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Research Article

Building Digital Resilience: How Smart Dynamic Capabilities Drive Transformation Performance in Turbulent Technological Landscapes

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Conflict of interest
The authors declare none.

Abstract

Despite substantial investments in digital technologies, many organizations struggle to achieve successful digital transformation outcomes. Drawing on the dynamic capability view, this study examines how smart dynamic capabilities, including digital platform capabilities and big data analytics capabilities, drive digital transformation performance through digital resilience. It also explores the moderating role of technological disruption intensity in this relationship. A quantitative research design was employed, using survey data from 301 employees in pharmaceutical firms in Pakistan, and the data were analyzed using structural equation modeling. The results show that both digital platform capabilities and big data analytics capabilities positively influence digital transformation performance, with digital resilience acting as a mediating mechanism. Furthermore, the intensity of technological disruption weakens the positive effect of digital resilience on transformation performance, suggesting that excessive technological turbulence can undermine the effectiveness of resilience strategies. This study contributes to the digital transformation literature by advancing the application of the dynamic capability view by introducing smart dynamic capabilities as key drivers of digital resilience and transformation performance. It also provides new insights into how technological disruption conditions shape the effectiveness of resilience-driven transformation in turbulent environments.

Keywords: Digital transformation performance; Digital resilience; Dynamic capabilities; Big data analytics capability; Digital platforms capability; technological disruption.

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1 INTRODUCTION

A sustainable environment is essential for businesses (Fawad et al., 2025; Khan et al., 2023; Khan et al., 2026) and digital transformation and green technologies have become the strategic necessities across sectors, with organizations increasingly adopting digital technologies to boost efficiency, transform business models, increase sustainability, and maintain competitive advantage (Fengyun et al. 2024; Feroz et al., 2021; Khan et al., 2025). Despite significant investments, many companies struggle to translate technological initiatives into successful transformations, leaving a persistent implementation gap. Empirical evidence suggests isolated investment may not substantially enhance employees' capacity to discern external disruption, mobilize resource acquisition, and devise adaptive solutions (He et al., 2022). This challenge is often attributed to the instability of the digital environment, where continuous disruptions impede progress before their benefits are fully realized. In response to these challenges, digital resilience has developed as a crucial organizational capability, characterized as an organization's capacity to anticipate, withstand, recover from, and adapt to digital shocks (Boh et al., 2023). Empirical studies demonstrate its significance across diverse contexts, with digital transformation strengthening organizational resilience while simultaneously enhancing innovation capacity and adaptability (Khin and Ho, 2018; Ullah et al., 2025).

Despite growing attention, both academic and practical understanding of the mechanisms underpinning digital resilience and their contribution to digital transformation performance (DTP) remain limited. The first research gap concerns the micro-foundations of digital resilience. Although the dynamic capabilities view (DCV) provides a comprehensive theoretical lens for understanding organizational adaptation and transformation, many studies rely on broad constructs without identifying specific capabilities that cultivate resilience in practice (Ferraris et al., 2019). Recent research highlights complementary capabilities that serve as critical micro foundations. Digital platform capabilities (DPCs) represent organizational competencies that strategically leverage technological organizations to enable collaborative modernization and orchestrate the co-creation of multi-stakeholder value within digital ecosystems. Empirical evidence demonstrates that DPCs and resilience fully mediate the relationship between digital capital and SMEs' growth (Aghazadeh et al., 2024). BDACs represent an organization's capability to integrate technological infrastructure and human expertise to extract actionable insights from large, complex datasets, thereby achieving a competitive advantage and informed strategic decision-making. Research demonstrates that these capabilities advance decision-making processes, enabling organizations to mitigate the effects of supply chain disruptions while enhancing their resilience (Bronzo et al., 2024).

Collectively, these constitute what this study refers to as smart dynamic capabilities, a synthesis of platform integration and analytics-driven sensing capabilities. Yet, their combined influence on digital resilience and transformation performance remains empirically underexplored. The second gap relates to boundary conditions that shape the value of these capabilities in fostering digital resilience. The significance of dynamic capabilities may vary depending on the intensity of technological disruption, as demonstrated by foundational work on organizational responses to digital disruption (Karimi and Walter, 2015). Research further shows that competitive intensity strengthens the relationship between BDAC and market performance (Olabode et al., 2022), while other studies found that BDAC significantly moderates the relationship between Digital transformation and innovation performance (Hongyun et al., 2025). Accordingly, this study formulates and empirically evaluates a comprehensive framework that investigates:

(a) how DPCs and BDACs jointly foster digital resilience,

(b) the direct relationship between digital resilience and DTP,

(c) the mediating role of digital resilience in linking smart dynamic capabilities to transformation performance,

(d) how technological disruption intensity moderates the relationship between digital resilience and DTP.

