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Digital Leadership and Organizational Performance in the Post COVID-19: Mediating Roles of Human Capital Development and Technological Innovation

Md. Alamgir Mollah ¹, Mohammad Bin Amin ^{2,*}, Md. Jewel Mia ¹, Rashed Mahmud Shakil ³ and Md. Atikur Rahaman ⁴

¹ Department of Management Studies, University of Barishal, Kornokathi, Barishal (8254), Bangladesh

² Department of Business Administration, Faculty of Business Studies, Bangladesh Army University of Science and Technology (BAUST), Saidpur (5310), Nilphamari, Rangpur, Bangladesh

³ Department of Business Administration, Uttara University, Dhaka (1230), Bangladesh

⁴ School of Economics and Management, Jiujiang University, Jiujiang (332005), Jiangxi, China

* Correspondence: binamindu@gmail.com

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Abstract: Digital leaders are inevitable to foster greater human capital development and technological innovation for successful organizational management activities especially after the COVID-19 pandemic. The intention of the study is to explore the association between digital leadership (DL) and organizational performance (OP) with the mediating effects of human capital development (HCD) and technological innovation (TI). To achieve these goals, 260 convenient samples were collected from the employees of different service and manufacturing industries of Bangladesh, and AMOS structural equation model (SEM) has used for testing hypothesis by following resources-based view (RBV) theory. The results proved that DL significantly influences OP and HCD partially mediating the relationship, while TI has no significant mediating effect. The present findings infer that DL play a crucial role in supporting human development, such as developing employees' DL skills, increasing technological professionalism, and driving an innovative mindset for organizational success after the COVID-19 pandemic. Although the pandemic is over, managers and policymakers need to concentrate on upgrading organizational TI level and employee's digital skills and capabilities for ensuing competitive performance and organizational sustainability.

Keywords: Digital Leadership; Human Capital Development; Technological Innovation; Organizational Performance; COVID-19 Pandemic

1. Introduction

Due to the COVID-19 pandemic, global business climate has undergone substantial transformation and it impact spread out personal, organizational, and global economy [1]. After the COVID-19, managers of the organizations tend to increasingly concerned about the human resource related to employee engagement and managing tough situation and its impact on OP [2]. The COVID-19 pandemic has brought significant changes to Bangladesh's economic, social, medical and education systems, halting all kinds of development process. During this period exports decreased 16.93%, imports declined by 17% and employment revenue dropped by 11%, resulting in widespread

financial distress and traumatic situations [3]. Surprisingly, pandemic the pandemic has had huge impact on standing macroeconomic stability and has disrupted public livelihoods, intensifying poverty to 40.9% [4]. They also mentioned that global trade has been decreased by 5.3% in 2020 and poverty might engross 2% in each year [4]. Thereafter, like other countries, the COVID-19 pandemic has had a multifaceted impact on Bangladesh, challenging its economic stability, social structures, and business operations. To cope with global digital trends, economic progress must be resumed and therefore, the need for digital leadership is inevitable. As the pandemic has collapsed economic, social, education and business systems, Bangladesh must focus on TI and HCD to address upcoming challenges and achieve organizational sustainability. As the COVID-19 has affected social, economic and technological situations significantly and after the pandemic the effect of DL on OP with mediation effect of HCD and TI need to be explored.

Moreover, the modern business environment is multifaceted and evolving quickly, which has increased the urgency of advanced technology, effective leadership, and HCD to ensure long-term organizational success. Pandemic and global transformation have significantly accelerated the pace of technological change, thereafter the developing country facing challenges to develop human capital and implement new technology for sustainability. In addition, with the ground-breaking developments in automation, data analytics, and communication, the digital transformation tsunami has drastically altered leadership approaches [5]. It is observed that, damage of pandemic effect can be handled through technological advancement [1] and also ensuring human development. Prior research recommended that businesses that have implemented advance technology will generate 32% of their overall income by 2022; and that highly advanced digital industries will generate 48% of their sales via digital passages [6]. Additionally, up to 60% of establishment growth is supported by DL when digital technologies are implemented in German firms [7].

Here, conferring to leadership theory, DL is an approach that integrates the usage of digital technology with a transformational leadership (TL) style [8] with digital skills. Here, HCD included investment for employee training for enhancing productivity [9], developing the knowledge, skills and capability of individuals employees [10]. Therefore, it can assume that DL can enhance digital skills and knowledge through on-the-job training. Additionally, TI technological innovation infers organizations seeking to uphold a competitive edge through enhanced processes and products [11] and depends on the factors such as relative advantage and complexity [12]. Along with this as COVID-19 pandemic has compounded growing labor market and increased job demand [10] and in the era IR 4.0, human, technology and organizations are interconnected with technological systems, operations, and organizational systems [13]. Therefore, face after global pandemic situation and pace with global requirement need to ensure technological innovation. In this regard, the United Nations (UN) has set a 2030 agenda to advance sustainable development [14]. Moreover, sustained companies offer a bright chance to combat unemployment and promote creative economic development in metropolitan areas [15,16].

Moreover, HCD is crucial to the functioning of enterprises, which could raise an organization's level of performance by providing the labor force with modern skills [17]. In addition to leveraging digital skills, DL insights, and strategies to propel success, executives face critical challenge and the formidable task of ensuring that their endeavors contribute positively to the environment and society. According to Marimuthu et al. [18] HCD is an essential component of a company's assets and workforce management strategy, which helps increase output and preserve competitive advantages.

