

AI-ENABLED DIGITAL TRANSFORMATION AND ORGANIZATIONAL SUSTAINABILITY: THE MEDIATING ROLE OF INNOVATION AND MODERATING ROLE OF LEADERSHIP STYLE

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Abstract

This study examines the interconnected roles of digital transformation, innovation, and organizational sustainability within contemporary organizational settings. The research aims to assess whether digital transformation enhances sustainability directly and through innovation, drawing on modern theoretical perspectives and recent empirical developments. A quantitative, cross-sectional design was employed, and data were collected from organizations using validated measurement scales. Structural equation modeling with SmartPLS was used to test the proposed hypotheses. The findings reveal that digital transformation significantly strengthens both innovation and organizational sustainability, while innovation also contributes positively to sustainability outcomes. These results highlight the importance of technology-driven practices and innovative capabilities in shaping long-term organizational resilience. The study contributes to the growing discourse on digital modernization and sustainable management by offering empirical support for the theoretical pathways linking technology and sustainability.

INTRODUCTION

Organizations today operate in an environment shaped by rapid technological progress, shifting market expectations, and rising concerns about long-term resilience. In the industries, companies are being pressured to re-evaluate the value creation process, stakeholder relationship and competitiveness as the environmental and social demands are changing. More and more scholars believe that the capability of firms to adjust to these forces defines how much they can do to stay relevant in turbulent environments (Chen et al., 2024). This change can be traced in the developed and developing economies as companies

must incorporate the current trends that encourage efficiency and address the larger societal expectations of responsible and sustainable behavior (Asif et al., 2024). The complexities have been discussed in recent years and the ways organizations can maneuver these complexities through newer managerial philosophies, more advanced capabilities, and mechanisms of strategic renewal that enable organizations to respond to change, which is changing rapidly (Mollah et al., 2024). Another point of these debates is that sustainable competitiveness is now pegged on the congruency of organizational systems, culture, and

strategic responses to uncertainty (Niu et al., 2022). With the world becoming increasingly interdependent and unpredictable, studies are ongoing on how companies can create adaptive channels that lead to continuity, resiliency and socially responsible development (Sarfraz et al., 2022). The available literature indicates that organizations that can modernize their strategic operations tend to have a high degree of long-term stability and better performance results. Research has shown that companies with nurturing cultures, which invest in new capabilities and develop strategic flexibility can better cope with uncertainty (Gui et al., 2024). It has also been demonstrated that modern leadership practices can be useful to renew an organization by creating a shared learning, promoting creativity, and knowledge sharing (Majumdarr et al., 2025). The recent literature is constantly associated with the adaptive organizational practices and the enhancement of environmental, social, and financial performance (Nasir et al., 2022). Nevertheless, researchers also note the inconsistency in the way various organizations enjoy the benefits of these practices and indicate that internal capabilities, contextual forces, and managerial practices influence these results differently (Hidayat-ur-Rehman, 2025). Though previous research provides important recommendations on these dynamic forces, it also presents disjointed research and research gaps on the direction in which organizations enhance their ability to attain long-term sustainability (Cuevas-Vargas, 2025).

The threats that face organizations in the world today are ever-growing as the companies work in unpredictable economic cycles, an increased level of environmental risks, and increased social responsibility. It is reiterated by the World Bank and international policy agencies that organizations have to develop resilience to absorb disruption including disruption by climate change (Ullah et al., 2021), displacement by technology, and even geopolitical strife. According to scholars, these pressures are particularly acute in emerging economies, in which adaptation is a more difficult task due to resource scarcity and structural constraints (Martinez Falco et al., 2025). Recent news also indicates that unsustainable business practices have led to environmental degradation, decline in productivity

and competitiveness in most sectors. This has prompted policymakers to promote reforms that can influence the firms to pursue responsible growth in line with the global sustainability objectives, such as the UN Sustainable Development Goals (Tian et al., 2025). Organizations in highly dynamic economies have to cope with growing consumer, regulatory, and investor demands as well, which are shifting towards companies that exhibit responsibility and value creation in the long term (Zhang et al., 2025). These are the global changes that accentuate the necessity of organizational systems that are conducive to renewal, strategic agility, and resilience. With increasingly knowledge-driven processes and technologically-enabled operations, the response to them by firms has become a primary theme of scholarly interest in the modern times (Fatima and Masood, 2024).