The study aims to contribute to the current literature by exploring critical dimensions of DT in organizations, focusing on the interconnections among DPC, BDAC, and dig. Firstly, by investigating how DPC and BDAC jointly foster digital resilience, the study provides insights into how organizations can better navigate disruptions. This understanding is vital as businesses increasingly rely on technology to maintain operational continuity amid uncertainty. Secondly, examining the direct relationship between digital resilience and DTP underscores resilience's impact on organizational outcomes. Insights gained from this analysis can guide leaders in prioritizing resilience-building strategies to enhance their transformation efforts, ultimately driving competitiveness and innovation. Thirdly, by analyzing the mediating role of digital resilience in linking smart dynamic capabilities to transformation performance, this study enriches the discourse on dynamic capabilities, highlighting resilience as a performance facilitator and offering a nuanced understanding of how flexibility and adaptability contribute to successful transformations. Moreover, the study's exploration of how technological disruption intensity moderates the relationship between digital resilience and DTP is particularly relevant in today's fast-paced digital landscape. This sheds light on the variability in resilience's impact on transformation performance based on disruption levels, helping organizations tailor their strategies to cope with different degrees of technological change.

This research contributes to a nuanced theoretical model of how smart dynamic capabilities enable resilient digital transformation processes. By examining how digital platforms and analytics capabilities foster digital resilience and the moderating role of technological disruption, this study advances theoretical understanding while providing strategic guidance for managers to reinforce digital resilience and optimize technology investments under volatile conditions.

2 LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

The DCV advanced the Resource-Based View (RBV). DCV focuses on an organization's ability to adapt to a changing environment by developing dynamic capabilities. "Dynamic capabilities bridge the gap between the firm's resources and changing business environment." (Barney, 1991). RBV emphasizes leveraging existing resources. In contrast, DCV emphasizes the need to develop capabilities that enable effective responses to external changes. In this study, BDAC and DPC are derived from the DCV framework. They represent dynamic capabilities that enable firms to reconfigure and adapt their resources to environmental change. Moreover, DTP performance refers to the extent to which organizations effectively leverage digital technologies to enhance operational efficiency, innovation capability, and strategic outcomes, thereby translating digital investments into measurable organizational value (Vial, 2021; Xu et al., 2024a; Khan et al.,2026). It reflects not only the adoption of digital tools but also the degree to which these technologies are integrated into business processes to improve agility, responsiveness, and competitiveness (Bharadwaj et al., 2013; Sebastian et al., 2020). Prior research emphasizes that DTP is multidimensional, encompassing improvements in productivity, customer experience, innovation output, and decision-making quality (Verhoef et al., 2021; Zhang and Wang, 2024). Scholars further argue that achieving strong DTP requires alignment between technological capabilities and organizational resources, as well as the ability to continuously adapt to evolving digital ecosystems (Heubeck, 2023; Warner and Wäger, 2019). In this sense, DTP is increasingly viewed as an outcome of dynamic capability development, where firms must reconfigure their digital assets and processes in response to environmental changes (Jin et al., 2023; Teece, 2007).

2.1 Digital Platform Capabilities and Digital Resilience

Digital resilience is cultivated through the DCV resource sensing, seizing, and reconfiguring mechanisms enabled by DPC (Browder et al., 2024; Liu et al., 2023). These higher-order organizational routines, through architectural flexibility, ecosystem orchestration, and adaptive learning pathways, allow firms to anticipate, respond to, and recover from the disruption (Aghazadeh et al., 2024; Ahmed et al., 2022). Specifically, architectural flexibility enables companies to reallocate technological and organizational resources in dynamic settings quickly (Browder et al., 2024; Mehedintu and Soava, 2022). Ecosystem orchestration enables inter-firm collaboration and cooperative innovation, thereby increasing collective resilience (Dubey et al., 2023; Furstenau et al., 2022). Furthermore, adaptive learning enables a heightened sense of and acquisition of knowledge, which is effective for strategic response in a crisis (Browder et al., 2024; Liu et al., 2023). Empirical studies in various industries support these mechanisms. They established positive relationships between DPC and the adaptive and planning capabilities of the firms during the COVID-19 pandemic (Li et al., 2022; Liu et al., 2023) and have been shown to mediate the role between digital resources, growth relationships, DPC, and digital resilience (Aghazadeh et al., 2024). Furthermore, these capabilities contribute to the agility of manufacturing SMEs (Ahmed et al., 2022) and enhance the capacity of firms in technology and specific healthcare systems to absorb, adapt, and recover during disruptions (Dubey et al., 2023; Furstenau et al., 2022). Therefore, firms with high digital platform capabilities are better equipped to develop and maintain digital resilience against technological disruption. Based on the above arguments, we propose that:

H1: Digital platform capabilities have a positive effect on digital resilience.

2.2 Big Data Analytics Capabilities and Digital Resilience

BDACs are dynamic capabilities that integrate and reorganize internal and external resources to respond to the digitally changing environments and augment sensing, seizing, and reconfiguring capabilities in response to digital disruptions (Mikalef et al., 2019). BDACs play an important role in digital resilience within modern organizations.

Grounded in the DCV context, BDACs are more advanced routines that organizations enable firms to detect environmental changes, process complex data patterns, and re-architect resources in response to disruptions (Bronzo et al., 2024). Such capabilities include infrastructure, human resources, and managerial skills, which together facilitate organizational adjustment and strength. BDACs can be utilized to enhance digital resilience in three distinct ways. Among these, firstly, it reduces latency. BDACs minimize time delays, process data, and finalize decisions, enabling faster responses to disruptions (Bronzo et al., 2024). Secondly, it offers predictive analytics, which provides better environmental scanning and early warning systems, enabling measures to be taken in advance (Akter et al., 2016). Lastly, it offers real-time resource optimization, which adjusts live data resources in response to volatile conditions. Empirical studies from diverse contexts, including automotive supply chains (Bronzo et al., 2024), small and medium enterprises (Ciasullo et al., 2022) and humanitarian operations (Dubey et al., 2021) suggested that BDACs enhance resilience at readiness, response, recovery, and adaptability stages (Zamani et al., 2023). It is essential to recognize that contextual factors, such as digital maturity and strategic positioning, can impact the relationship between BDAC and resilience. It also affects organizations that have developed digital capabilities, enabling them to gain greater advantages through BDAC investments (Bahrami and Shokouhyar, 2022). While the theoretical and empirical support is substantial, the literature remains disjointed, and it is essential to have integrated frameworks that comprehensively explain the causal processes (Huynh et al., 2023). In conclusion, BDACs serve as a central dynamic capability that significantly enhances digital resilience, providing a critical strategic advantage in unpredictable digital environments. Based on these arguments, we propose that:

H2: Big data analytics capabilities have a positive effect on digital resilience.

2.3 Digital Resilience and Digital Transformation Performance

A substantial body of literature indicates that digital transformation is beneficial to organizational resilience (Xu et al., 2024b; Zhang et al., 2025). The reverse relationship remains unexplored. Digital resilience is an organization's capability to anticipate, resist, recover from, and adapt to digital disruptions. It is a higher-order dynamic capability that should enhance transformation outcomes. This perspective is grounded in the DCV, which states that in a dynamic environment, a firm's ability is to sense, predict, and reconfigure its resources compared to its competitors (Zhang et al., 2021). Consequently, organizations with strong digital resilience are better equipped to identify challenges in digital transformation implementation (He et al., 2022). This heightened capability increases the likelihood of turning digital investments into performance improvements. Emerging empirical evidence is still limited; for instance, studies suggest that an organizational ability is to handle disruptions, plan and execute, and carry out plans in a complex and dynamic environment (Codara and Sgobbi, 2023). This implies that for successful digital transformation, technological efforts must be aligned with existing resilience practices. Furthermore, studies on SMEs have reported that organizational learning is crucial and impacts the success and performance of digital transformation (Al Omoush et al., 2025). Despite these significant insights, a notable research gap remains in the existing literature. However, most studies have focused on how transformation builds resilience; a critical investigation of how resilience itself drives successful transformation is lacking. To bridge this gap, we propose that:

H3: Digital resilience positively influences the performance of digital transformation.