Human capital is essential to maintaining the organization's competitiveness and increasing productivity and TI is also vital for adjusting the upcoming challenges and maintain stable operation and performance. In this regard the following Table 1 depicts the recent summary of the literature review seeking the study gap.

Table 1. Research summary and gap analysis.

References	Methodology	Study Area	Findings	Gap
Mollah et al. [19]	A total of 416 samples gathered and SPSS and AMOS have used	IT organizations in Bangladesh	DL has substantial impact on OP and on financial performance and digital transformation and digital innovation mediates within the link	HCD or TI has not been used as mediator
Chatterjee et al. [20]	Total 335 samples collected, and PLS-SEM used	Different organizations	Organizational IT capabilities, innovation capabilities and digital workplace policy effect on OP while DL play moderating role	Here DL plays a mediating role rather than TI serving as mediator
Susilawati [21]	A qualitative approach with descriptive study	Sub-districts public service	DL is the key for overcoming barrier and become success during COVID-19	It motivates conducting an empirical study after COVID-19
Azzam et al. [22]	Total 102 samples collected, and AMOS used	Jordan business perspective	Dynamic capabilities significantly support competitive advantages while DL moderated the relationship	Motivates the use of DL as dynamic capability and considers HCD and TI as mediators
Yusuf et al. [23]	A total of 765 samples collected from employees and PLS-SEM used	Public organizations	DL has a positive influence on OP and digital transformation mediates between the relationship	Instead of digital transformation, TI might influence the relationship between DL and OP
Norouzi et al. [24]	A total of 244 samples collected from managers and SPSS and PLS used	Knowledge-based companies	DL positively influences firm performance with the mediation effect of dynamic capabilities and model innovation	It inspires the consideration of TI as mediator
Benitez et al. [25]	A total of 117 samples collected, and PLS-SEM used	Different European firms	DL is supportive for improving firm's innovation performance by platform digitalization	Platform digitalization is affected through IT innovation
Artüz and Bayraktar [26]	A total of 193 samples collected, and SPSS used	Banking sectors	DL practice positively influences individual performance with mediation effect of organizational learning	As organizational learning related to HCD thereafter here we have considered it as mediation
Hamadamin and Atan [27]	Total 600 samples collected for Iraq	Universities employees	HCD positively influences on complete performance	HCD has not been used as mediator
Subramony et al. [28]	Total 20 samples collected from India	-	HCD mediates the relationship between leadership and	HCD can be focused on mediator

			organizational performance	
Alagaraja et al. [29]	Total 138 samples collected	Small business organization in USA	Combination of leadership and people management contributes to HCD which enhances firm performance	HCD is applicable for use as mediator
Lang et al. [30]	A total of 20 samples collected from the CEOs or managers	Manufacturing industry	Investment capability leads to competitive performance through TI.	So, TI can be used as mediator
Jin and Lee [31]	Total 150 samples collected SMEs from Korea	From Korea Securities Dealers Automated Quotations SMEs	Results show R&D support business performance while TI have positive impact on management performance	They didn't focus on DL capacities to examine the mediating effect of TI capabilities.
Chen et al. [32]	A total of 150 samples collected from 102 senior managers and 258 employees	Taiwan strategic business units	Transformational leader behavior influence TI	It inspires the connection between DL, TI, and organizational performance

However, several previous research have found that DL has a positive influence on firms performance in Korea with mediation influence of digital culture and digital competencies [33], sustainable OP with IT competencies and organizational learning [34] and the impact of DL on competitive performance [35]; effect of DL capabilities on innovation performance through the platform digitalization capabilities [25]; DL practices effect on individual performance through learning organization [26]; DL impact on performance with mediation effect of organizational commitment in E-commerce [36]. Thus, based on the above literature, it is evident that there is numerous research related to DL and OP in different perspectives around the world.

However, there is a lack of research that points out the post-pandemic effect of DL on OP with the mediating effects of HCD and TI have remained unexplored. Though, Erhan et al. [37] suggested to empirically tested DL in different perspective, new mediation can be empirically tested with predictors of DL. According to Table 1, which summarizes research, where it is found a qualitative research describing post-pandemic situation in Bangladesh [3,4]. Along with this, some empirical studies were published after the pandemic in Bangladesh [19,35,38]; however none of them focused on COVID-19 pos-pandemic situations and have not considered HCD and TI as mediating variables. So empirically testing this research would provide a new methodological contribution. Therefore, considering the post-pandemic scenario, addressing research gaps and emphasizing the situational demand for DL to foster HCD and TI, this study has focused on examining the influence of DL on OP with the mediating effect of HCD and TI in developing economies.

2. Literature Review and Hypothesis

2.1. Theoretical Grounds

In the age of IR 4.0, digital leadership dynamism is crucial for technology management, human development, innovation, and long-term organizational success. DL theories include various concepts and factors critical for effective leadership in the digital era [39]. DL roles can be defined in

different ways and perspectives, such as behavioral role players, resources for organizations, and dynamic capabilities. Summary of past theory is shown in the following Table 2:

Table 2. Theoretical background and literature sources for the variables.

Variables	Theory used	Reference(s)
Digital Leadership (DL)	Dynamic capabilities	Mihardjo and Rukmana [40]; Mollah et al. [19]
	Behavioral theory	Shin et al. [33]
	RBV	Borah et al. [41]
Human Capital Development (HCD)	RBV	Gerhart and Feng, [42]; Khayinga and Muathe [43]; Fareed et al. [44]
Technological Innovation (TI)	RBV	Ahn et al. [45]; Irwin et al. [46]; Liu et al. [47]
Organizational Performance (OP)	RBV	Shin et al. [33]; Fareed et al. [44]

Source: Author's compilation.

