), but in-depth research studies of Intellectual Capital dimensions and innovation are still lacking. IC components should be investigated in terms of how they influence innovation and performance. Hence, this study will also investigate the role of IC dimensions on firm performance and this study will also examine the mediating role of technological innovation between IC dimensions and firm performance.

LITERATURE REVIEW

THEORETICAL EXPOSITION

The theoretical framework of this study guides its direction, drawing on three theoretical expositions: Human Capital Theory (HCT), Resource-Based View (RBV), and Social Exchange Theory (SET).

Human Capital Theory: "Zig Ziglar states, People do not work for organizations that do not invest in their growth." He emphasized that when companies cultivate the potential of their

employees, those employees are more likely to contribute to the success of the business. Similarly, economist Gary Becker (1962) highlighted that akin to capital or land, people are an essential resource in any production process. According to Mubarik, M. S. (2016), human capital, which includes employees, their knowledge, skills, abilities, and attitudes, is essential for achieving sustainable competitive advantage.

Resource-Based View: The concepts related to organizational value creation through resources and competencies, were initially proposed by Penrose (1959) and further examined by Bontis (2001). It differentiates between ordinary capabilities, which are necessary for maintaining current operations, and dynamic capabilities, which enable adaptation and innovation in response to market changes. The resource-based perspective emphasizes that long-term success relies on the accumulation of technology and human resources, rather than merely on strategic positioning. The dynamic capabilities framework highlights the importance of creating, retaining, and managing unique intangible assets, allowing organizations to effectively respond to opportunities and risks. Ultimately, strong dynamic capabilities are critical for sustaining competitiveness and achieving long-term profitability.

Social Exchange Theory: Take care of your Employees, they take care of your Customers By (Jack welch, GE). In "Understanding Human Social Behavior," Homans, G. C. (1974), along with O'Donnell, David* and O'Regan, P. (2000), defines social exchange as the relationships that exist among individuals and organizations, including suppliers, customers, and employees. Social exchange theory, a well-established framework for examining human interaction, has undergone significant evolution and draws upon insights from various disciplines such as anthropology, sociology, and psychology. This theory encompasses important perspectives, including communication, individual circumstances, exchange rules, and the foundations of relationships. Despite its rich historical background and its influence on philosophical thought, the diverse models within social exchange often lack cohesion, leaving many insights underexplored by organizational scientists (Homans, G. C. 1974). Nonetheless, social exchange theories provide practitioners with valuable insights into the dynamics of social relationships, emphasizing the reciprocal nature of behaviors in exchanges.

Intellectual Capital: Natural resources alone do not guarantee economic growth; rather, intellectual capital (IC) has emerged as an essential element for both corporate and national development (Edvinsson, L., 1997). Organizations can enhance their competitive advantage by effectively leveraging new skills to manage and utilize knowledge. A sustainable competitive

edge increasingly relies on strategic assets such as knowledge and dynamic capabilities that foster innovation. Intellectual capital, encompassing human skills, education, experience, and organizational relationships, is viewed as a valuable resource with a profound impact on a firm's performance (Cohen, S., & Kaimenakis, N., 2007). Intellectual capital (IC) is typically described by scholars in three broad categories: human, structural, and relational capital, though the specific terminology may differ among authors. In a knowledge-driven economy, IC is fundamental to a firm's value, fosters sustainable competitive advantage, and enhances daily performance outcomes.

"Human capital" (HC) The importance of HC can be traced back to 1960 by the Nobel laureate of 1992 in economics, Grey Becker. HC refers to the competencies, knowledge, and values that employees possess, which are essential for driving innovation and increasing productivity within an organization. Based on the work of economist Gary Becker (1964), this concept highlights that investing in education, training, and health provides greater returns than merely investing in physical capital. HC is a transient organizational asset, leaving when individuals depart. It includes the knowledge, skills, abilities, creativity, and attitudes that collectively enhance job performance among staff (Mahmood & Mubarik, 2020). Additionally, people's intelligence and abilities set human capital (HC) apart as a strategic asset that stimulates innovation in a business. External elements like political stability and institutional frameworks must be taken into account for HC to be managed effectively. Employee growth and the organization's overall performance are intimately related to HC, which stands for the organization's implicit knowledge (Mubarik et al. 2022).