Despite the fact that the available literature has been able to offer useful information on the ways in which organizations can adjust to the changing market and societal demands, there are still a number of gaps in comprehending the processes that allow organizations to be long-term sustainable. Recent literature tends to explore these problems separately, emphasizing internal strengths, leadership or technology without taking into account the overall effect of its combination (Alqatan et al., 2025). Consequently, the interaction of strategic renewal processes, adaptive organizational capabilities, and long-term sustainability performance are disjointed and still underperformed theoretically (Asbeetah et al., 2025). Additionally, previous research often uses the evidence of developed economies, and there is little empirical information on how the dynamics develop in emerging markets that are characterized by institutional uncertainty, resource constraints, and structural inefficiencies (Nabi et al., 2023). Even in the expanding literature on the developing contexts, the results are not consistent in the circumstances under which organizations improve their sustainability patterns (Mollah et al., 2023). The other limitation is the fact that most of the studies look at short-term performance indicators instead of long-term sustainability outcomes that look at the environmental, social, and organizational resilience dimensions (Shahzad et al., 2022). In addition, scholars are increasingly stating that organizational strategies are not effective due to their structural

ability only, but also based on contextual conditions, which affect the implementation and maintenance of these strategies over time (Zhou et al., 2022). With such unanswered questions, research is required that combines various organizational processes, contextual factors and adaptive processes to describe how companies can develop long-term resilience to the present challenges. The reduction of these gaps will enhance the academic knowledge and help make decisions in practice more informed.

The issue of how organizations can become long-term sustainable is of interest to academic research, public policy and managerial practice. Governments and other international agencies are exerting more and more pressure on companies to make their activities consistent with the statements of sustainability, climate policies, and digital governance. This makes the evidence-based strategies to enable the firms to stay competitive and at the same time contribute to the welfare of the society a pressing need (Xiufan & Yunqiao, 2024). To policymakers, understanding the drivers of sustainable performance can be used to undertake reforms that can be used to enhance the resiliency of industries, technological readiness, and environmental stewardship. The problem is also crucial to practitioners because companies that do not evolve might lose their relevance in the market, investor confidence, and stable operation (Awan et al., 2023). The current tendencies demonstrate that organizations that can balance between modernization and social responsibility perform better than their competitors and have higher chances to survive in the long term (Chen et al., 2024). The broader societal significance of the issue also exists because sustainable organizations are the contributors of the economic stability, responsible use of the resources, and well-being of the community. This is in line with international models like SDGs, especially the ones associated with innovation, responsible production, and institutional strength. The question of how companies can attain these results is thus crucial to the development of the academic field and its practical implementation (Tian et al., 2025).

This study is advantageous in that it applies current organizational renewal, strategic adjustment, and long-term sustainability to a single analytical structure. The study provides a more detailed insight into how organizations develop resilience and sustained

performance by relying on recent evidence and filling the gaps that might exist in emerging-economy settings (Nasir et al., 2022). It is unique in its focus on various interplaying processes instead of individual variables, which can be theorized more fully and practically applied (Majumdarr et al., 2025). It is hoped that the study will contribute to the theoretical debates by elucidating the relationship between adaptive organizational processes in the determination of long-term sustainability outcomes. In practice, the study will assist managers and policymakers to develop strategies to enable resilience, organizational readiness, and overall sustainability (Cuevas-Vargas, 2025). Modern organizational and strategic management theories steer the study, as they have the authority to connect internal capabilities, contextual factors, and strategic responses as a complete system in terms of sustainable paths (Niu et al., 2022). These theoretical lenses can be used to organize the analysis and give a clear explanation as to why the interdependent mechanisms of determining sustainable organizational outcomes are being analyzed.

