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Nexus among Digital Leadership, Digital Transformation, and Digital Innovation for Sustainable Financial Performance: Revealing the Influence of Environmental Dynamism

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Abstract: In the era of digitalization, the role of IT firms and the capabilities of digital leadership for driving digital transformation and managing environmental dynamism for the proliferation of digital innovation and organizational performance for sustainability are still scant, producing a knowledge gap. To fill this gap, this study aims to investigate the role of digital leadership in enhancing organizational performance, with the mediating impact of digital transformation and digital innovation, and the moderating role of environmental dynamism in the relationship between digital transformation and innovation. To investigate the conceptual model, we used survey data of 416 responses from small, medium, and large IT organizations in Bangladesh and deployed the AMOS 24 package software for the analysis of structural equation modeling (SEM). The results showed that digital leadership has a significant impact on digital transformation, digital innovation, and organizational performance. Digital innovation partially mediates the relationship between digital leadership and organizational performance. Although environmental dynamism has no significant effect in relation to digital leadership and innovation, it has an indirect influence on the structural model. The results from before and after moderation proved that environmental dynamism might not have a significant moderating effect on relationships, but it has significant power to change other interrelationships and hamper organizational sustainability.

Keywords: digital leadership; digital transformation; digital innovation; perceived environmental dynamism; organizational performance

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1. Introduction

The digital economy and the evolution of new advanced technologies such as artificial intelligence (AI), big data, IoT, cloud computing, and social media are emerging as significant issues. Every element of social and economic activity is transformed and impacted by digital technologies [1] which are increasingly unpredictable and volatile [2], and concern for organizational sustainability. Even though the environment is volatile, information technology (IT) firms are pursuing operational activities comprising digitally skilled leadership, transformation, and innovation to meet customers' expectations for embracing organizational success and sustainability. Particularly, digital leaders possess

dynamic capabilities to effectively manage uncertainty as key role players while adapting to cultural and technological changes [3] which is supportive of organizational sustainability. With the pace of globalization, organizations are becoming more digital [3,4] and technological systems are reshaping HRM relations with societies, economics, and politics [5]. In South Korea, people are using apps to purchase from Tesco's virtual outlets while waiting to board a train [6], and providing bus or train fares by scanning QR codes, while, in China, individuals are commonly using WeChat as a money-transfer medium. What is the state of the traditional system? Obviously, it became obsolete due to new innovations. These kinds of digital innovation (DIN) obviously ensued from the constant support from digital leadership, IT organizations, and IT-oriented resources for sustainable competitive advantages. In Bangladesh, IT sectors are playing a significant role in the improvement of smart Bangladesh, in the form of smart citizens, governments, economies, and societies, to achieve "Smart Bangladesh Vision 2041".

Digital leadership (DLP) is conceptualized as the combination of transformational leadership and digital skills [7], capable of facing environmental dynamic challenges and grasping opportunities arising from digital evaluation [8], while digital transformation (DT) is a planned change with the help of technologies [9] using IT infrastructure, data, cloud computing, mobile communication, and social media communication for the purpose of serving customers [10]. In IT organizations, this transformation is followed by examining the limitations of existing software or solutions, introducing new solutions, and replacing existing ones. Nambisan et al. [11] defined digital innovation "as the creation of market offerings, business processes, or models that result from the use of digital technology", whereas digital innovation (DIN) in IT firms infers developing and upgrading software solutions to integrate with upgraded technologies to support non-tech companies such as service, banking, manufacturing, e-commerce, health care, etc. Three reasons for innovation and transformation are (i) the change in market requirements; (ii) digitally born startup disrupting; and (iii) the increase in customer expectations, where digital leadership is one of the main pillars for digital transformation [12] and digital innovation. On the other hand, due to environmental dynamism, organizations need to re-assess efficiency and human resources, and redesigning current business processes.

Prior research has investigated the connections between digital leadership practices (DLP) and digital innovation (DIN) [13–15], as well as DLP and organizational performance (OP) [16–18]. Pertaining to this, Senadjki et al. [19] discovered that digital transformation (DT) has a substantial role in connecting DLP and business performance in the general sector, but this relationship was not investigated in the context of the information technology (IT) enterprises. On the other hand, Khin and Ho [6] performed a study in the IT sector, examining the relationship between organizations' digital orientation and capacity as predictors and DIN as mediators for both financial and non-financial success. This study indicates that, to evaluate organizational sustainability, it is crucial for IT organizations to comprehend the interaction between complex and dynamic surroundings, as well as the moderating influence of environmental dynamism. That is why there is still a need to analyze the effects of digital leadership practices (DLP) on transformation and digital innovation (DIN) in IT organizations, as well as its influence on organizational performance. Additionally, the function of digital enterprise digitalization (ED) in moderating these effects has not been examined in the context of an IT company. The reason why IT organizations undergo digital transformation (DT) is to facilitate innovation by establishing a solid IT infrastructure, resilient systems, efficient data management, and flexible procedures that foster innovative settings. Thus, this research focuses on addressing literature gaps by raising the following questions:

RQ1. *Do digital leadership's dynamic capabilities lead to digital transformation, digital innovation, and organizational performance for attaining sustainability?*