Structural capital (SC), or an organization's internal knowledge and processes, is a crucial component of intellectual capital. Intellectual property rights, organizational structures, internal procedures, and company culture are some of its constituent parts. SC is essential for preserving knowledge inside an organization, especially when personnel come and go, and it helps human capital (HC) perform effectively. Important components of SC include databases, business planning, and systems that assist in achieving organizational goals. Unlike human resources, SC remains within the organization and can be formally documented. The effective use of SC, HC, and relational capital is crucial for fostering business growth and innovation in today's worldwide society. Furthermore, SC and organizational capital are commonly used interchangeably due to their close association. When everything is taken into account, SC significantly increases a business's adaptability and sustainability.

In the 21st century, relational capital (RC), which highlights its function in generating value through human capital (HC) and structural capital (SC), is increasingly recognized as an essential component of intellectual capital (IC). By integrating the information acquired from external interactions with suppliers, customers, and the community, RC raises an organization's overall value (Mubarik et al., 2016). Advertising is crucial for building relationships and boosting community involvement through strategic methods. The relationship between social capital and organizational success emphasizes how crucial trust and collaboration are among network members. This highlights the need for more research on how universities might create this intangible resource to strengthen relationships and promote knowledge development, as social capital is frequently overlooked in existing studies on higher education institutions and their third goal. Organizations can generate value through strategic alliances and cooperative efforts with the aid of relational capital, which is the knowledge acquired from external interactions (Ryu et al., 2021).

IC and Firm Performance: Recent research highlights the significant impact of various dimensions of intellectual capital (IC) on business performance. Structural capital, in particular, is known to lower costs while improving the quality of operations and final products, thereby contributing to organizational success. Studies conducted across multiple countries, including Turkey, Tanzania, Europe, India, and Australia, have demonstrated positive correlations between components of IC, especially human capital (HC), and financial performance metrics such as return on equity (ROE) and employee productivity. Additionally, Xu, J., & Liu, F. (2020) studies employing the adjusted-VAIC model have confirmed that the dimensions of human, relational, and structural capital positively affect organizational performance. The following hypotheses are proposed:

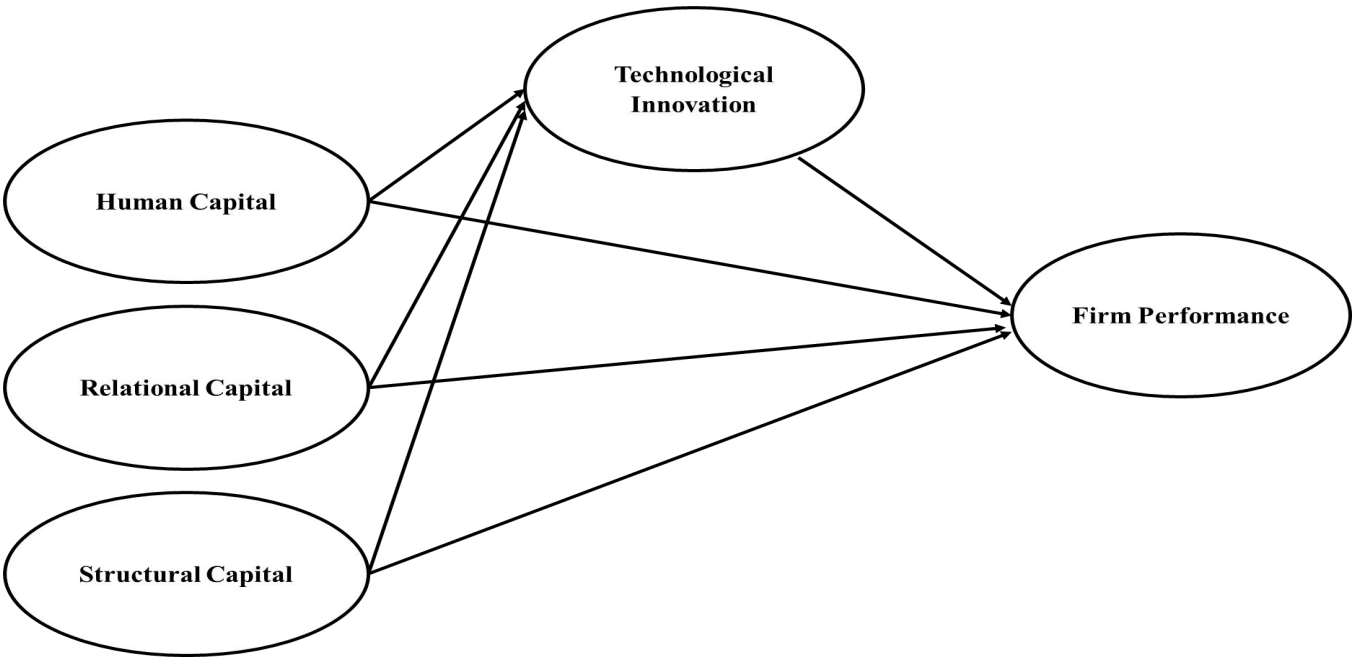
- H1a: HC has a positive impact on firm performance.
- H1b: SC has a positive impact on firm performance.
- H1c: RC has a positive impact on firm performance.