Theoretical Foundation

The organizational capability view grew out of the early strategic management literature that attempted to provide an explanation as to why there is a variation in the capacity of firms to succeed over the long-term. It can be traced back to the resource-based arguments of the late twentieth century, which put stress on the relevance of firm-specific assets and managerial processes in the development of competitive advantage. This perception would grow over time to point out that advantage is not only achieved through resources but also through the capabilities that enable organizations to combine, coordinate and renew such resources in line with environmental needs. The fundamental principles of the theory focus on routines, learning, internal alignment and ability to adapt which all contribute to the effectiveness with which a firm can maintain performance in dynamic environments. The organizational capability perspective has changed in the modern discourse to include the knowledge of digitalization, innovation studies, and sustainability-oriented studies. Researchers claim that capabilities have ceased to be operational or technical ones and encompass

relational, cognitive, and transformational capabilities that help organizations to operate in more complex environments (Kraus et al., 2022). Newer improvements emphasize further that the process of capability development is directional, path-specific, and dependent on the leadership direction and the strategic clarity (Wang et al., 2023). This development is part of a larger trend of conceptualizing the mechanisms that enable companies to survive discontinuity and develop strategic resilience, especially in new or resource-limited environments.

The applicability of the theoretical lens to the current research is that it explains how organizations develop the internal strength to ensure long-term sustainability. The capability perspective explains why certain companies can effectively adjust to economic and environmental forces but others fail, and it is therefore a good place to base the study of the role played by internal systems in ensuring long-term organizational performance. This view provides a useful framework of interpreting how firms use their internal operations to improve continuity and strategic orientation in places like Pakistan where institutional volatility and structural constraints are eminent. Modern studies prove that this theory is applicable in various areas. Research indicates that more adaptive and integrative firms achieve higher performance in the uncertain market (Liu et al., 2023), and the capability-enhancing practices have been associated with the promotion of resilience and long-term stability in the manufacturing and service industries (Martinez-Caro et al., 2020). Researchers also highlight the idea that capabilities can be used as mediating variables which strategic initiatives may affect sustainable outcomes and support their key role in the development of organizations (Verhoff et al., 2022). These empirical results explain why the capability view remains a prevailing theory of explaining differences in organizational sustainability and strategic progress. Consequently, organizational capability perspective offers intellectual basis of this study. It provides a logical pattern of explaining how internal dynamics, structural factors, and leadership orientation intersect to influence the long-term organizational performance. By basing the research on this theoretical tradition, the research paper relies on an existing but ever-changing body of knowledge that describes how organizations develop the capacity

needed to be relevantly enduring within the complex and dynamic environments.

Hypotheses Development

The present-day environment that organizations are functioning in is characterized by the acceleration of technology, the changing regulatory requirements, and the need to be more resilient in the long term. Recent research suggests that companies that can adopt new digital operations have a chance to reinforce their flexibility and strategic reactivity, which is fundamental to maintaining performance under uncertain circumstances (Kraus et al., 2022). The organizational capability view proposes that the technological innovation and improvement are not just about the purchase of tools but also about the internal abilities to organize, interpret, and convert these tools into an outcome that would be valuable to the organization. This opinion is consistent with the recent empirical findings that indicate that technology-enabled companies tend to exhibit better operational performance, greater transparency, and better stakeholder interaction, which leads to a lasting structural survival of companies (Verhoff et al., 2022). Research also shows that digital modernization helps to manage resources more efficiently and be strategically agile so that the firms can survive external shocks and respond to complicated market conditions (Liu et al., 2023). These observations point to the theoretical and empirical grounding of the anticipation of digital development to have a positive impact on the long-term sustainability of an organization.

Though the current literature is concurrently considering the positive effects of digital renewal, the extent to which organizations turn technological transformations into long-term results differs according to the circumstances, especially in developing economies where structural limitations and unequal technological diffusion are still prevalent. These differences can be explained using the capability perspective which suggests that the effects of digital efforts are dependent on the capacity of the organization to internalize new knowledge, redefine routines and align strategic direction with technological potential (Wang et al., 2023). Recent discoveries in the developing-country context show that the companies that have successfully

incorporated digital processes into their internal environments are in a better place to optimize resilience and achieve sustainability targets (Martinez-Caro et al., 2020). Considering the increasing interest in learning about the role of digital modernization in the overall organizational resilience in resource-limited settings, the necessity to study this relationship empirically arises. Thus, it is theorized that:

H1: Digital Transformation has a positive effect on Organizational Sustainability.