Digital leaders have diverse skills such as being visionary and with a clear purpose, providing experimental facilities, thinking outside the box, allowing cross-organizational communication, being good communicators, and mastering strategy and cooperation [13]; being creative, though a leader; being a global visionary; and being an inquisitive and profound leader [14]. Among the many characteristics of DLP are the mentionable capacity, such as digital literacy and leadership skills [15]; agility, participatory networking, open-mindedness, and trustworthiness [16]; and innovative thinker agility, uncertainty tolerance, and a natural teammate fostering digital talent [17]. On the other hand, there are three types of innovation: product/service innovation, process innovation, and model innovation. DIN means "the creation of market offerings, business processes, or models that result from the use of digital technology" [11]. Mainly, DIN is associated with new platforms, products, or services to meet the growing needs of customers. Khin and Ho [6] clearly stated that digital innovation is "the development of new products, services, or solutions by using digital technology". IT firms typically provide new software or upgrade systems with new ways to meet customer needs. Digital technology is also linked up with social media, smart phones, and the analysis of different embedded services [18], and now engaging AI-related activities. Kohli and Melville [19] mentioned that DIN has several stages, such as initiating, developing, implementing, exploiting, managing internal and external organizations, and achieving the final outcome. In IT organizations, DIN focuses on developing software or solutions based on customer requirements and continuous improvement, which leads to greater sustainable financial performance. Therefore, the combination with digital skills makes digital leaders unique, with the dynamic characteristics bestowed by DLP as a main pillar for organizational transformation, and innovation leads to sustainable organizational performance.

RQ2. *Do digital transformation and digital innovation play a mediating role in the model?*

Generally, digital transformation happens in three ways: (i) re-examining the organization's boundaries; (ii) inaugurating new products or services for customers; and (iii) reshaping organizational products. In IT organizations, DLP plays a crucial role for DT by re-examining present situations, developing innovative new solutions, and reshaping their software service to meet customer needs. Previous literature revealed that DT has different outcomes, such as changing business models, leader employment interconnections, employees, personnel knowledge, and organizational cultural changes [10,20]. In this study, DT focuses mainly on organizational digitalization activities, gathering large amounts of data, networks with different IT organizations, and efficient customer focus. IT organizations have a strong IT infrastructure and expertise in their respective fields, which is crucial for encouraging digital innovation to meet the expected growing needs of customers and achieve sustainable performance. Therefore, all these activities are initiated by digital leaders, and the outcome of this transformation has a positive influence on DIN and OP.

RQ3. *In the present model, as a moderator, what role does environmental dynamism play?*

The study intends to investigate how environmental dynamism (ED) or environmental uncertainty influences the interrelationship of DLP and DIN in the conceptual model for sustainability. The firm's environment encompasses all the physical and social elements directly influencing how individuals within the organization make their decisions [21]. Environmental dynamism refers to the level of unpredictability within an industry, encompassing the speed of change and innovation as well as the uncertainty surrounding customers' behaviors and actions [22]. Actually, ED denotes the rate of organizational external change and its reflection in the internal environment [23]. In this perspective, Jansen et al. [24] documented the "changes in technologies, variations in customer preferences, and fluctuations in product demand or supply of materials". In IT firms, due to globalization, technological advancements, and market fluctuations, customer needs constantly hamper

sustainability and, therefore, need change to propel DIN. However, the effect of ED cannot be underestimated [25] because disruptive technology can make an industry outdated, such as when the evolution of digital cameras forces Kodak film out of the market. In the previous study, Yu et al. [26] found that ED moderated the relationship between operation capability and productivity, but they have not acknowledged that ED not only affected hypothesized direct relationships but also affected other links. In previous studies, academicians and researchers mainly focused on whether ED has a significant moderating effect or an insignificant effect between the relationships, overlooking the effects of the proposed model and sustainability. This study aims to find the moderating role of ED between DLP and DIN as well as the role of ED in influencing model relationship differences.

2. Literature Review and Hypotheses Development

2.1. Dynamic Capabilities View (DCV) and Resource-Based View (RBV)

DCV is an extension of RBV theory, which attempts to integrate and acknowledge the utilization of environmental issues related to the surroundings for the purpose of achieving sustainable performance in a volatile business environment [26–28]. We specifically draw on DCV and RBV theory to address the study questions by developing and testing a hypothesized concept. Dynamic capability denotes "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" [28]. DLP capabilities are strategically crucial for managing IT firms in volatile environments because they enable database decision making, database management, efficient software and web development, IT support, and meeting customers' expectations through DT and innovation [13,14].

The most common and widely used theory is RBV, powered by capabilities used for providing value creation and related to organizational performance [29]. The capabilities are "organizationally embedded, non-transferable firm-specific resources whose purpose is to improve the productivity of the other resources possessed by the firm" [30]. Moreover, Barney [31] said that resources that are valuable, rare, inimitable, and non-substitutable are used to support gaining competitive advantages and superior performance [29,32]. In IT firms, DT is considered a unique resource because IT infrastructure, knowledge, reserved data, and customs support systems are assets for the organizations. Moreover, to sustain themselves in the digitally dynamic world, IT firms focus on innovative software-based solutions to achieve customer trust and ultimately lead to sustainable financial performance.

2.2. Digital Leadership (DLP) and Organizational Performance (OP)

Leadership literature emphasizes the importance of DLP for managing technological environments to achieve organizational sustainability [33]. The theory of DCV and RBV focuses on an organization's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments [34]. We draw upon DCV theory to conceptualize DLP capabilities as a pivotal asset for IT firms to integrate internal systems while supporting DT and innovation, and enhancing organizational financial performance in an ongoing volatile environment. Digital leaders are adorned with diverse capabilities, including digital literacy, a positive attitude, skill acquisition, knowledge sharing, and a participative style [35]. Moreover, they have a "portfolio of digital skills, market and business skills, and strategic leadership skills" [36]. These capabilities are used for managing internal and external organizational factors. As a result, these skills encourage strategy and decision making for enhancing organizational performance. Back to the definition, DLP combines a leader's aptitudes and culture to best utilize digital technology and create value for their companies [37]. If organizations move from traditional to advanced systems with properly skilled leaders, it encourages a change in culture and support for innovation and enhanced performance. Several studies have already proven that DLP has a significant impact on OP [38] and sustainable OP [33]. As DLP is admired for its dynamic and multidimensional capabilities, it will definitely support organizational value development. Therefore, the following hypothesis was proposed:

H1. *DLP positively influences OP.*

2.3. Mediating Role of Digital Innovation (DIN)

In this era, organizations are also focusing on information and communication (ICT) for knowledge sharing, Internet-based innovation, and a new type of leadership for organizational management [39]. DLP entails directing and exerting influence for organizational strategies [40], where organizations are aware of business objectives [9]. Innovation involves using IT and creating values [41] and emphasizes improving relational and analytical information processing for greater customer involvement and an open platform [42]. Indirectly, IT and customer relationships work toward long-term goals and organizational sustainability. Notably, along with dynamic digital skills, DLP is associated with creating a vision for the organization, which leads to achieving expected goals. On the other hand, Budianto et al. [43] mentioned that digital leaders are capable of making decisions by using their digital vision and capabilities. In the previous study, it was found that dynamic capabilities have a positive impact on innovation management [44] and DLP has a positive influence on innovation [45]. Besides this, DLP is positively interconnected with innovation [46], innovation performance [36] and innovative behavior [47]. An effective relationship between DLP and DIN is crucial for cultivating a culture that promotes creativity, adaptability, and technological progress. Moreover, the previous literature has shown that innovation and OP have a positive correlation [48], although negative influence evidence also exists [49]. Khin and Ho's [6] study supported the idea that DIN has a significant role in financial performance. They also proved DIN has a mediating role between IT capability and organizational performance. Although the influence of DLP on innovation is a familiar issue, as a mediating role of DIN in IT firms, the interrelationship of DLP and OP is yet to be explored. Digital leaders' diverse dynamic capabilities and digital skills drive DIN, which is expected to foster sustainable OP. Based on this logical point, we assumed the following hypothesis:

H2a. *DLP positively influences DIN.*

H2b. *DIN positively influences OP.*

H2. *The effect of DLP and OP is mediated by DIN.*

2.4. Mediating Role of Digital Transformation (DT)

Digital transformation is a wide and multifaceted [50] and multidimensional system that can affect organizations in different ways. Because of digital disruption, one-third of the top 10 enterprises are forced to be replaced [40], and its reflections are suppressed in all parts of society. Globalization, improved organizational efficiency, competitive pressure, regulatory compliance, organizational agility, innovation and growth, technology shifts, and changing customer expectations are driving IT firms to embrace digital transformation (DT). DT aligns with complex digital technology for value creation, technology management, formulating strategies, and adopting culture [51,52]. We draw on DT capabilities from an RBV perspective, as its adoption capabilities create unique value for enterprises. An effective leadership style and a leader's capabilities play a crucial role in supporting DT in Portuguese businesses [40]. DLP is capable of transforming and integrating digital technology into business operations as a propeller for DT [53,54]. Nadkarni and Prügl [55] added that technological factors as well as actors like transformative leadership, managerial and organizational capabilities, culture, and working environments are supportive of DT. As IT firms have businesses associated directly with technology, their environment and culture are always focused on innovation and adaptation, which are led by DLP. Therefore, digital leaders' capabilities are playing a key role in the transformation of IT firms to meet customer needs and manage organizational sustainability.

Moreover, innovation encompasses the utilization of information technology to generate value [41] and focuses on enhancing consumer engagement through the utilization of relational and analytical information processing as well as the implementation of open-platform structures [42]. Around 300,000 employees and 600,000 freelancers are supporting 4500 IT organizations in Bangladesh [56] for the purpose of daily operations, organizational management, and customer support for sustainable digital management. IT organizations support the development of cloud enterprise resource planning (ERP), which deploys networks for the organization for real-time connection and information sharing for the maximization of resources through innovation Therefore, integrating digital technologies into a transformation endeavor establishes a basis for fostering innovation. IT firms' capabilities of integrating technology and DT in innovative ways propel them to thrive in OP. Zhou et al. [57] found that DT mediates between executive confidence and environmental technology and management innovation in Chinese public enterprises. Taiwan's financial industries proved that DT strategies fully mediated between technology and OP. It is also found that DT mediates between CRS and authenticity in Korean electronic products [58,59] and between CSR and corporate innovation in the Vietnam context [60]. Besides this, a study in Saudi universities found that DT mediates between organizational culture and job satisfaction among faculty members [61]. Lastly, Senadjki et al. [62] found that DT mediates between DL and performance. However, the influence DLP has on DT leads to DIN in IT sectors, which creates a research gap and motivates researchers to explore these areas. Therefore, the following hypothesis is assumed:

H3a. *DLP positively influences DT.*

H3b. *DT positively influences DIN.*

H3. *The effect of DLP and DIN is mediated by DT.*

2.5. Moderating Role of Environmental Dynamism (ED)

When the environment is stable, technological change is insignificant, and customer choices and preferences do not change, dynamic capabilities are costly and even destructive [63], but, in a dynamic environmental situation, dynamic DLP is essential for handling the volatile environment for sustainability. In highly dynamic environments, environmental factors are rapidly changing; therefore, digital transformation and innovation become crucial for adaptation and sustainability. Teece et al. [28,64] proposed that dynamic capabilities can fight with environmental change, which is associated with a bumping role in environmental dynamism. As IT sectors are dealing with very high environmental dynamism, they therefore need to adapt through DT and innovation by DLP. Eisenhardt and Martin [27] expressed that the form of dynamism is different according to the perspective; here, the investigation focuses on what moderating roles ED plays between DLP and DIN.