The Mediating Effect of Technological Innovation: The significance of Intellectual Capital (IC) and Human Capital (HC) in driving business execution and technological advancement. It emphasizes that the loss of technological development capability can lead to obsolescence in the market. HC, essential for product innovation, requires substantial investment and time to develop. Organizational Innovation is viewed as a key source of sustainable competitive advantage, leading to increased productivity (Zhang, X.-B., et al 2021). According to the RBV,

differences in business performance stem from a firm's internal characteristics, including strategic assets that offer long-term competitive advantages due to their uniqueness and difficulty to imitate. Dynamic capabilities, defined as the ability to adapt resources for innovation, are also crucial. Additionally, HC is linked to creativity and innovation performance. Factors such as technological resources and how they are managed within the organization affect innovation outcomes (Zhang, H.-Y., & Lv, S., 2015). A conducive work environment fosters knowledge sharing and supports innovation. Strong supply chains (SC) and customer relationships (RC) enhance innovation activities. The three hypotheses regarding the mediating role of technological innovation in the relationships between HC, SC, and RC with firm performance:

- H4a: Technological innovation mediates the relationship between HC and firm performance.
- H4b: Technological innovation mediates the relationship between SC and firm performance.
- H4c: Technological innovation mediates the relationship between RC and firm performance.

Conceptual Framework



RESEARCH METHODOLOGY

Research Design: The study is a cross-sectional, quantitative analysis using a mono-method survey to collect data on three independent variables (Human Capital, Relational Capital, Structural Capital), one mediating variable (Technological Innovation), and one dependent

variable (Firm Performance) from top and mid-level managers in Pakistan's textile sector.

Data Collection Procedure: Data was collected through an online questionnaire distributed via Google Forms. Snowball sampling techniques were employed due to low initial response rates. The researcher visited several textile companies in Karachi, Hub, Peshawar, Faisalabad, and Hyderabad, collecting responses from 350 employees, with 308 valid samples accepted.

Population: The study focuses on top and mid-level managers within the textile sector of Pakistan, which employs approximately 15 million people, making it the second-largest employment sector in the country.

Sampling: With 15 million employees in the industry, a sample of 75 responses per variable was determined, totaling 225 for the independent variables and 75 each for the mediating and dependent variables.

Instrument: The primary data was collected through a questionnaire adapted from existing research, utilizing a five-point Likert scale for responses, ensuring reliability for data collection.

RESULTS AND DISCUSSION

Measurement and Model Assessment: We analyzed the PLS model equations to evaluate our research findings in Pakistan's textile sector. The measurement of this data is based on values obtained through the PLS-SEM method, aligned with the established framework.

DISCRIMINANT AND CONVERGENT VALIDITY

	Items	Loading	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
FP	FP1	0.723	0.910	0.913	0.826	0.584
	FP2	0.793				
	FP3	0.796				
	FP4	0.761				
	FP5	0.745				
	FP6	0.835				
	FP7	0.879				
	FP8	0.753				
	FP9	0.789				

HC	HC1	0.785	0.899	0.902	0.819	0.589
	HC2	0.742				
	HC3	0.773				
	HC4	0.807				
	HC5	0.755				
	HC6	0.828				
	HC7	0.893				
	HC8	0.815				
RC	RC1	0.736	0.830	0.832	0.880	0.595
	RC2	0.752				
	RC3	0.795				
	RC4	0.759				
	RC5	0.811				
SC	SC1	0.877	0.826	0.826	0.885	0.659
	SC2	0.831				
	SC3	0.786				
	SC4	0.747				
TI	TI1	0.738	0.898	0.899	0.819	0.587
	TI2	0.721				
	TI3	0.776				
	TI4	0.770				
	TI5	0.836				
	TI6	0.758				
	TI7	0.804				
	TI8	0.818				

DISCRIMINANT AND CONVERGENT VALIDITY

According to the research, outer loading serves as an indicator of the reliability of outer items. As stated by F. Hair Jr et al. (2014), an outer loading value of 0.70 or higher is considered to signify consistency. In our model, we found that 30 items achieved outer loading values ranging from 0.70 to 0.83, as outlined in Table 4.1.