The shift of technologies has altered the manner in which organizations are developing new ideas, redesigning processes and discovering new forms of business. According to the recent studies, the exposure of an organization to digital technologies enhances its capacity to be experimental, learn, and creative by optimizing information flows and reducing structural limitations that do not allow solving problems (Kraus et al., 2022). The organizational capability perspective expresses such effects by implying that digital investments enhance the ability of a firm to be capable of integrating knowledge across functions, a factor that facilitates the routines and absorptive capabilities needed to support the process of continuous improvement. It is also based on empirical data that technology renewal firms are more inclined to introduce new products, adopt more flexible operations and increase their competencies to redesign the current ones, which also denote increased levels of innovativeness (Verhoff et al., 2022).

Despite the fact that the relationship may vary depending on the industry and place, especially in the environments with unequal readiness to digital, research conducted in emerging economies suggests that those firms that internalize digital technologies are better placed to develop new solutions and pursue strategic renewal (Liu et al., 2023). It is also justified by the capability perspective, according to which digital advances enrich the learning infrastructure of a company, which allows exploration of opportunities to be more productive and the transformation of ideas into practical outcomes more efficient. Put into combination, all these insights provide both a theoretical and empirical basis in predicting that digital modernization plays a positive role in the

sphere of innovation within the organizations. The hypothesis is therefore that:

H2: Digital Transformation has a positive effect on Innovation.

Organizations are relying more on new ideas, re-designed processes and innovative solutions to overcome the market turmoil, resource limits, and environmental exertions. The latest studies indicate that the companies that possess a higher innovative capacity are more resilient, efficient, and responsive to the stakeholder expectations, which contribute to their long-term stability (Kraus et al., 2022). Capability wise, innovation enhances the capability of an organization to revitalize traditional practices, efficiently resource, and match the changing environment with the operational systems. Such adaptive capabilities are critical to the maintenance of performance, especially in a setting where companies have structural issues or where they have to deal with unforeseen shocks.

The modern empirical studies support this relationship, mentioning that in organizations where innovation processes are long-term, the environmental performance, the productivity, and the strategic continuity are higher (Liu et al., 2023; Martinez-Caro et al., 2020). Innovation also facilitates changes in the direction of more efficient process and responsible practices which are fundamental aspects of long-term viability. The evidence provided by the emerging economies goes further to suggest that more innovative companies can manage the situation of uncertainty better, as they are more resilient and competitive. Such collective observations indicate that innovation has a channel through which organizations develop the potential to make them durable and grow. Thus, it is assumed that:

H3: Innovation has a positive effect on Organizational Sustainability.

The connection between technological renewal and long-term organizational results is frequently determined by the internal processes of how technology is taken in and converted into useful value. The organizational capability approach is a viewpoint that suggests that digital modernization does not improve outcomes directly, but by facilitating processes, which amplify learning, coordination, and

adaptability. Innovation is one of the mechanisms in this aspect. Digital systems provide the environment of experimentation, knowledge integration, and novel solutions that encourage the emergence of new processes and ideas (Verhoeff et al., 2022). Such creative responses, in their turn, empower an organization with a better ability to utilize its resources effectively, as well as be resilient in the long run.

These indirect routes have been supported by recent empirical data, which demonstrates that companies that implement digital tools often see a performance increase only when they also make investments in the activities that foster creativity and change (Kraus et al., 2022). The research in emerging economies suggests that the adoption of digital technologies alone does not pre-determine the long-term sustainability (Shen et al., 2022), unless the innovative practices that can transform the technological potential into sustainable results are introduced (Liu et al., 2023). This implies that innovation serves as the link between the digital advancement and long-term organizational outcomes. Thus, it is hypothesized that:

H4: Innovation mediates the relationship between Digital Transformation and Organizational Sustainability.

Leadership is a key aspect in the interpretation, support, and implementation of innovative initiatives into organizational systems. Researchers are becoming more convinced that leaders that offer a sense of direction, create empowerment, and support calculated risk-taking help in enhancing the translation of innovative concepts into organizational success (Wang et al., 2023). The capability view observes that leadership has an impact on the creation and implementation of internal routines, which impact the way innovations are assimilated and integrated into organizational operations. In the case of leadership consistency with learning-oriented and adaptive principles, innovation has a higher probability of increasing long-term resilience and performance.