2.4 Mediating Role of Digital Resilience between DPC and DTP

The DPC provides the technological basis for change, but it has no direct impact on DTP. This study posits that the key enabler of converting technological potential into actual performance improvements is digital resilience. This perspective is based on the reasoning of the Dynamic Capabilities argument, which holds that capabilities should be directed toward adaptive capabilities to attain a competitive advantage (Rizana et al., 2024). This sequential process is supported by empirical evidence. For example, in service companies, DPCs have been found to positively contribute to adaptive and planning capacities, which are fundamental elements of resilience (Liu et al., 2023). This suggests that DPCs are significant factors of organizational resiliency. To reinforce this further, SMEs' research findings on this matter confirm that the relationship between digital resources and growth is fully mediated by digital platform qualities and sustainability (Aghazadeh et al., 2024). Similar findings have been reported by other researchers, who concluded that digital transformation itself is a mediator of capabilities and performance (Prakasa and Jumani, 2024) and that the use of digital platforms enhances relational capital, which frames the resilience of digital entrepreneurship (Mignenan, 2022). These studies converge on a common principle: that digital capabilities influence the result through mediating adaptive processes. digital resilience lean, responsive ability that is developed as a result of transformation endeavors (Rizana et al., 2024). Therefore, this study argues that the utility of DPCs is realized to the fullest when they are used to build a more resilient organization. This resilience must anticipate, resist, and evolve toward a successful transformation. Therefore, we propose that:

H4a: Digital resilience positively mediates the relationship between digital platform capabilities and digital transformation performance.

2.5 Mediating Role of Digital Resilience between BDACs and DTP

According to the DCV, static resources only improve performance when applied to reconfiguration. According to this school of thought, to achieve performance results with static resources, the resources must be reconfigured and deployed using higher-order, dynamic capabilities (Su et al., 2022). Within this paradigm, BDACs are a powerful asset but require activation. Digital resilience is the key intermediary dynamic capability: the capacity of an organization to predict, absorb, recover, and adapt to both digital disruptions and maintain operational and strategic continuity (Park and Choi, 2026). The extreme case is that BDAC facilitates the necessary sense-making processes of environmental scanning and analytical understanding, but it is the meta-capability of digital resilience that coordinates the organizational reaction to digital issues (Khan and Tao, 2022). There is empirical support for the pathway from BDAC to performance outcomes via resilience. It is essential to note that a study (Lin et al., 2025) found a direct relationship between BDA capabilities and firm performance, mediated by organizational resilience. However, a direct relationship was not established, indicating complete mediation. This observation is supported by the unique environment of digital transformation, where a study (Aghazadeh et al., 2024) found that digital resilience fully moderates the relationship between digital capabilities and transformation success in SMEs. Building upon this, BDAC has been found to increase organizational resilience and strategic flexibility considerably (Wided, 2023). The mediating mechanism operates in two steps: BDAC promotes proactive resilience by facilitating anticipatory adaptation via predictive analytics. In parallel, it builds reactive resilience through facilitating quick recovery and organizational learning following a disruption. Collectively, these aspects significantly enhance organizational adaptability, an essential source of high DTP in dynamic environments (Dubey et al., 2021). This intermediate role is further supported by analogous evidence for other dynamic capabilities, such as strategic agility and ambidexterity, which play a similar mediating role between performance outcomes and analytics resources (Ferraris et al., 2019). Therefore, based on the above arguments, we propose that:

H4b: Digital resilience positively mediates the relationship between big data analytics capabilities and digital transformation performance.

2.6 Moderating Role of Technological Disruption between Digital Resilience and DTP

Technological disruption and digital resilience effectiveness have conflicting theoretical viewpoints, as both enhancement and inhibitory effects on DTP have been revealed in the literature (Wirtz et al., 2022). These boundary conditions play a critical role for an organization operating in more volatile technological conditions. Several studies indicate that technological disruption can enhance the effectiveness of digital resilience by activating adaptive mechanisms within organizations and accelerating organizational learning (Awad and Martín-Rojas, 2024). For instance, adverse events have been shown to strengthen the relationship between digital transformation and operational resilience, suggesting that disruptive conditions may enhance transformation capacities (He et al., 2023). Supporting this perspective, companies that introduced digital transformation were more resilient than those without similar capacity, suggesting that disruption could amplify the benefits of digital resilience investments (Xu et al., 2024b). Moreover, organizational resilience is positively influenced by digital transformation, both through exploitative and exploratory innovation pathways (Zhang et al., 2021). Furthermore, the service required creative businesses to be flexible and resilient in responding to uncertain times, thereby enhancing their resilience (He et al., 2022). Conversely, recent research suggests that technological disruption may negatively impact digital resilience by causing resource fragmentation and capacity overload (Boh et al., 2023). Data from 223 Chinese companies indicate an association between higher market turbulence and poorer environmental performance when digital transformation levels are higher, suggesting that disruptive contexts could diminish the positive effect of digital capabilities (Li, 2022). Other studies note that organizations may experience growing pains in the initial stages of disruption and that major port firms tend to obtain fewer marginal benefits during such periods. This may indicate systematic capacity constraints during extreme technological change (He et al., 2023). These challenges may be heightened when organizations face competing demands between resilience requirements and the need to adapt to rapidly changing technology (Guo et al., 2023). Based on this argument, we propose that:

H5: Technological disruption negatively moderates the relationship between digital resilience and digital transformation performance.

Figure 1 illustrates the theoretical framework of the study

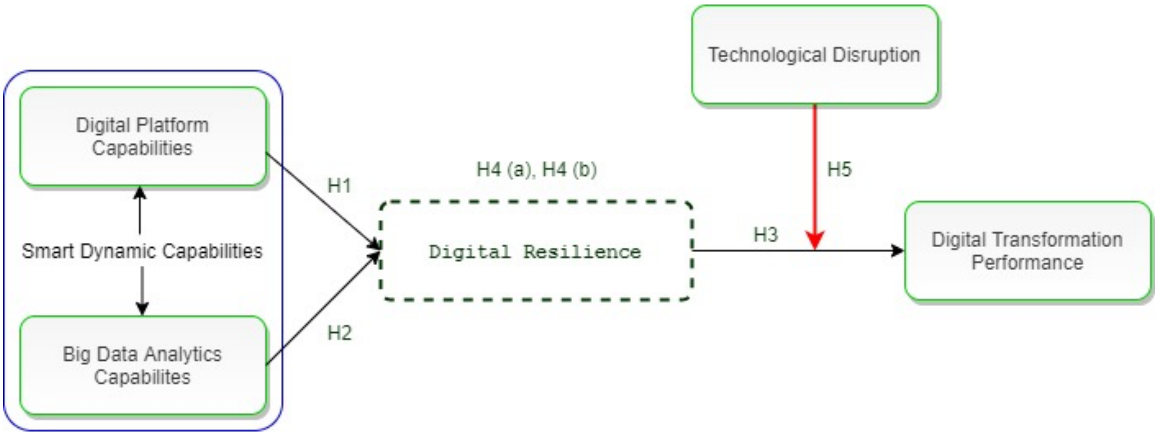

Figure 1. Framework of the study

Source(s): Authors' Own Work.

3 RESEARCH METHODOLOGY

3.1 Data Collection

This research used a two-stage simple random sampling design. First, pharmaceutical manufacturing firms were identified from the official registry of the Drug Regulatory Authority of Pakistan (DRAP), established by the Drug Regulatory Authority of Pakistan Act, 2012. This registry is the most comprehensive database of licensed pharmaceutical manufacturers in the country. Primary data was collected using a structured, self-administered questionnaire designed by the research team. The questionnaires were distributed through on-site visits, email, and professional social media platforms to ensure broad participation across the target population. 400 English-language questionnaires were distributed to employees of the pharmaceutical industry at various organizational levels, including line managers, middle managers, executives, area managers, and entry-level staff. Participation in this study was entirely voluntary, and all respondents were informed of the research's purpose prior to data collection. 328 responses were received, after rigorous screening, 301 responses were retained as valid for analysis. Twenty-seven responses (8.2%) were excluded due to incomplete information or inconsistent patterns, resulting in a 91.8% response validity rate. The final sample size of 301 exceeds the minimum threshold of 200 recommended for structural equation modelling (SEM) and ensures adequate statistical power for reliable analysis (Hair et al., 2019). Although respondents included employees from entry-level staff to senior executives, all focal constructs in this study (i.e., digital platform capabilities, big data analytics capabilities, digital resilience, and digital transformation performance) represent organization-level phenomena. Following past research (Klein and Kozlowski, 2000), this study adopts a key informant approach, where individuals at different hierarchical levels provide perceptual assessments of firm-level constructs based on their knowledge and involvement in digital transformation activities. This approach is widely used in organizational and IS research when firm-level aggregation is not explicitly modeled, as employees across levels are exposed to and engaged with digital systems and transformation processes within their organizations. Detailed demographic characteristics and respondent profiles are presented in Table 1.