INTERNAL CONSISTENCY

The acceptable threshold for assessing internal consistency in reliability testing is a combined reliability and Cronbach's alpha coefficient of 0.70 or higher, as noted by F. Hair Jr et al. (2014). The values presented in Table 4.1 range from 0.82 to 0.91 (F. Hair Jr et al. (2014), surpassing the established standard. Combined reliability is favored over Cronbach's alpha because it provides more consistent coefficients that account for varying item loadings. The compound reliability values range from 0.819 to 0.885, with values exceeding 0.90 indicating strong consistency. Conversely, dimensions that do not meet these standards are considered undesirable.

CONVERGENT VALIDITY

Convergent validity pertains to the degree to which two theoretically related measures or constructs are indeed correlated. To establish this type of validity, the Average Variance Extracted (AVE) score for each variable must be at least 0.50 (Chin, W. W.1998). As shown in Table 4.1, all variables achieve this criterion, with AVE scores ranging from 0.58 to 0.65.

DISCRIMINATE VALIDITY

Campbell, D. T., & Fiske, D. W (1959) introduced the concept of identification validity, which assesses test validity using a threshold of 0.85. Scores falling below this threshold indicate acceptable measures, while higher values suggest redundancy and an absence of effectiveness decrement. Discriminative validity ensures that unrelated measures do not overlap, thereby enhancing overall construct validity. In our findings, the values for discriminative validity (AVE) are as follows: business performance at 0.584, human capital at 0.589, relationship capital at 0.595, structural capital at 0.659, and innovation at 0.587.

HETEROTRAIT-MONOTRAIT RATIO (HTMT)

	FP	HC	RC	SC	TI
FP					
HC	0.793				
RC	0.841	0.878			
SC	0.896	0.871	0.826		
TI	0.853	0.741	0.820	0.827	

The Heterotrait-Monotrait Ratio (HTMT) is a metric utilized to assess discriminant validity within constructs. Introduced by Henseler et al. (2015), HTMT computes the average of Heterotrait-Heteromethod correlations among variables and contrasts it with Mono-Trait-

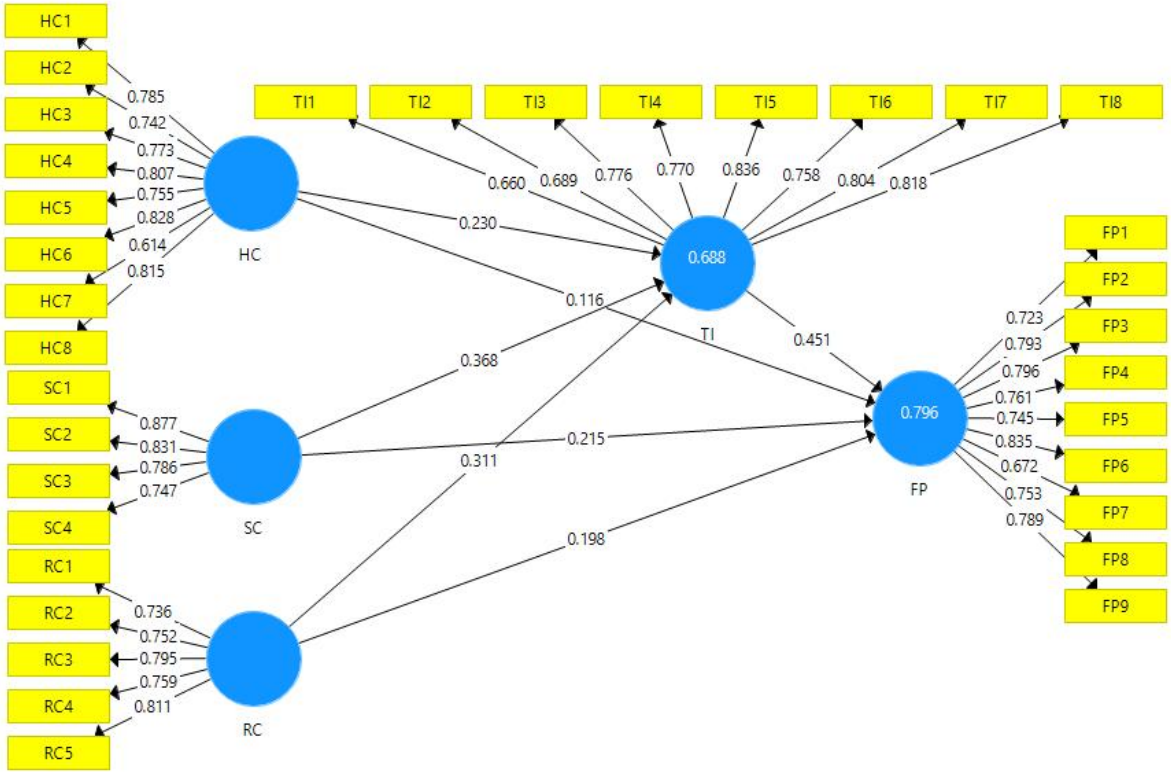
Heteromethod correlations. An HTMT value exceeding 1 suggests that the variables are dissimilar. For adequate discriminant validity, HTMT values should ideally be below 0.90, with values under 0.85 being preferred, as indicated in the accompanying table.