This study provided theoretical insights into dynamic capability and RBV theory. Leaders require a diverse skill set, including technical, human, and conceptual talents, to effectively address organizational difficulties [48]. In times of rapid technological change, effective leadership requires effective communication, organizational skills, subject-specific expertise (especially IT), and self-reflection [49]. Recent leadership literature emphasizes the importance of motivational qualities [50] as well as digital skills [8]. These ideas highlight the need for leaders to understand and integrate with the global technology revolution, as well as the new features and difficulties posed by digitalization [51]. According to strategic management literature, particularly from an RBV perspective, firms with distinctive resources and talents may maintain a competitive edge in volatile markets and beat closed competitors and industry rivals [52]. Additionally, Barney [52] demonstrated the concept of RBV, characterized by valuable, rarity, imitability and sustainability, for the purpose of generating competitive advantages. Firms invest in HCD through training, education, and employee development to achieve competitive advantages, as these capabilities are very difficult to replicate [53]. Similarly, technological and innovation capabilities are considered strategic resources for achieving efficiency [54] as they are complex, firm-specific and path dependent, making difficult to imitate [55]. Driven by DL integration of HCD and TI enhances the effectiveness of IT companies by fostering innovation, improving productivity and ensuring financial success. Therefore, HCD and TI serve as valuable resource generation approaches for achieving complete organizational performance, which justifies their alignment with the RBV theory.

2.2. Digital Leadership and Organizational Performance

After the COVID-19 pandemic, the surge in digital transformation and the emergence of artificial intelligence (AI) have accelerated the need for DL. Zada [56] stated that the COVID-19 epidemic and technological advancements are exerting significant pressure on digital transformation, driven by evolving pattern of data used in decision-making and the shift towards digitalization of service. Originally, DL is an approach to leadership designated to adapt to the changes brought about by industry-related technical advancements. It is expected of a digital leader to be risk-taking,

empathetic, agile, visionary, and constantly willing to work with others. In this sense, building social capital is expected of digital leaders in order to establish a productive corporate culture [57–59]. The association between DL and sustainable performance was empirically examined by Mollah et al. [34] in South Korean organizations and Table 1 also show the research related to DL and OP. DL may bring about a transition that can inspire new ideas and methods that can boost productivity and spur expansion. The indication for the positive benefits of DL on performance is compelling, yet there are still some gaps, especially post pandemic COVID-19 scenario. Therefore, the subsequent hypothesis has been proposed.

H1. DL has a positive effect on OP.

2.3. Human Capital Development (HCD) As Mediator

Human capital refers to the processes involved in raising the level of knowledge, skills, abilities, and social values of employees through education, training, and other professional activities. By encouraging lifelong learning, developing digital competencies, and improving worker flexibility, digital leadership improves HCD. According to Marimuthu et al. [18], Human capital, an essential component of a company's asset and workforce management strategy, plays a crucial role in enhancing productivity and maintaining competitive advantages. It is essential to maintaining the organization's competitiveness and increasing productivity which can be developed by the DL. Human capital is vital for an organization's competitive advantage, and strategic HRM aims to manage employee skills, capabilities, and knowledge in an efficient and effective manner, thereby meaningfully influencing the organization's strategic target accomplishment.

Moreover, to develop digital human capital, organizations must encourage employees to work and learn digital skills through digital leases. In this way, working and learning can enhance digital skills among employees, and ultimately, organizations can gain efficacy and a competitive advantage. DL is the combination of TL and digital skills while the human resource as a crucial resource that should complement other resources to improve a OP. HCD could be considered an organizations investment that will develop the competence of their personnel to achieve competitive recompenses; here, HCD mediates strategic innovation and OP [60]. Human capital investments boost works self-efficacy and motivate work engagement, as well as task performance. These mechanisms highlight the improvement of employees' capabilities, inspiration, and opportunities as prognosticators of business units' performance when mediated by human capital and inspirational pathways. This study focused from a Bangladeshi perspective where DL is predictors, OP is the outcome variables, and HCD and TI is the mediator. Therefore, the following hypothesis has been proposed.

Thus, **H2:** HCD has a mediating role between DL and OP, which develops 2 following hypotheses:

H2a. DL has a positive impact on HCD.

H2b. HCD has a positive impact on OP.

2.4. Technological Innovation (TI) As Mediator

The focus of innovation research has recently shifted to technological innovation, which includes fields like management, marketing, finance, and production engineering, as more corporate operations move to digital platforms. Technology innovation is the process by which an enterprise's system is dynamically rebuilt in response to shifting enterprise needs because of the development of

digital technology. The ability to effectively use digital technologies to accomplish a team or an organization is known as ‘digital leadership’ [61]. Another way to characterize DL is as an effort to bring about innovation through promoting experimentation and risk-taking [62]. According to Oberer [59], the idea of DL should go beyond simply digitizing an analog clock or an indicator within a system. To manage and grow various businesses, innovative thinking is required due to digitalized workflows and management philosophy. Numerous studies on DL and innovation can be found when the literature is considered [58,63,64]. Therefore, DL and TI are significant factors that are interconnected and may influence each other.