Moreover, digital leaders have diversified skills for managing digital environments and the capabilities to work in dynamic environments for sustainability. Based on this motivation, DLP is essential to creating new solutions to meet evolving customer needs through innovation. The typical literature has supported the idea that ED has a positive moderating role for dynamic capabilities [22]. According to Permana et al. [65], ED has a positive role in the case of dynamic capabilities. It is also found that industry dynamism, market performance, and operational capabilities are significantly correlated to industry dynamism, while ED moderates between operational capabilities and operational performance [66]. Empirical investigation also demonstrated that, in a stable environmental dynamism, the relationship between DLP and DIN is insignificant, while, in a turbulent environment, it is also positive [22,67]. If digital leaders' roles are very dynamic and active, this might also neutralize the negative environmental turbulence in organizations. As IT sectors are very dynamic and the environment is constantly changing, this study proposes the following hypothesis:

H4. *ED moderates the relationship between DT and DIN.*

3. Methodology

To achieve the research goal, this study utilized a quantitative method to investigate the relationship among DLP, DT, DIN, ED, and OP by gathering and examining primary survey data to test the hypothesis. The unit of analysis of this study is IT enterprises that are operating and serving customers through IT solutions in the technology market. This part of the research explains the details of the research procedure, the reasons behind the selection of the IT industry, and how the data were gathered.

3.1. Sampling Process and Data Collection

To examine the interrelationship among the constructs by analyzing hypotheses, this study collected samples from small, medium, and large IT firms in Bangladesh. The reasons behind selecting IT firms are that they are working to support organizational sustainability. On the other hand, as Bangladesh is a developing country, she wants to achieve the "Smart Bangladesh" vision while also encouraging digital business. IT firms make huge contributions to the economy, and it is surging. Therefore, there is a need for investigation of DLP capabilities for maintaining DT, DIN, and OP in dynamic environmental situations for sustainable competitive advantages.

In this study, we categorized firms into small-, medium-, and large-scaled based on the criteria outlined by Moazzem [68]. According to Moazzem [68], small firms have fewer than 50 employees, medium firms have between 50 and 99 employees, and large firms employ more than 100 employees. For sample selection, we have used convenience sampling method. Samples were collected from workers in IT organizations, adhering to these classifications. The data were collected based on an online-based system. Before participating in the survey, there was a description and purpose of this study to help understand the survey motive. The research team distributed a total of 500 questionnaires to the targeted respondents. Among these, 426 responses were collected, including 206 from IT firms. After excluding 10 unusable or invalid responses, the final sample size for the study was 416. Notably, data were collected at two different times. The first time we gathered around 250 pieces of data from October 2022 to January 2023, and the second time we collected another 176 pieces of data from March 2023 to April 2023 from different respondents operating in Bangladesh. Thus, this study achieved a response rate of 83.2%, which is considered acceptable. This is because, in comparison, previous studies have reported the following response rates: Karim et al. [69] achieved 79%, Shahneaz et al. [70] 77.9%, Islam et al. [71] attained 60.6%, Amin et al. [72] achieved 52.25%, and Mahmud et al. [73] reached 47.2% in the context of Bangladesh.

3.2. Measurement Items

After an inclusive literature interview and discussions with IT workers, we prepared our research theme. In order to assess DLP, this study has used six items developed by Ulutas and Arslan [74], which were later used by Erhan et al. [47] and Shin et al. [75] which were five-point Likert scales ranging from (1) "strongly disagree" to (5) "strongly agree". Then, the measurement of DT was conducted using the scale developed by Nasiri et al. [76] and used by AlNuaimi et al. [10] through five indicators. Along with this, to measure DIN, this study has used six items from Paladino [77], and Khin and Ho [6]. Lastly, to assess ED, this study has used four items on a five-point Likert scale used by Li and Liu [22]. Finally, to assess the organizational financial performance, this study used three items from Khin and Ho [6].

3.3. Respondents' Demographic Information

The respondents in the IT firms are dealing with numerous software solutions to provide services to banks, manufacturing, retail organizations, education, etc. Out of 416 responses from 206 firms, around 83.8% are male, 14.7% are female, and 0.2 prefer not

to express their gender identity. Then, the employees have work experience ranging from 1 to less than 6 years, which is about 63.8%, followed by less than 1 year experience at 15.1%. Next, we have the frequency of firm age: results showed that 45.7% of IT organizations are operating for more than 5 years to less than 11 years, followed by 24.3% of organizations operating for less than 5 years, and 12.7% of organizations have more than 20 years of operational experience. Finally, the size of the organizations revealed that 30.8% are small, 14.9% are medium, and around 54.3% are large IT firms. Lastly, of the respondents, about 30.8% are junior IT officers, followed by senior officers (29.3%), and about 12.2% are top-level employees.

4. Results

After completing the data collection, the data were analyzed and presented using SPSS 23 for frequency, descriptive statistical, and correlation analyses. After that measurement model, convergent validity, discriminant validity, and hypotheses testing through the structural equation model, the AMOS 24 software has been used. Due to the widespread acceptance and availability of AMOS, researchers can find in-depth structural interrelationships among the constructs. Moreover, AMOS methods are very sensitive and useful for the large sample size. This study has multiple methods of analysis. We have identified the measurement model fit and, secondly, the structural model fit [78]. Before determining the structural model, we tested common method variances. Following that, we have tested the reliability and validity of the model. Next, we conducted a two-step hypothesis testing process. First, we tested the direct and indirect relationships of the proposed model without the moderation effect of ED, and then we tested the model with the moderation effect of ED. Finally, we have compared the differences or influences in the two models to find the indirect influence of the ED.

4.1. Common Method Variance

First, we have tested the Kaiser–Meyer–Olkin (KMO) and Bartlett's test, where the results of KMO are 0.917, which is closer to 1 and considered excellent for factor analysis. This high degree of sampling adequacy suggests that each variable in the dataset is dependably and accurately predicted by the other variables. Bartlett's test of sphericity ($X^2 = 4531.78$, $df = 276$, $p < 0.001$) found strong correlations among the constructs, suggesting a suitable factor analysis. The test verifies that the correlation matrix is not an identity matrix, proving that there is enough interconnection between the variables to provide meaningful factors. In Appendix A, Table A2 shows the results from the KMO and Bartlett's test.