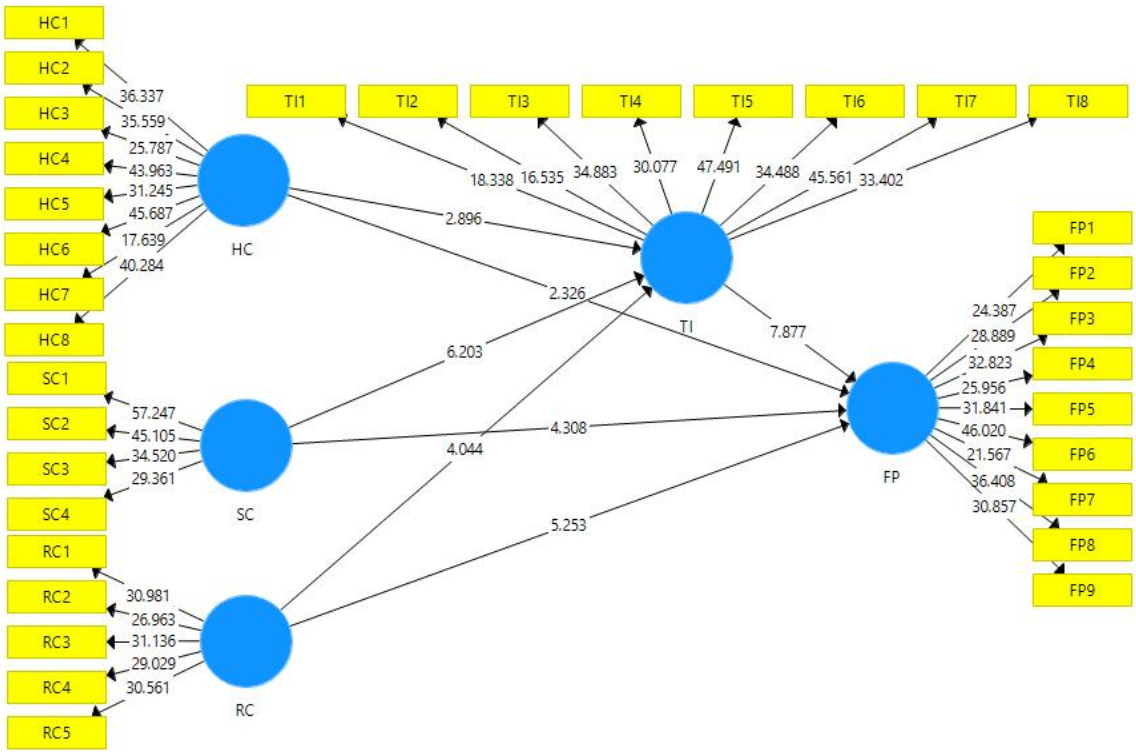
PATH COEFFICIENT

Path Coefficient

	Std Dev	T Value	P Values
Direct Effect			
HC -> FP	0.051	2.288	0.022
HC -> TI	0.078	2.954	0.003
RC -> FP	0.038	5.166	0.000
RC -> TI	0.074	4.186	0.000
SC -> FP	0.051	4.240	0.000
SC -> TI	0.058	6.325	0.000
TI -> FP	0.057	7.918	0.000
Specific Indirect Effect			
HC -> TI -> FP	0.039	2.642	0.008
RC -> TI -> FP	0.036	3.874	0.000
SC -> TI -> FP	0.033	4.969	0.000

Path analysis demonstrates that the desired outcomes have been achieved based on the coefficient of intervals. According to Hypothesis Testing, human capital has a significant impact on firm performance, while relational capital also significantly influences firm performance. Structural capital shows a noteworthy effect on firm performance, marked by a p-value of 0.0 and a t-value of 4.24. Furthermore, technological innovation has the most substantial effect on firm performance, indicated by a coefficient of 0.057. Additionally, all hypotheses regarding the mediating effect are significant, suggesting that technological innovation plays a potentially mediating role in firm performance.


HC1
HC2
HC3
HC4
HC5
HC6
HC7
HC8
SC1
SC2
SC3
SC4
RC1
RC2
RC3
RC4
RC5
0.785
0.742
0.773
0.807
0.755
0.828
0.614
0.815
0.877
0.831
0.786
0.747
0.736
0.752
0.795
0.759
0.811
HC
SC
RC
TI1
TI2
TI3
TI4
TI5
TI6
TI7
TI8
0.660
0.689
0.776
0.770
0.836
0.758
0.804
0.818
0.688
TI
0.230
0.116
0.368
0.311
0.215
0.198
0.451
0.796
FP
FP1
FP2
FP3
FP4
FP5
FP6
FP7
FP8
FP9
0.723
0.793
0.796
0.761
0.745
0.835
0.672
0.753
0.789


HC1
HC2
HC3
HC4
HC5
HC6
HC7
HC8
SC1
SC2
SC3
SC4
RC1
RC2
RC3
RC4
RC5
36.337
35.559
25.787
43.963
31.245
45.687
17.639
40.284
57.247
45.105
34.520
29.361
30.981
26.963
31.136
29.029
30.561
HC
SC
RC
TI1
TI2
TI3
TI4
TI5
TI6
TI7
TI8
18.338
16.535
34.883
30.077
47.491
34.488
45.561
33.402
TI
2.896
2.326
6.203
4.044
4.308
5.253
7.877
FP
FP1
FP2
FP3
FP4
FP5
FP6
FP7
FP8
FP9
24.387
28.889
32.823
25.956
31.841
46.020
21.567
36.408
30.857

DISCUSSION

DISCUSSION OF FINDINGS