Moreover, from a conceptual standpoint, TI encompasses any gradual or significant alteration in technology that is integrated into a product or process, including modifications in high-value activities like service and management. Businesses with strong TI capabilities can achieve impressive results [65]. According to Wadho and Chaudhry [66] on manufacturing companies in Pakistan, a company’s decision to innovate, its investment in innovation, its innovative products, and its sustainable performance (labor productivity) are all positively correlated. Similarly, Gunday et al. [67] established there was a constructive association between organizational, marketing, product, and process innovations and firms sustainable performance in the perspective of manufacturing firms in Turkey. According to Lee et al. [68], organizational innovation directly and favorably affects the sustainable performance of South Korean low-tech companies. Evidence of a favorable correlation between innovative activities and company success in transition economies was also presented by Ramadani et al. [69]. The subsequent hypotheses have proposed.

Thus, **H3**: TI has a mediating role between DL and OP, that represents 2 following hypotheses:

H3a. DL has a positive impact on TI.

H3b. TI has a positive impact on OP.

2.5. Conceptual Framework

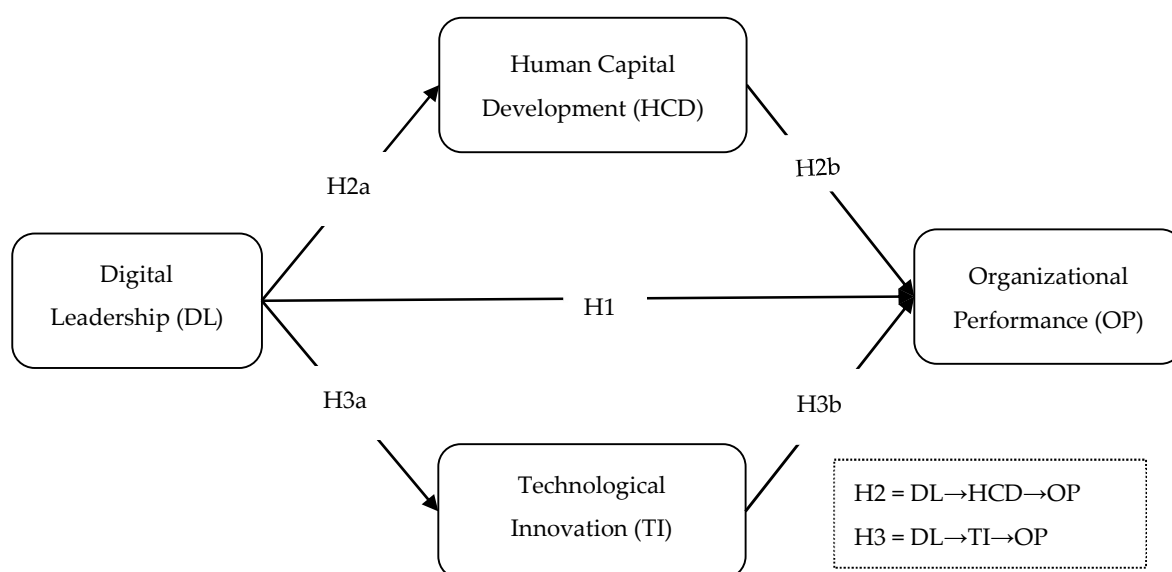


Figure 1. Conceptual framework of the research.

Based on the contextual importance of current research necessity for addressing COVID-19 pandemic [1,2,5,13] and fulfill the research gap [37] and considering the above literature this study has proposed the following conceptual framework in Figure. 1 below:

3. Methodology

The conceptual study was framed to investigate the influence of DL on OP (see Figure. 1). In this model DL is key variables for enhancing HDC and TI which leads to predators as OP. Regarding research techniques, we analyzed the data using SPSS 23 and AMOS 24.0. We evaluated our assumptions using structural equation modeling and bootstrapping, which is more appropriate considering the goals of our work. The unit of the analysis included the employees of the different organizations form Bangladesh.

3.1. Sampling Techniques

To conduct this study, the researcher collected 260 data following convenient sampling methods from different manufacturing, service, and other organizations from Bangladesh. To gather the sample data, study used literature and a structural questionnaire through an online-based survey (see Appendix A). The consent of the respondents to this questionnaire was obtained, and around 500 questionnaires were distributed, from which 285 responses were returned. Notably, to minimize the data biasness around 25 sample responses were eliminated from the sample due to similar responses such as all being 1, 3 or 5. The respondents include various genders, ages, educational levels, and job experiences. Among the respondents, males made up 75.38 percent of the total valid responses, and female respondents made up 24.62%. Of that respondent, highest number (31.92%) were 21–25 years old. Additionally, about 53.08% of graduates had postgraduate degrees, and 25.77% had the number of respondents with 6–10 years of working expertise. The following Table 3 represents the demographic data of the respondents:

Table 3. Respondents’ Demographic Profile.