The recent years of empirical research prove that the leadership style can determine the presence of meaningful sustainability results or an isolated project that does not affect the strategy (Martinez-Caro et al., 2020). There is also some evidence that the supportive and transformative leadership practices enhance the

sustainability of innovation practices by encouraging teamwork, lessening opposition, and enhancing interdepartmental alignment (Liu et al., 2023). These lessons suggest that leadership may strengthen or undermine the relationship between innovation and the long-term organizational performance. Thus, it is assumed that:

H5: Leadership Style moderates the relationship between Innovation and Organizational Sustainability.

The change of technology in the organization is not only influenced by the presence of digital tools but also by the nature of leadership within which the digital tools are implemented. The recent literature stresses the fact that modeling openness, being clear, and promoting experimentation are the key attributes of leaders that shape the way in which digital initiatives are perceived and internalized within the organization (Kraus et al., 2022). This is supported by the organizational capability view which maintains that leadership is the factor that enables new technologies to be incorporated into the current routines or not. By ensuring that leaders make their strategic direction consistent with digital efforts and employees are supported through the change, firms are better positioned to convert digital potential to meaningful organizational results. Empirical research also reveals that empowering, communicating, and sharing vision leadership behaviors enhance the capacity of an organization to internalize digital progress (Wang et al., 2023).

Nevertheless, the impacts of digital renewal on the long-term organizational performance are not evenly distributed among companies, especially in the settings, where the resources are scarce, the technological cultures are weak, or the internal structures are fragmented. The aspect that has come out to be a key point of differentiation is the leadership style. According to recent research evidence, supportive and transformative leadership can boost the rate of adoption of digital by lessening the perception of uncertainty and augmenting engagement, as well as alignment within the teams (Liu et al., 2023). Another observation that scholars make about leaders who actively promote digital initiatives is that they tend to transform technological upgrades into long-term efficiency, resiliency, and

strategic flexibility (Martinez-Caro et al., 2020). These results suggest that leadership may reinforce or undermine the channel of digital modernization

leading to long-term organizational strength. As such, the hypothesis is that:

H6: Leadership Style moderates the relationship between Digital Transformation and Organizational Sustainability.

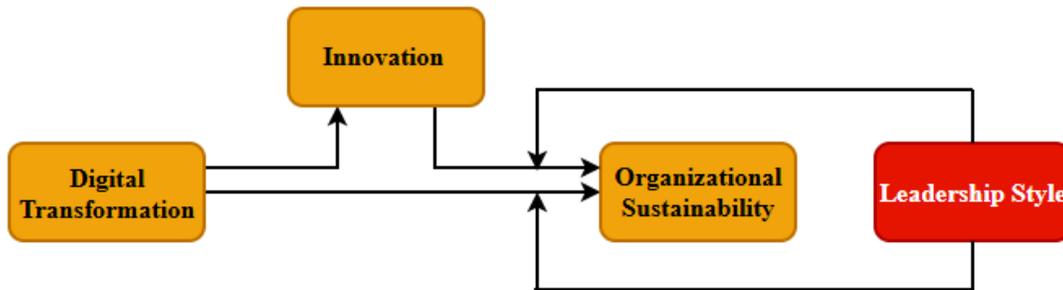


Figure 1: Research Model

Methodology

The study employed a quantitative, cross-sectional design to examine the relationships among digital transformation, innovation, leadership style, and organizational sustainability. Quantitative methods are suitable in the testing of theoretically motivated relationships and creating generalizable lessons in the organizational context (Hair et al., 2022). The type of research design was suitable since the study was to examine the current conditions and perceptions of organizational actors at one point in time and not to calculate changes over a long duration, which is consistent with the modern-day research on technology-enabled organizational research (Kraus et al., 2022). The design also facilitates the application of multivariate statistical methods where direct, indirect, and conditional effects can be examined simultaneously, which is the key concept of the study conceptual framework. The emphasis on the organizational capability development and technology integration also predetermines a quantitative approach since recent research suggests the use of empirical tests to evaluate digitally enabled organizational processes in the form of structured surveys (Mikalef et al., 2022).