Moreover, to address the common method variance (CMV), we employed both procedural and statistical methods. As part of our procedural techniques, we used two separate scales to promote objective responses, conducted pilot tests on selected samples, and sourced our questions from reliable sources. Next, Harman's single-factor common latent methods and correlation technique were deployed. The first component explained 36.43% of the variation, below the 50% threshold indicated by Podsakoff et al. [79]. In Appendix A, Table A3 shows the results from Harman's single-factor test. Therefore, this study raises no concerns about common method bias.

4.2. The Measurement Model

The study inspected the data reliability, discriminant validity, and path coefficient. Convergent validity evaluates the extent to which a measurement is strongly connected with other measurements that assess the same concept [80]. In the case of measurement model validity using the recommended indices, the findings revealed $\chi^2 = 323.23$, $\chi^2/\mathrm{df} = 1.826$, Goodness of Fit Index (GFI) = 0.933, Adjusted Goodness of Fit Index (AGFI) = 0.912, Root Mean Square Residual (RMR) = 0.025, Root Mean Square Error of Approximation (RMSEA) = 0.045, Comparative Fit Index (CFI) = 0.961, Tucker–Lewis Index (TLI) = 0.954, Incremental Fit Index (IFI) = 0.962, and p-value for Close Fit (PCF) = 0.873. Similar results were also found for the structural equation model analysis. The study assessed the con-

vergent validity by examining the indicator reliability (factor loadings), average variance extracted (AVE), and composite reliability (CR) as presented in Table 1. All the loadings were above the threshold value of 0.40. However, DLP1, DIN6, and ED4 were deleted because, in the measurement model fit, their loading was reflected below 0.6. We assessed the convergent validity of the study model by conducting tests for composite reliability (>0.70), average variance extracted (>0.50), and Cronbach's a (>0.70) [81,82]. Moreover, we tested multicollinearity by measuring the variance inflation factor (VIF). The value ranges between 0 and 10; therefore, there is no concern for multicollinearity issues [80]. Our results show that all the VIFs fall under 2, which indicates that this study has no multicollinearity problem.

Table 1. Summary of the reliability and construct validity analysis.

Variables	Items	Items Deleted	Factor Loading	AVE	CR	Cronbach's α	VIF
1. Digital Leadership	DLP2	1 (DLP1)	0.718	0.583	0.875	0.818	1.542
	DLP3		0.627				
	DLP4		0.638				
	DLP5		0.664				
	DLP6		0.670				
2. Digital Transformation	DT1	None	0.754	0.613	0.888	0.835	1.718
	DT2		0.737				
	DT3		0.693				
	DT4		0.688				
	DT5		0.677				
3. Digital Innovation	DIN1	1 (DIN6)	0.827	0.589	0.877	0.856	1.574
	DIN2		0.786				
	DIN3		0.663				
	DIN4		0.700				
	DIN5		0.623				
4. Environmental Dynamism	ED1	1 (ED4)	0.654	0.590	0.812	0.756	1.404
	ED2		0.744				
	ED3		0.754				
5. Organizational Performance	OP1	None	0.763	0.725	0.888	0.842	-
	OP2		0.812				
	OP3		0.830				

In order to evaluate the discriminant validity of the constructs, the Fornell–Larcker criterion was used. This criterion takes into consideration the degree to which a variable differs from another construct. To ensure discriminant validity, the square roots of AVE should be greater than the other correlation coefficients [81]. Table 2 shows that all the bolded bracketed values are greater than the square roots of AVE, and ensures that there is no concern for discrimination validity.

Table 2. Discriminant validity (Fornell–Larcker criterion).

Variables	1	2	3	4	5
1. Digital leadership	**(0.764)**				
2. Digital transformation	0.543 **	**(0.783)**			
3. Digital innovation	0.435 **	0.535 **	**(0.767)**		
4. Environmental dynamism	0.421 **	0.427 **	0.461 **	**(0.768)**	
5. Organizational performance	0.468 **	0.501 **	0.552 **	0.476 **	**(0.851)**

Note(s): ** $p < 0.01$; diagonals (in bold) represent the square root of average variance extracted (AVE) while the other entries represent the correlations.

4.3. Structural Model

In this research, firm age and firm size have been considered as controlled variables, and the results found that both firm age (β = 0.088, $p < 0.05$) and firm size (β = 0.125, $p < 0.05$) have a significant role in controlling OP. It infers that, when IT organizations have a longer operating experience and firm sizes are large, they have higher performance and sustainability. In order to determine the links between the variables for hypothesis testing, the structural model was evaluated. As shown in Table 3, a comparative analysis was performed before the interaction of ED and after the interaction of ED in the hypothesized model. Along with this, to test the path analysis, Bootstrap 5000 has been applied for assessing structural equation modeling [83]. In the model without moderation or before the moderation effects of ED, the results depicted the direct positive impact of DLP on OP (β = 0.268, $p < 0.001$), DLP on DIN (β = 0.204, $p < 0.001$), and DLP on DT (β = 0.543, $p < 0.001$). Therefore, *H1*, *H2a*, and *H3a* are supported. Then, the results revealed that the relationship between DIN and OP (β = 0.430, $p < 0.001$) and DT and DIN (β = 0.424, $p < 0.001$) is all significant. Therefore, *H2ba* and *H3b* were also supported. The mediation was calculated by using the Gaskin plugin in AMOS 24. In the indirect relationship, DLP to DIN to OP (β = 0.088, $p < 0.001$) and DLP to DT to ODIN (β = 0.231, $p < 0.001$) are significant. Therefore, *H2* and *H3* are supported.