Demographic	Categories	Frequency	Percent (%)
Gender	Male	196	75.38
	Female	64	24.62
Age	Below 20	47	18.08
	21-25	83	31.92
	26-30	55	21.15
	31-35	64	24.62
	Above 36	11	4.23
Educational Qualification	Higher Secondary Certificate	12	4.62
	Graduates	110	42.31
	Postgraduates	138	53.08
Job Experience	Less than 1 year	46	17.69
	1 to 5 years	45	17.31
	6 to 10 years	67	25.77
	11 to 15 years	63	24.23
	More than 16	39	15.00
Total samples		260	100%

3.2. Measurement Items

To assess the model, this study has considered earlier research instruments; each item on each scale was assessed using a five-point Likert scale, with 1 representing is 'strongly disagree' and 5 representing 'strongly agree.' The 18 survey questions in the current study were broken down into the two sections of demographic information including gender, age, education, experience and variables. In this study, DL was measured with six items [33,37]. The sample items included, "A digital leader shares his own experiences about technological opportunities that will increase the contributions of his colleagues to the structure of the learning organization." Then for assessing HCD, this study has considered eight items [70]. The sample items included, "The organization supports employees in upgrading their skills and qualifications where necessary." Next, to measure TI, it has considered six items [71]. The sample items included "Developing new innovation based on new technology is a strategic priority in my organization." Lastly, to measure OP, we have used five items [34,72]. A sample item included, "Compared to our competitors, our organization's performance is more successful". The questionnaire is included in Appendix A.

3.3. Common Method Bias (CMB) Test

As a part of exploratory factor analysis (EFA), it has followed CMB test through the analysis of Kaiser-Meyer-Olkin (KMO) measure of Sampling adequacy is used for factor analysis suitable for principal components analysis (PCA) which value is 0.923, and the Bartlett Test of Sphericity ($p < 0.001$) is significant which incites analysis appropriateness. Also, to test the CMB problem, this study has used Harman's single-factor test, which results in a value of 47.35%, which is less than the 50 percent threshold that infers non-biasness among the study variables [73]. Additionally, the variance inflation factor (VIF) value (please see Table 6) for the analyzed results was less than 3 [74] which infers there is no multicollinearity.

4. Results

4.1. Measurement Model

Table 4. Results of the model fit indices.

Model fit indices	Cut-off criteria	Measurement model Value	Structural Model Value
χ^2	≤ 3.5 to 0	378.722	445.785
χ^2/d	More than 1.0 and less than 5.00	1.875	2.196
RMR	≥ 0.05	0.013	0.034
RMSEA	Below 0.10 a very good fit	0.058	0.068
GFI	$> .90$	0.885	0.869
AGFI	$> .80$	0.856	0.837
CFI	$> .90$	0.976	0.967
TLI	$> .90$	0.972	0.962
IFI	$> .90$	0.976	0.967

Note(s): RMR = Root Mean Square Residual; RMSEA = Root means square error of approximation; GFI = Goodness of fit; AGFI = Goodness of fit; CFI = Comparative fit index; TFI =Tucker Lewis index; IFI = Incremental fit Index.

To test the data reliability, validity, and confirmatory factor analysis of the proposed framework, SPSS and AMOS software were used. For exploratory factor analyses, (EFA) factors are loaded into their representative items, and were used to ascertain this. The following Table 4 shows the indicators of the model fit indices in this study:

The results showed that GFI = 0.885, AGFI = 0.856, RMSEA = 0.058, CFI = 0.976, TLI = 0.972, RMR = 0.013, $\chi^2/df = 1.875$, and $\chi^2 = 378.722$ in the case of the measurement model assessment (Figure. 2). Table 4 shows that the structural model likewise had comparable outcomes. According to the recommendation of Anderson and Gerbing [75], GFI and AGFI values show more than 0.8, which is a suitable value. That being the case, we may confidently put our research model to the test. One may see the measuring model in Figure 2.

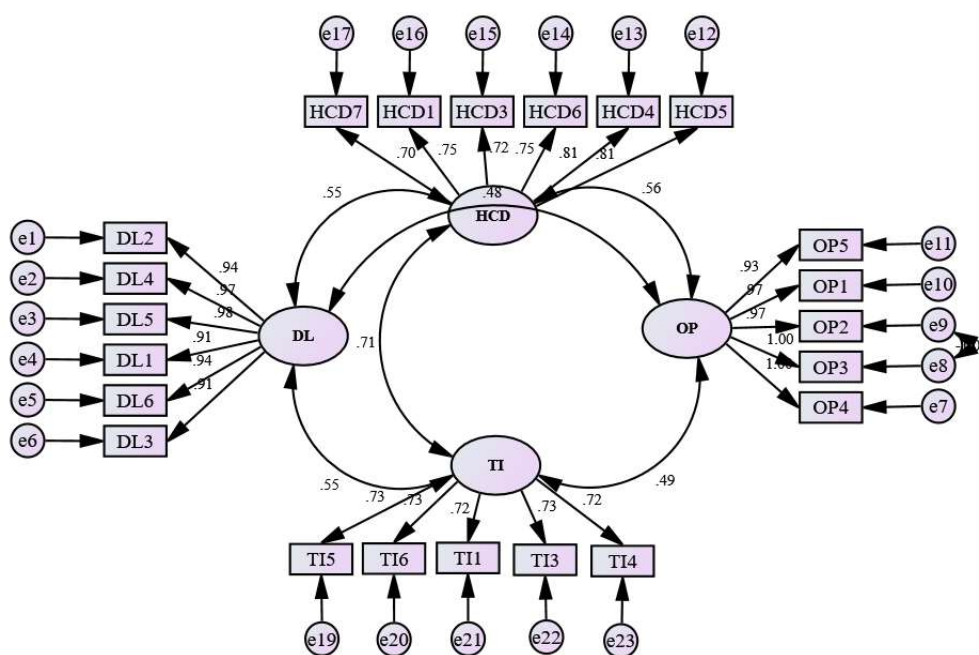


Figure 2. Measurement model of the research (Source: AMOS software calculation).