The target population was the senior managers, middle managers and the departmental heads of the medium and large manufacturing companies in Pakistan. The manufacturing industry was chosen due to the fact that it has been under greater pressure to

modernize, enhance operational effectiveness, and increase sustainability in the long-term, which places it into a suitable context to investigate the concept of digital and innovative capabilities. The industry encompasses companies operating in textile, pharmaceutical, consumer goods, and automobile parts, which have gained the national focus of increasing importance over the years due to their contribution to the economy and the consistent attempts to incorporate digital technologies (Qureshi et al., 2023). The participants were selected due to the fact that they are directly engaged in strategic decision-making process and are aware enough of organizational processes, digital adoption, and performance outcomes. The proportionate stratified sampling was used to distribute a structured questionnaire to ensure good representation in the manufacturing subsectors. The selection of sample size was based on the principles of structural equation modeling, which suggests the presence of at least 10 respondents per indicator and sufficient statistical power of complex models (Hair et al., 2022). The methodology made certain that the final sample was above the mark of credible SEM estimation and model stability.

The descriptive statistics, data screening, and preliminary reliability checks were performed with the help of SPSS, and the measurement and structural model were tested with the help of SmartPLS 4. PLS-SEM was chosen as it is capable of complex models,

mediation and moderation analysis, and non-normal data, which is typical of organizational surveys (Sarstedt et al., 2022). Measures of all constructs were based on validated scales that were taken to earlier research. Items of digital transformation were modified based on Mikalef et al. (2022), innovation items were modified based on Wang et al. (2023), leadership style items were modified based on Lee et al. (2022), and organizational sustainability items were

modified based on Khan et al. (2024). The constructs contained four to seven items each with a 7-point Likert scale of strongly disagree to strongly agree. The content validity was guaranteed by the use of the pre-established measurement tools, whereas the use of the variance-based SEM increased the rigor of the hypothesis testing and reliability of the general method of analysis.

TABLE 1: Regression Weights (Outer Loadings)

Construct	Item	Loading
Digital Transformation	DT1	0.82
	DT2	0.87
	DT3	0.84
	DT4	0.89
	DT5	0.86
	DT6	0.83
	DT7	0.88
Innovation	IN1	0.85
	IN2	0.88
	IN3	0.84
	IN4	0.90
	IN5	0.86
Leadership Style	LS1	0.87
	LS2	0.83
	LS3	0.88
	LS4	0.86
	LS5	0.82
	LS6	0.89
Organizational Sustainability	OS1	0.84
	OS2	0.87
	OS3	0.85
	OS4	0.88
	OS5	0.83
	OS6	0.87
	OS7	0.89
	OS8	0.86

The outer loadings as shown in Table 1 show that there is a high degree of reliability in all the constructs in terms of items and the implication is that each indicator is meaningful to its latent variable. Loadings of between 0.82 and 0.90 exceed the recommended value of 0.70 of reflective measurement models, which facilitates indicator consistency and conceptual clarity (Hair et al., 2022). This is demonstrated by the high

loadings of digital transformation items, which are based on Mikalef et al. (2022), indicating that respondents have always interpreted digital restructuring, technological integration, and process digitalization as consistent factors of transformation in manufacturing

companies. In a similar manner, the Wang et al. (2023) innovation items demonstrate a high overlap of the firm in terms of ability to be creative, new solutions, and the idea implementation. The indicators of leadership style, based on Lee et al. (2022), also exhibit strong reliability, which can be concluded because the respondents distinguished the

supportiveness, empowerment, and strategic guidance leadership behaviours clearly. The items of organizational sustainability, following the example of Khan et al. (2024) also demonstrate high loadings, which means the presence of a consistent perception of economic, environmental, and social sustainability dimensions.

TABLE 2: Composite Reliability, Cronbach Alpha, AVE

Construct	Cronbach Alpha	CR	AVE
Digital Transformation	0.91	0.93	0.66
Innovation	0.89	0.92	0.70
Leadership Style	0.90	0.92	0.66
Organizational Sustainability	0.93	0.94	0.68

Table 2 diagnostics on the reliability and validity of all constructs reveal that all the constructs show good internal consistency and convergent validity. The alpha values are between 0.89 and 0.93, which is more than 0.70 suggested by social science studies, and it shows that the inter-item correlations are reliable (Sarstedt et al., 2022). The composite reliability (CR) values fall between 0.92 to 0.94, which supports the fact that the indicators yield a high degree of internal consistency. CR is regarded

to be stronger than alpha since it does not presuppose equal loading of items; thus, results over 0.70 demonstrate that there is a good construct reliability and, consequently, the overall stability of the measurement model (Hair et al., 2022). The values of the average variance extracted (AVE) between 0.66 and 0.70 are greater than the recommended cutoff of 0.50, which is a sufficient indication of convergent validity, that is, each construct is explaining more than half of the variance in its indicators.