Hypothesis 1a (H1a). Human capital positively influences firm performance in Pakistan.

Hypothesis 1a posits that human capital has a positive impact on firm performance, and the evidence supports this assertion. Research conducted by Xu, J., & Liu, F. (2020) and Xu and Wang (2018) demonstrates that human capital contributes to enhanced earnings and profitability. Furthermore, studies in Sri Lanka reveal that all components of intellectual capital, human, relational, and structural, are positively correlated with firm performance.

Hypothesis 1b (H1b). Structural capital (SC) has a positive effect on firm performance. This hypothesis examines the positive correlation between structural capital and performance outcomes. Our analysis corroborates this hypothesis, demonstrating that structural capital indeed exerts a positive influence on performance. Supporting research by Ahmed et al. (2019), along with findings from Mubarik et al. (2016) and Yang et al. (2009), further reinforces this relationship.

Hypothesis 1c (H1c). Relational capital (RC) positively affects firm performance. The tested result of the hypothesis is accepted and shows there is a positive association between relational capital and firm performance. Xu and Wang (2018) finding states that relational capital has a significant impact on firm performance, especially on financial performance in the Korean manufacturing industry. Looking at this strong evidence and results tested it is supported that RC impacts FP.

Hypothesis 2a (H2a). Technological innovation mediates the relationship between HC and firm performance. H4a states that technological innovation mediates the relationship between human capital and firm performance, although the results of the hypothesis tested indicate that technological innovation mediates human capital and firm performance; hence results and conclusion of Xu et al. (2019b) also indicate the same results, so our results are also the same. Therefore, our results are also correct and accepted.