4.2. Reliability and Validity Test

To test the reliability Cronbach's alpha was used where the value of the four variables exceeded 0.60, inferring scales' reliability and internal consistency. Furthermore, the convergent validity, of the constructs showed the score of factor loadings are significant ($p < 0.001$), and their regression measurement range from 0.905 to 0.975 for DL, 0.699 to 0.809 for HCD, 0.723 to 0.729 for TI, and 0.933 to 0.997 for OP. Based on the above findings, we can see that our construct has strong reliability results, and high items loadings indicate that this model ensured convergent validity [75]. Furthermore, the AVE values the variables are larger than 0.60, showing that the study has strong convergent reliability [76]. Along with this, Table 6 shows the study's mean, standard deviation, and correlation matrix with discriminant validity. The value in bold, marked inside the parenthesis, represents the root square of the AVE value. This value is higher than the horizontal and diagonal representative correlation values. Therefore, it infers that the model has sufficient discriminant

validity. The following Table 5 shows the results of convergent validity. However, the following Table 5 represents the factor analysis and reliability of this research:

Table 5. Output from factor analysis.

Constructs	Items	Factors Loadings	CR	AVE	MSV	Cronbach's (α)
Digital Leadership (DL)	DL1	0.91	0.978	0.882	0.304	0.978
	DL2	0.939				
	DL3	0.905				
	DL4	0.967				
	DL5	0.975				
	DL6	0.936				
Human Capital Development (HCD)	HCD1	0.754	0.890	0.576	0.505	0.889
	HCD3	0.724				
	HCD4	0.805				
	HCD5	0.809				
	HCD6	0.755				
	HCD7	0.699				
	Technological Innovation (TI)	TI1				
TI3		0.729				
TI4		0.723				
TI5		0.727				
TI6		0.73				
Organizational Performance (OP)		OP1	0.97	0.989	0.949	0.312
	OP2	0.974				
	OP3	0.995				
	OP4	0.997				
	OP5	0.933				

Additionally, the following Table 6 represents the descriptive statistics, collinearity statistics and discriminant validity of this research:

Table 6. Descriptive statistics and discriminant validity.

Variables	1	2	3	4
1. DL	(0.939)			
2. HCD	0.551***	(0.974)		
3. TI	0.551***	0.487***	(0.759)	
5. OP	0.484***	0.558***	0.711***	(.727)
Mean	4.490	4.456	4.406	4.509
SD	0.482	0.500	0.484	0.494
Collinearity (VIF)	1.470	1.808	1.773	-

Note(s): *p < .05, **p < .01, ***p < .001; The value in a bold marked inside the parenthesis is the root square of the AVE value.

4.3. Testing hypotheses

To empirically test the reliability and validity of this study, the researchers used SPSS and AMOS software. To remove the limited data bias, study have also utilized a bootstrapping 5,000 bootstrap samples with 95% bias-corrected confidence intervals resampling method to look at the mediating

effect and the other two hypotheses [77]. Then study tested the direct and indirect effects of the proposed research framework. First, the results showed that DL is positively associated with OP ($\beta = 0.215, p < .05$), therefore, H1 was accepted. This infers that post-pandemic situations organizations with effective DL are expected to exhibit better performance [35]. Secondly, results showed that DL has positive impact on HCD ($\beta = 0.554, p < .05$), and HCD also affects OP ($\beta = 0.357, p < .05$). Ultimately, Hypothesis H2 proved that HCD significantly mediates between DL and OP. Therefore, H2 is accepted. Therefore, digital leaders are involved in HCD, which ultimately encourages lifelong learning, develops digital competencies, and improves worker flexibility. Moreover, this study proved that working and learning can enhance digital skills among employees, and ultimately, organizations can gain efficacy and competitive advantage. The integration of DL skills for the development human resources is supposed to have a significant resource which would be used with other resources to enhance a OP [60]. Along with this, it again proves that with the encouragement of digital leaders, a company can engage in asset and workforce management strategies that help increase output and preserve competitive advantages [18].

Then, the outcomes showed that DL affects TI ($\beta = 0.558, p < .05$), but TI insignificantly affects OP ($\beta = 0.144, p > .05$). Ultimately, the mediation effect of TI is insignificant ($\beta = 0.083, p > .05$). Therefore, H3 is rejected. Surprisingly, the result infers that digital leaders are very capable of enhancing TI, though TI is not sufficiently able to influence OP in post-pandemic situations, which is the opposite of the previous study [78], although, H3a is supported. This infers that the DL effort is very much presided over by innovation through promoting experimentation and risk-taking [62]. Though the philosophy of DL is to manage and grow various businesses, innovative thinking is required due to digitalized workflows. However, in most cases, digital leaders struggle to get enough financial and other support from the authorities to implement necessary innovation. Though DL and OP are positively associated [67], as a developing country, these findings showed a real picture of TI. The following Table 7 shows the results of hypotheses test:

Table 7. Results of the hypothesis test.

Hypothesis and Pathways	Direct Effect	Indirect Effect	Interaction Effect	95% Confidence Interval	P-Value	Decisions
H1 DL → OP	0.215**			(0.046, 0.389)	0.015	S
H2 DL→HCD→OP		0.204***		(0.089, 0.343)	0.001	S
H2a DL → HCD	0.554***			(0.467, 0.639)	0.000	S
H2b HCD → OP	0.357**			(0.150, 0.549)	0.002	S
H3 DL→TI→OP		0.083		(-0.010, 0.201)	0.084	NS
H3a DL → TI	0.558***			(0.447, 0.656)	0.000	S
H3b TI → OP	0.144			(-0.022, 0.330)	0.093	NS

Note(s): *p < .05, **p < .01, ***p < .001; DL = Digital leadership; HCD = Human Capital Development; TI = Technological Innovation; OP = Organizational performance; S/ NS = Supported/ Not supported.