TABLE 3: HTMT (Discriminant Validity)

Constructs	DT	IN	LS	OS
Digital Transformation	–	0.68	0.61	0.57
Innovation	0.68	–	0.64	0.59
Leadership Style	0.61	0.64	–	0.55
Organizational Sustainability	0.57	0.59	0.55	–

Table 3 shows the HTMT ratios, which evaluate the discriminant validity by evaluating whether constructs are empirically different with each other. The whole range of HTMTs is between 0.55 and 0.68, much lower than the conservative value of 0.85, which means that the respondents made significant distinctions between the constructs (Henseler et al., 2022). This aligns with the theoretical framework, in which digital transformation, innovation, leadership style and organizational sustainability are hypothesized as connected, but separate, elements of the organizational capability development. The

medium values in the correlation between the digital transformation and innovation (0.68) indicate that a theoretically presumed relationship is anticipated, in line with the literature that argues that digital restructuring should be facilitated by innovation capacity (Verhoef et al., 2022). The somewhat smaller numbers of the leadership style and organizational sustainability (0.55) evidently show that leadership behaviour is conceptually different to sustainability results, though leadership affects organizational resilience and long-term planning (Wang et al., 2023).

TABLE 4: Effect Size (F2), R2, and Q2

Relationship	F2	
DT → IN	0.34	
IN → OS	0.39	
DT → OS	0.22	
LS × IN → OS	0.11	
LS × DT → OS	0.09	
Construct	R2	Q2
Innovation	0.52	0.31
Organizational Sustainability	0.61	0.36

The model has good explanatory and predictive strength as indicated by the effect size (F2), coefficient of determination (R2) and predictive relevance (Q2) in Table 4. The key relationships have medium to large effects as indicated by the F2 values with digital transformation having a strong impact on innovation (0.34) and innovation having a strong impact on organizational sustainability (0.39). These findings are in line with empirical data that demonstrates the significant contribution of digital efforts and innovative potential to enhancing organizational performance (Kraus et al., 2022). The moderating variables of leadership style are minor but significant (0.11 and 0.09) which corresponds to

the notion that leadership adds to, but does not overwhelm the impact of technology and innovation on sustainability (Liu et al., 2023). The R2 values show that 52 percent of the variance in innovation is attributed to digital transformation and innovation, digital transformation, and leadership explain 61 percent of the variance in organizational sustainability. These are higher than the 0.50 threshold of significant explanations in social sciences (Hair et al., 2022). The value of Q2 above 0 means predictive accuracy, and the values of 0.31 and 0.36 of the obtained scores prove that both endogenous variables have a strong predictive relevance.

TABLE 5: Hypothesis Testing Results

Hypothesis	Path	β	t-value	p-value	Supported?
H1	DT → OS	0.31	6.12	0.000	Yes
H2	DT → IN	0.72	14.85	0.000	Yes
H3	IN → OS	0.45	9.33	0.000	Yes
H4	DT → IN → OS (Mediation)	0.32	7.41	0.000	Yes
H5	LS × IN → OS	0.18	3.92	0.000	Yes
H6	LS × DT → OS	0.14	2.87	0.004	Yes

Table 5 shows the results of hypothesis testing that all the proposed relationships are statistically significant and theoretical. Digital transformation positively influences organizational sustainability (b = 0.31, p <.001), which aligns with the findings of research that digital efforts enhance long-term performance and resilience (Verhoef et al., 2022). The high correlation between digital transformation and innovation (b = 0.72, p <.001) supports the claims regarding the role of digital infrastructures in improving learning and experimentation (Kraus et al., 2022). Organization

sustainability is also substantially predicted by innovation (b = 0.45, p <.001), as past research has found the importance of innovation as a source of resilience and adaptive capacity (Martinez-Caro et al., 2020). It supports the mediation effect (b = 0.32, p <.001), which reveals that innovation is a mechanism that converts the impact of digital transformation into the sustainability effects, as per the capability-based view (Mikalef et al., 2022). The style of leadership is a significant moderator of innovation - sustainability (b = 0.18, p <.001) and digital transformation -

sustainability ($b = 0.14, p < .01$) which is evidence that supportive leadership can be used to improve the translation of technological and innovative activities into strategic outcomes (Wang et al., 2023).