Table 3. Results of the hypotheses (comparative results of ED effect as moderation).

No.	Hypothesis	Model without Moderation			Model with Moderation			Observed Change
		Path Coefficient	*p*-Value	Decision	Path Coefficient	*p*-Value	Decision	
H1	DLP→OP	0.268 ***	0.000	S	0.269 ***	0.000	S	No
H2a	DLP→DIN	0.204 ***	0.000	S	0.139 *	0.021	S	No
H2b	DIN→OP	0.430 ***	0.001	S	0.424 ***	0.000	S	No
H3a	DLP→DT	0.543 ***	0.000	S	0.543 ***	0.000	S	No
H3b	DT→DIN	0.424 ***	0.001	S	0.360	0.155	NS	Yes
Mediation								
H2	DLP→DIN→OP	0.088 ***	0.001	S	0.052 *	0.021	S	No
H3	DLP→DT→DI	0.231 ***	0.000	S	0.192	0.155	NS	Yes
Moderation								
H4	DLP × ED→DIN				0.000	0.965	NS	-

Note(s): * $p < 0.05$, *** $p < 0.001$; DLP = digital leadership; DT = digital transformation; ED = environmental dynamism; DIN = digital innovation; OP = organizational performance; S = supported; NS = not supported.

In the model with moderation analysis in Table 3 and Figure 1, the moderation effect of ED is insignificant in the relationship between DLP and DIN (β = 0.00, $p > 0.05$), while the relationship of DT to DIN becomes insignificant (β = 0.360, $p > 0.05$). Moreover, the mediation relationship of DLP to DT to DIN turned from significant to insignificant (β = 0.360, $p > 0.05$). Therefore, *H3b*, *H3*, and *H4* were rejected. In sum, the moderation effect of ED has an insignificant role in the prescribed relationship (DLP to DIN), but it has the capability to significantly change the interrelationship of the structural model in IT firms.

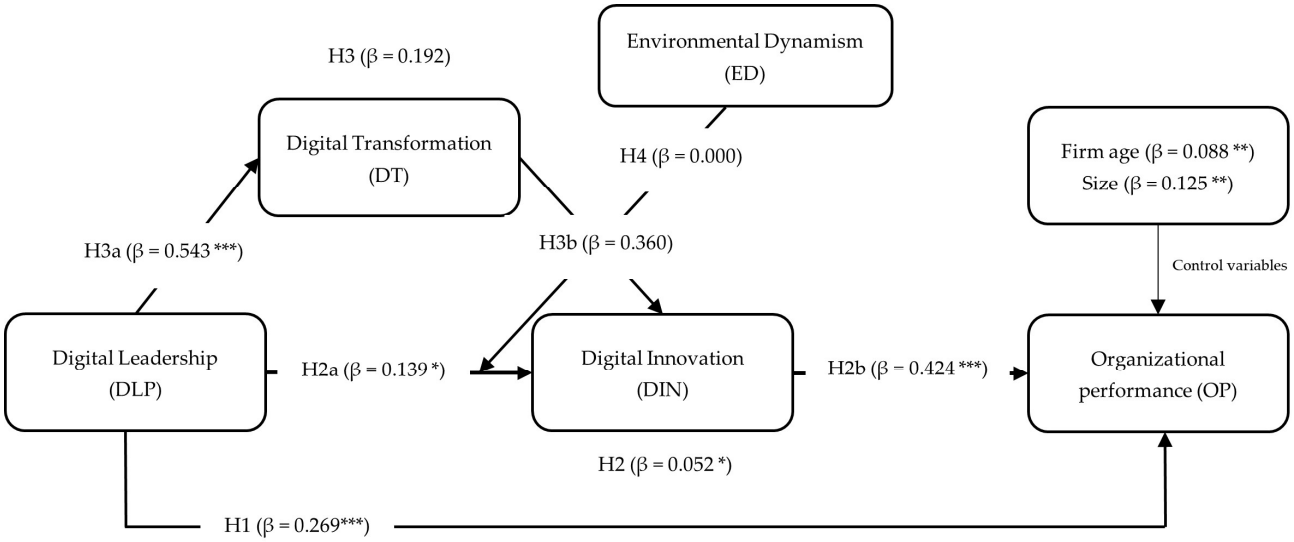

Figure 1. Path analysis of structural model. Note(s): * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

5. Discussions

The research is designed to fulfill three objectives. First, it is an attempt to reveal how DLP dynamic capabilities drive DT, DIN, and OP for sustainability. Second, we investigate the intervening roles of DIN between DLP and OP and DT between DLP and DIN. The third but most important investigation is a comparative analysis of the moderating effect of ED before and after the interaction in the model. The hypothesized model was examined to attain the research goal and reveal the answers to the questions. The consequences are empirical attempts to support the conceptual model and test hypotheses based on the structural model. The research goal is successfully achieved by obtaining all the answers to the questions. There might be an argument about why DT is used as a mediator between DLP and DIN, but why not set DIN as a mediator in the link between DLP and DT? The reason behind this logic is that IT organizations have a strong IT foundation, a robust infrastructure, a data management system, and an agile process to create environments for DT—DT enables DIN. Overall, the results of the study support DC and RBV theories that link DLP and OP and show ways of promoting sustainability.