5. Discussions

Though there is a plethora of study to discover the effect of DL, out of this the purpose of this study was to discover the driving role of DL for enhancing OP after, including the mediation effect of HCD and TI. The post pandemic situational study in Bangladesh proved that HCD is growing but

TI is not sufficient for ensuring OP. In the previous study it is found that transformational leadership affect TI [32]; while TI positively influence performance in China [79] in India [80]. However, in this result it is found that DL has significant effect on TI but TI have insignificant positive effect which expresses insignificant mediation effect of TI in the relationship between DL and OP. The reason behind this reflects that the COVID-19 pandemic has significantly lowered our economic, social and business operations [4]. As per findings COVID1-19 has lessen investment [4] which is also the true reflection in TI in developing nations like Bangladesh. Though the importance of DL has increased with the pace of digital innovation culture in IT sectors [38]. However, after the post pandemic COVID-19 the political turmoil, economic and social vulnerability results in less focus on investment in TI and results organizational performance. Also, digital leaders' dynamic capabilities are expected to demonstrate better sustainability in terms of economic, social, and environmental aspects. It expects to find evidence supporting the hypothesis that there is a positive relationship between TI and OP. Organizations that invest in and implement innovative technologies are anticipated to experience better sustainability outcomes. After the pandemic Bangladesh need to focus on TI along with HCD for ensuring competitive performance.

5.1. Theoretical Contributions

The study contributes to the development of dynamic capabilities theory and RBV theory by integrating DL as critical factors for improving HCD and increasing OP, though TI has a weak relationship. The research supports the view of dynamic capabilities to keep pace with the fluctuations of the business environment and emphasizes the importance of DL in driving innovation and organizational sustainability. These findings are consistent with previous study by Mihardjo and Rukmana [40] and Mollah et al. [19]. Theatrically, leaders can support employees through motivation, skill development, and empowering innovation for competitive organizational advantages. Along with this, another study by Mollah et al. [38] found that theoretically DL dynamic capabilities significantly influence organizational performance, aligning with the RBV theory, which is consistent with this finding. Additionally, in the IT sector HCD primarily focuses on achieving competitive advantages, as it is difficult to imitate [53], thereby qualifying as strategic resource. Furthermore, this research supports Grant's [54] arguments that IT innovation is a strategic resource and aligning with Teece et al. [55], who explained that IT innovation is highly complex and path dependent, making it difficult to imitate. So, in this era, proper integration and application of DL can ensure organizational sustainability. Therefore, this study highlights the need for organizations to integrate a TI and HCD culture at all managerial levels and increase investment in R&D activities to enhance innovation capability, along with other strategic resources to improve performance. Finally, the findings suggest that leaders' vision and dynamism for digital transformation and addressing COVID-19 pandemic mindset help in formulating strategic frameworks grounded on innovative business models, leading to improved organizational effectiveness and efficiency which is not only hard to imitate but also essential for addressing industry 4.0 necessities.

5.2. Managerial Implications

This research empirically tested the interrelationship between DL, HCD, TI, and OP. Along with theoretical implications, this study has some practical implications. First, organizational leaders, especially owners and CEOs, should prioritize enhancing DL capabilities for successful tackling

COVID-19. It is considered that DL may improve job performance while also contributing to corporate efficiency and growth [81]. An organization that embraces digitalization and is led by a leader with digital competency can respond swiftly to the global multicultural network, fostering an environment where change is welcomed, and employees are prepared for new experiences every day at work. In this perspective, Avolio et al. [82] demonstrated that virtual leaders have power to speculate the technological shift and practice. Furthermore, it has been found that DL enables organizations to compete on a global scale, especially in industries such as manufacturing, education, and healthcare [83]. This is particularly significant in the context of global competition, as DL helps organizations innovate, improve productivity, and adapt to rapidly changing technological landscapes, thereby enhancing their competitive advantage in international markets. Secondly, HR and talent management professionals should also concentrate on the design and implementation of different types of training for digital skills and competency enhancement and additionally need to increase investment in information technology improvement. In this perspective Wright et al. [53] highlight that HCD includes skill development, training programs, and leadership development, plays crucial role and necessary tools for sustaining in digital age.

Although the COVID-19 pandemic has significantly weakened the economy; however, the necessity of DL for maintaining competitiveness in the digital era has become even more evident. Also, Bartik et al. [84] support this view by noting that COVID-19 severely impacted the small business, emphasizing the necessity for relief programs to ensure long term sustainability and help business adapt to the rapidly evolving landscape. Along with this, attracting and retaining digital leaders and proper performance management metrics related to digital competency and innovation should be valued. Thirdly, IT experts and team members must set strategic goals for the organization to enhance HR competency for workplace performance, which is enhanced by DL through the integration of cutting-edge technology [58]. Along with that Zhao et al. [85] clearly mentioned that, after the COVID-19, the focus shifted from merely adopting technological tools to the strategic use of leadership capabilities, which integrate technological innovations with organizational goals thereby, enhancing overall performance.