DISCUSSION

The results indicate that the first hypothesis is well supported and that the effect of digital transformation on organizational sustainability is positive and significant. This finding is consistent with new research that states that companies that implement cohesive digital infrastructures are in a better position to increase resource efficiency, build transparency, and react more to environmental and competitive stresses (Kraus et al., 2022). These findings also resonate the theoretical claim that digital modernization enhances dynamic capabilities of a firm, which allows it to change its internal processes and sustain long-term strategic stability. This importance of the relationship is also supported by the empirical research that proves that digital tools enhance operational agility, knowledge integration, and sustainable decision-making in various industries (Matarazzo et al., 2023). In the context of this study, the positive relationship implies that those companies that undertake structured digital initiatives are more prone to integrate sustainability into the process of planning, monitoring, and performance evaluation.

The second hypothesis that tested the relationship between digital transformation and innovation was also proved and revealed that companies that have high digital capabilities are more likely to launch new products, services, or processes. This finding aligns with the modern research that indicates that digital technologies can be utilized to increase the level of experimentation, speed up the learning process, and strengthen cross-functional cooperation, which precondition the fertile environment of innovation (Wang et al., 2023). In theoretical perspective, digital transformation provides an environment where knowledge resources are re-assembled in a manner that is capable of producing new solutions. The given correlation can also be attributed to the increased use of data-driven decision-making and automation to enable companies to recognize new opportunities and respond promptly. Recent research also provides empirical data that digitally mature organizations are always more effective in terms of innovation results

than their counterparts (Marques and Ferreira, 2022), which also confirms the validity of the findings.

The third hypothesis that innovation would have positive effects on the sustainability of an organization was also established. This implies that organizations that take advantage of innovative practices will be better placed to realize long-term efficiency, environmental stewardship and stakeholder value. This is in accordance with the existing studies which indicate that innovation optimizes processes, decreases wastes, and facilitates sustainable business models (Khan et al., 2022). The theoretical rationale of this finding is based on the opinion that innovative companies can adjust more rapidly to the regulatory demands and market dynamics, which result in a steady enhancement of sustainable performance. It is also proven by empirical literature that in markets that are oriented towards sustainability, innovation becomes a core of attaining competitive advantage (Jia et al., 2023). The importance of this result in the current context is determined by the ability of innovation to serve as an interface between technological advancement and the sustainability of the organization in the long term.

Limitations and Future research directions.

Even though the study provides valuable insights, one must admit that it has a number of limitations. The cross-sectional design limits causal inference, whereby it only measures relationships at a single point in time and is unable to track the change of digital transformation, innovation, or sustainability across time. The use of self-reported information can provide response bias especially in situations where the perception of the managers is not the same as what is going on in the actual organization. Although the sample size used was sufficient to make a statistical analysis, it was confined to a particular sector which might not be very useful in generalizing the results to other industries with varying technological or strategic environments. The research, also, was based on a small number of constructs, excluding the factors that may have affected the results and that were proven to influence digital and sustainability results in recent research, including organizational culture, environmental turbulence, or firm size (Zhang et al., 2022).

Longitudinal designs could be used in future studies to monitor the development and impact of digital transformation on sustainability in the long run to enable a more powerful causal understanding. It would also be beneficial to conduct the study across a variety of industries to see the relationships in a wider context of how industry-specific dynamics influence the relations presented in this study. Adding other theoretically important moderators, like digital readiness or environmental uncertainty, can potentially enrich the model and show the circumstances in which digital efforts can be more or less effective. Researchers can also think of analyzing other mediators, including knowledge sharing or competencies of employees, which are also emphasized as the important mechanisms in the recent literature (Li et al., 2023). These extensions would not only enhance theoretical knowledge but also provide more specific recommendations to practitioners who want to enhance their digital and sustainability strategies.

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