Hypothesis 2b (H2b). Technological innovation mediates the relationship between SC and firm performance. H2b states that technological innovation mediates the relationship between structural capital and firm performance, although the results of the hypothesis tested indicate that technological innovation mediates structural capital and firm performance. Hence results and conclusion of Xu et al. (2019) also indicate the same results, so our results are also the same.

Therefore, our results are also correct and accepted.

Hypothesis 4c (H4c). Technological innovation mediates the relationship between RC and firm performance. H4c states that technological innovation mediates the relationship between relational capital and firm performance although the results of the hypothesis tested indicate that technological innovation mediates relational capital and firm performance hence the results and conclusion of Ryu et al., (2021); Xu et al., (2019b), also indicates the same results so our results are also same. Therefore, our results are also correct and accepted.

MANAGERIAL IMPLICATIONS

Empirical evidence of the research shows human capital has a positive impact firm performance, results of the study show that an increase in human capital will increase firm performance in the manufacturing sector of Pakistan. Therefore, organizations should increase the effectiveness and efficiency of human capital to improve their performance if the performance of human capital will increase it will directly and definitely improve firm performance. So organizations should take human capital seriously and invest in human capital as the result shows that human capital improves firm performance. Those organizations that will improve human capital will increase the firm's performance. Results of the research show that structural capital has a positive impact on firm performance. Structural capital has a direct relationship with firm performance proved in the results therefore organizations must work to increase the structure capital because the increase in structural capital will increase the firm performance according to the results of this study and some other research coincide with the same Therefore firm should invest in increasing intellectual capital i.e unique process, patients copyrights, policies and unique innovations which can change firm from other competitors it will increase the overall performance of the firm and increase its profitability. Evidence of the research shown in the discussion of the result leads that relational capital has a significant positive impact on firm performance. It also indicates that improving the relational capital will increase the firm performance. Relational capital is all about relationships between stakeholders within the company and outside the organization relational capital is also called social capital. Relational capital is all about the psychological contract of employees with employers, vendors, partners, and suppliers. A company having good relationships can work effectively due to its relationships. Relational capital can also be used as a competitive advantage this relationship with employees can create innovation and loyalty within the company case for the vendors, suppliers, and other stakeholders. Looking at these all practical implications and results of data

we can say relational capital will directly improve firm performance. Therefore, the firm should increase intellectual capital to improve its firm performance in the textile industry of Pakistan. Results of the research study show that IC and all three dimensions of Human Capital, relational capital, and structural capital positively affect technological innovation. Human capital states the knowledge skills experience and education of a person that directly contributes to creating technological innovation in the firm, structural capital is all about the policies, procedures, copyrights patents plants, etc this structural capital is also fully engaged in creating technological innovation even technological innovation is basic unit for creating the technological innovation. Relational capital is all about the relationships with stakeholders. Relationships of a firm with its employees and suppliers also contribute to creating technological innovation. Looking at this empirical evidence we can say if the company wants to create technological innovation it should increase its human, structural, and relational capital.

CONCLUSION

Numerous studies emphasize the significance of intellectual capital (IC) in enhancing firm performance; however, research on the effects of its components mediated by technological innovation is scarce, particularly within Pakistan's textile sector. This study evaluates the impacts of Human Capital, Relational Capital, and Structural Capital on firm performance, highlighting technological innovation as a mediator. Utilizing Partial Least Squares Structural Equation Modeling (PLS-SEM), the findings reveal that all three components of IC positively influence both manufacturing performance and technological innovation in Pakistan. The research affirms the mediating role of technological innovation between the IC components and firm performance, aligning with previous literature.

LIMITATIONS

Every research study has its inherent limitations. In our investigation of the textile industry in Pakistan, we reached out to employees from a limited number of textile companies. Although our objective was to collect over 500 responses from across the sector, we ultimately gathered data from only 308 employees across three provinces. Nevertheless, this study successfully addressed all major research concerns and questions. While our research focuses specifically on the textile industry, there are ample opportunities to explore other sectors within the manufacturing industry in future studies. We employed a convenience sampling technique for this research; however, we encourage other researchers to consider utilizing different sampling methods in their investigations.

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