To obtain the answers to *RQ1*, *H1*, *H2a*, and *H3a* were tested. The outcome reveals that DLP dynamic capabilities have a significant effect on OP, DT, and OP in both models. Therefore, *H1*, *H2a*, and *H2b* are supported by answering the questions that DLP leads to DT, DI, and OP. The substantial effect is consistent with past findings by Shin et al. [75], who found DLP on OP; Wasono and Furinto [46] found DLP is positively linked with innovation. Porfírio et al. [40] described leadership capability as having a positive influence on DT. This finding infers that DLP makes IT enterprises digitally capable and emphasizes embracing DLP to better manage the organization's internal environment and meet consumer expectations through DT and innovation to achieve firms' expected performances. Therefore, IT enterprises focus on hiring and caring for DLP. As digital leaders are highly capable of handling digital tools and techniques such as software and web development, network administration, cyber security, IT support, and database management, they influence DIN and performance. Moreover, visionary, goal-focused, outside-the-box thinking, intra- and inter-organizational communication, and mastery in digital skills and strategy prove to be positive supports for DT, DIN, and OP.

Then, to obtain answers for *RQ2*, *H2b*, *H2*, *H3b*, and *H3,* were tested. The findings revealed two types of results: without moderation, the results showed that DIN had a significant effect on OP, and DT also had a significant positive effect on DIN. While DIN mediates between DLP and OP, DT also mediates the interlink between DLP and DIN, which is similar to the findings of Zhou et al. [57]. However, when the interaction of ED is added to the model, the results show that ED has an insignificant effect on DLP and

DIN. Surprisingly, after the interaction of the ED hypotheses, *H3b* and *H3* turn out to be insignificant. It infers that ED has a weaker influence on the results of the model, although it makes the sustainable business environment unstable. Finally, in a comprehensive model with the interaction of ED, the final proposed model depicts that *H2b* and *H2* are supported and *H3b* and *H3* are rejected. The significant positive role of DIN and OP suggests that DLP is vital for enhancing DIN in IT enterprises by creating new markets, new business processes or models, new solutions in the combination of hardware and software, AI-integrated services, new apps, and embedded services for customers, which can enhance organizational financial performance.

Then, to obtain the answer to *RQ3*, *H4* was tested. The results showed that ED has an insignificant moderating effect between DLP and DIN. However, the interesting findings revealed in the study were that, due to the ED direct effect of DT on DIN (*H2b*), the mediation effect of DT (*H3*) turned insignificant. Researchers may neglect or discourage foreseeing insignificant external effects, but external environments have an influence on other interrelationships. In summary, although ED does not have a direct effect, indirectly, it hampers the intervening role of DT between DLP and INV. Therefore, based on the above results, it can be inferred that, due to the DLP dynamic role, the ED effect can be minimized and maintain sustainability in organizations.

6. Study Implications

6.1. Theoretical Implications

This study makes some important theoretical contributions to DCV and RBV. First, it is a successful attempt to find the relationships among DLP, DT, DIN, ED, and OP in IT firms. Theoretically, Teece et al. [28] mentioned that dynamic capabilities have a positive role in neutralizing environmental dynamism and enhancing innovation and performance. In support of that, the results proved that DLP has a significant effect on DIN, similar to previous studies [36,47,84]. These results proved that digital leaders' digital skills and dynamic capabilities as visionary, creative, inquisitive, and profound leaders [14] support DT and DIN for organizational financial sustainability. Digital leaders have diverse skills such as providing experimental encouragement, thinking outside the box, allowing cross-organizational communication, having sound strategic knowledge, and being very cooperative [13]. On the other hand, this theoretically denotes DCV and RBV theory are interconnected. Our findings reveal that DLP has a significant effect on DT, DIN, and OP, providing insight into the idea that digital leaders' dynamic capabilities have a significant contribution toward propelling DT and innovation in IT firms. DLP, DT, and DIN are very essential for organizational sustainability and performance. Specifically, in Industry 4.0, in spite of ED, the role of the digital leader for DT and DIN is undeniable. This study's theoretical and empirical results revealed digital leaders' leading capabilities to maintain IT organizations facing internal and external challenges for innovation and organizational financial sustainability.

6.2. Managerial Implications

From a practical point of view, the key contribution is the comparative measurement of the ED effect and the DLP role for enhancing DT, innovation, and financial performance for sustainability. To support this, the key outcome of our studies depicted that, due to the indirect effect of ED, the role of digital transformation has changed. First, provided that the mediating role of DIN is crucial for IT firms, where DLP capabilities are required for developing innovative software solutions and other services to achieve financial benefits and sustainability, based on the DCV, leaders' dynamic capabilities are crucial for the success of IT firms. To survive and achieve sustainable performance goals in volatile, dynamic, and competitive environments, it is vital for IT firms to deploy DLP to improve financial and non-financial performance. Digital leaders' activities like thinking outside the box, encouraging new experiments, inter- and cross-industry communication, preparing dynamic strategies, and cooperating make IT organizations competitive in any unpre-

dictable situation. Therefore, IT firms should place emphasis on DT-based innovation, which directly influences organizational performance.

Second, the results explained that DT has two results: one represents the mediation between DLP and DIN without interaction, but interactions show an insignificant role when the moderation of ED is added. This has significant implications for IT firms and managers. The results revealed that, if ED is overlooked, DT mediates between DLP and DIN, inferring that IT organizations depend on customer-driven decision-making and innovative software solutions. To meet the growing customer demand, IT firms prepare infrastructure and accumulate knowledge workers to stay locally and globally competitive for sustainability. Especially, DLP-advanced capabilities can handle external environmental effects efficiently. With this perspective, to address environmental challenges, integrate data and information, and achieve sustainability and success, IT organizations need to follow simplified presentations of systems and agility [85]. Although ED did not moderate the link, it demonstrates a deep understanding and influences. Due to ED, the mediating role of DT became insignificant, indicating that environmental instability is supposed to be overlooked and customer-demand-driven solutions are needed. Therefore, the expert handling and regular upgrading of IT firms can minimize external environmental impacts. Therefore, IT firms need to follow Gua and Xu [86]'s statement: 85 percent of firms invest in DT in the first year for achieving competitive advantages. Finally, IT firms need to be aware of the direct and indirect effects of external environmental factors on their businesses in order to achieve sustainability.