Fourthly, organizations need to adapt to the unpredictable nature of the digital environment and leverage DL and TI to navigate and thrive in turbulent times like COVID-19 pandemic. Such organizations should invest in digital marketing skills, IT capabilities, and learning capabilities to drive innovation and improve performance. DL can support employees' productivity, creativity, and long-term success. Finally, this study can guide managers, researchers, and policymakers in focusing on the need for DL for HCD and strategically concentrating on TI for enhancing OP. So, after the COVID-19 pandemic, this research clearly highlights the necessity of DL in emphasizing HCD and TI as a critical factor for gaining competitive advantage. The findings underscore the importance of integrating leadership capabilities with technology and talent development to navigate the post-pandemic challenges and ensure organizational success in the rapidly evolving business environment.

5.3. Policy Implications

In addition, with theoretical and practical implication this study has greater impact on policy formulation and implication to overcome COVID-19 pandemic situations. First, the university and industry collaboration necessary to understand the need for HCD and propelling technological

innovation. Second, to support this step responsible authority such as government and University Grant Commission (UGC) of Bangladesh need to urge new policy for developing industry 4.0 demand digital leaders, human capital and necessary steps to support technological innovation. Third, government also takes necessary steps to inspire non-governmental sector to come forward for capable human development. Finally, the policymakers should be aware and initiate necessary policy for developing DL, human capital and innovation for achieving competitive advantage in the southeast Asia.

5.4. Research Limitations and Future Study Directions

Although our research model explains the relationship between DL and OP with the mediating role of HCD and TI, there are limitations to the study and additional opportunities for further development. First, 260 cross-sectional samples were collected using a convenience sampling method, which is not large enough and might have potential bias. Therefore, in future, large samples should be gathered and a longitudinal study should be conducted to observe long-term effects in the economy and organizational performance. Second, other potential factors may have relative impacts on the above relationship, such as psychological empowerment, artificial intelligence (AI), emotional intelligence, a digital mindset, and social media, which could be tested in the future. Third, this research covers single-point data sources, which might vary with the pace of environmental changes. Therefore, future research could be conducted based on the multipoint data source and suggest solutions based on the findings. Along with this pre-COVID and post-pandemic comparison could be helpful for taking strategic decisions. Fourth, researcher have conducted the research from the perspective of Bangladesh as developing economies, but future researchers can explore different geographical areas. Finally, while data was collected from service and manufacturing companies, future researchers can attain the opportunity to gather responses from other types of organizations, such as IT companies.

6. Conclusion

DL plays a vital role in enhancing HCD in multidisciplinary organizations in developing countries. However, TI shows an unfavorable relationship with OP, suggesting less emphasis on TI following the pandemic. DL attitudes enable leaders to maintain constant attention to the competitive environment in order to develop human capital competence and long-term competitive organizational performance. As DL is viewed as an important factor in shaping company culture, supporting digital transformation, and preventing bad organizational behaviors such as social loafing [86]. A positive and significant association between DL and OP indicates that digital leaders' dynamic capabilities positively enhance performance, in line with the HCD. Although TI has an insignificant role in enhancing performance, which is valid in this case as conventional organizations have not focused on leveraging the benefits of TI, this study demonstrates that incorporating a digital culture for human development within an organization can lead to improvements and, in turn, enhance the sustainability of OP. Lastly, by employing DL, enhancing human technological skills, fostering TI, and embracing technological and environmental volatility, organizations can navigate trajectory of sustainable OP that not only improves financial outcomes but also creates a lasting positive impact on society.

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Appendix A1: Questionnaire

Variables	Questionnaires	Reference
Digital Leadership	DL1: A digital leader raises awareness of the employees of the organization about the risks of information technologies. DL2: A digital leader raises awareness of the employees about the technologies that can be used to improve organizational processes. DL3: A digital leader determines required ethical behaviors for information implementations with all the stakeholders. DL4: A digital leader plays an informative role to reduce the resistance towards innovations brought by information technologies. DL5: A digital leader shares his/her own experiences about technological possibilities that help his/her colleagues to learn about the organization's structure. DL6: To increase participation in the corporate vision, a digital leader guides the employees of the institution regarding the technological tools that can be used	Erhan et al. [37]; Shin et al. [33]
Human Capital Development	HCD1: Our employees have leadership skills HCD2: Our organization's employees evaluate their actions HCD3: Employees generally perform tasks with a lot of energy. HCD4: Our employees' competence is at a suitable level. HCD5: The organization supports employees in upgrading their skills and qualifications where necessary. HCD6: Our organization consistently generates new ideas. HCD7: Our employees are satisfied with the organization. HCD8: The organization is assured that it is getting the most from its employees	Vidotto et al. [70]
Technological innovation	TI1: Developing innovation based on new technology is a strategic priority in my organization TI2: Technological innovation activities improve teamwork among my colleagues TI3: My competency (knowledge, skill and ability) improves through Technological innovation activities TI4: My self-discipline has improved through technological innovation activities TI5: I am motivated to be involved in technological innovation activities TI6: My performance has gotten better through technological innovation activities	Osman et al. [71]

Organizational Performance	OP1: Compared to our competitors, our organization's performance is more successful. OP2: Compared to our competitors, organizational performance has a greater market share. OP3: Compared to our competitors, organizational performance is growing faster. OP4: Compared to our competitors, organizational performance is more profitable. OP5: Compared to our competitors, organizational performance is more innovative.	Lee and Choi [72]; Shin et al., [33]
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