7. Limitations and Conclusions

Despite some significant contributions, this study also has some limitations. First, the unit of analysis was employees' work at IT firms; therefore, these results cannot be generalized. Due to the active role IT organizations play, the business, society, and culture are submerged in the wave of digitalization. Therefore, future research should focus on the role of IT organizations in digitalization and its impact on business success and sustainability. This study was empirically tested based on DCV and RBV theory, with DLP as a key construct, DT and DIN innovation as focused intervening variables, and ED as a moderator. The results show that ED has an indirect effect on influencing the path analysis model. In the future, digital leaders' capability, employee trust, work satisfaction, IT platform, and organizational support could be tested. Third, this study deployed a quantitative research methodology; it is also required to apply qualitative research methods to find the behavioral change due to IT in the other organizations. Fourth, in the future, multi-level and comparative studies are encouraged to find key indicators of differences for the success and sustainability of the organization.

The era of digital technologies is relentlessly drifting, and sustainability depends on dealing with the dynamic capabilities of digital leaders. A digital leader's capabilities of integrating digital processes, analyzing data, and taking decisions with technology application [36] are useful for DT and innovation. In Bangladesh, IT sectors are playing a key role in the development of smart Bangladesh, in the form of smart citizens, smart governments, smart economies, and smart societies, as stated in the "Smart Bangladesh Vision 2041", which is declared by the government. There are 4500 software and ICT firms where more than 300,000 employees are working in Bangladesh [56]. The role of digital leaders in IT sectors for DT and innovation for smart Bangladesh is worthwhile. As a result, digital leaders' visionary and innovative work behavior and skills support IT organizations' success. Without DT and DIN, it is not possible to accomplish targeted goals and sustainability. This study outcome can aid in the potential growth and sustainability of the IT sector in developing countries, in particular by providing guidelines to policymakers. They can formulate and implement the IT-related relevant policies and practices being inspired from this study. Last but not least, digital leaders are the masters of handling dynamic environments, encouraging DT and innovation with their expert hands to satisfy the growing expectations of customers and make organizations successful and stable. In

the hyper-competition business, which faces local, global, and environmental pressure to improve performance and sustainability, DLP is the best solution to stay tuned.

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Appendix A

Table A1. Questionnaire.

Variables	Item Code	Items	Literature Source(s)
Digital Leadership Capabilities	DLC1	Supervisor/leader raises the awareness of the employees of the institution about the risks of information technologies	Ulutas and Arslan [74]; Erhan et al. [47]; Mollah et al. [33]
	DLC2	Supervisor/leader raises awareness of the technologies that can be used to improve organizational processes.	
	DLC3	Supervisor/leaders determine the ethical behaviors required for informatics practices together with all its stakeholders.	
	DLC4	Supervisor plays an informative role to reduce resistance to innovations brought by information technologies.	
	DLC5	Leaders share his/her own experiences about technological possibilities that will increase the contribution of his colleagues to the learning of organizational structure.	
	DLC6	In order to increase participation in the corporate vision, a digital leader guides the employees of the institution about the technological tools that can be used.	
Digital Transformation Capabilities	DT1	Our aim is to digitalize everything that can be digitalized.	Nasiri et al. [76]; AlNuaimi et al. [10]
	DT2	We collect large amounts of data from different sources.	
	DT3	We aim is to create more robust networking with digital technologies between the different business processes.	
	DT4	Our aim is to enhance an efficient customer interface with digitality.	
	DT5	We aim at achieving information exchange with digitality.	
Environmental Dynamism	ED1	Product or service in our industry updates quickly	Li and Liu [22]
	ED2	The acts of competitors are difficult to predict	
	ED3	The technology in our industry progresses quickly	
	ED4	To predict the change of customer needs is difficult	

Table A1. *Cont.*

Variables	Item Code	Items	Literature Source(s)
Digital Innovation	DIN1	The quality of our digital solutions is superior compared to our competitors'.	Paladino [77]; Khin and Ho [6]
	DIN2	The features of our digital solutions are superior compared to our competitors'.	
	DIN3	The applications of our digital solutions are totally different from our competitors'.	
	DIN4	Our digital solutions are different from our competitors' in terms of product platform.	
	DIN5	Our new digital solutions are minor improvements of existing products.	
	DIN6	Some of our digital solutions are new to the market at the time of launching.	
Organizational financial Performance	OP1	Sales performance of our company compared to competitors.	Khin and Ho [6]
	OP2	Net profit of the company compared to competitors.	
	OP3	Cash flow of the company compared to competitors	

Table A2. KMO and Bartlett's test.

Kaiser–Meyer–Olkin Measure of Sampling Adequacy.		0.917
Bartlett's Test of Sphericity	Approx. Chi-Square	4531.780
	df	276
	Sig.	0.000

Table A3. Total variance explained.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**
1	8.743	36.430	36.430	8.743	36.430	36.430
2	1.885	7.854	44.285			
3	1.556	6.483	50.768			
4	1.259	5.247	56.015			
5	1.155	4.812	60.827			
6	0.932	3.883	64.711			
7	0.832	3.466	68.177			
8	0.810	3.376	71.553			
9	0.655	2.730	74.283			
10	0.636	2.651	76.934			
11	0.572	2.383	79.316			
12	0.535	2.230	81.546			
13	0.492	2.048	83.594			
14	0.482	2.008	85.602			
15	0.458	1.910	87.512			
16	0.423	1.764	89.276			
17	0.390	1.624	90.900			
18	0.374	1.558	92.458			
19	0.354	1.474	93.931			
20	0.341	1.421	95.352			
21	0.307	1.279	96.631			
22	0.297	1.237	97.868			
23	0.280	1.168	99.035			
24	0.232	0.965	100.000			

Extraction Method: Principal Component Analysis.

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