3.2 Measurement Items

The study employed a five-point Likert scale that ranged from "strongly disagree" to "strongly agree." All of the constructs were taken from the literature. DPC was adopted from the past research (Cenamor et al., 2019; Khan and Tao, 2022). Sample items included "We have developed digital platforms for consumers to share prior experiences, knowledge, and expertise." BDAC was also adopted from a past study (Hao et al., 2019). Sample items included "We have advanced tools (analytics and algorithms) to extract value from big data." Digital resilience was adopted from a recent study (Aghazadeh et al., 2024). Sample items included "People are encouraged to recognize risk." Technological disruption was adopted from a study (Özkanlısoy and Bulutlar, 2022). Sample items included "The company has used artificial intelligence in its operations actively." DTP was adopted from (Yasmine et al., 2024). Sample items included "Digital transformation leads to increased revenue, increased productivity, and improved customer experience."

Table 1. Demographics

Attribute	Distribution	N	Percentage
Age			
	Below 25	45	14.95%
	25–34	131	43.52%
	35–44	85	28.24%
	45–54	38	12.62%
	55 and above	2	0.66%
Gender			
	Male	244	81.33%
	Female	57	18.67%
Education			
	Bachelor's Degree	108	35.88%
	Master's Degree	160	53.16%
	Doctorate (PhD)	33	10.96%
Job Title			
	Supervisor	67	22.26%
	Line Manager	48	15.95%
	Mid-Level Manager	53	17.61%
	Executive (CEO, Director, etc.)	41	13.62%
	Entry Level Staff	48	15.95%
	Area Manager	44	14.62%
Experience			
	Less Than 1 year	46	15.28%
	1–2 years	51	16.94%
	2–5 years	118	39.20%
	5–10 years	69	22.92%
	More than 10 years	17	5.65%

Source(s): *Authors` own creation*

4 DATA ANALYSIS AND RESULTS

4.1 Measurement Model

The psychometric properties of the measurement model were assessed following established guidelines for PLS-SEM in recent research (Becker et al., 2023). Internal consistency reliability was confirmed, with all composite reliability (CR) values and factor loadings above 0.70, as shown in Table 2. Convergent validity was supported by Average Variance Extracted (AVE) values above 0.50, indicating constructs explained more variance than measurement error (Purwanto and Sudargini, 2021). To evaluate common method bias (CMB), two procedures were applied. First, following Bagozzi's method, no inter-construct correlations exceeded 0.90, as shown in Table 2. Second, the full collinearity test confirmed that all variance inflation factor (VIF) values were below the stringent threshold of 5, indicating no multicollinearity (Kock, 2015; Ullah et al., 2025). These results collectively suggest that in the data, the common bias test is not persuasive, suggesting no significant collinearity or CBM.

4.2 Heterotrait-Monotrait Ratio

The Heterotrait-Monotrait ratio (HTMT), a correlation-based measure, was employed to assess discriminant validity. This method is recognized as more sensitive than traditional techniques, such as the Fornell-Larcker criterion (Rönkkö and Cho, 2022). The HTMT method addresses key limitations of classical tests. These tests may fail to detect inter-construct redundancy, especially when factor loadings are high (Roemer et al., 2021). As presented in Table 3, all HTMT values are below the conservative threshold of 0.90. This confirms the discriminant validity of all construct pairs. Although some dyads approach this threshold, the highest is between DTP and digital resilience, with a value of 0.894. However, they remain within the acceptable level (Purwanto and Sudargini, 2021). This proximity implies that the constructs are theoretically aligned while remaining empirically distinct. These results confirm that the model constructs are empirically different, even in the closely related domain of digital transformation. The HTMT analysis, therefore, supports the robustness of the measurement model for subsequent structural analysis.

Table 2. Convergent Validity

Item Code	Factor Loadings	Cronbach's alpha	Composite Reliability	AVE	VIF
Big Data Analytic Capabilities					
BDAC1	0.753				1.859
BDAC2	0.827				2.466
BDAC3	0.845	0.891	0.917	0.647	2.556
BDAC4	0.806				2.344
BDAC5	0.803				2.337
BDAC6	0.790				1.999
Digital Platform Capabilities					
DPC1	0.747				1.902
DPC2	0.815				2.364
DPC3	0.824	0.886	0.913	0.637	2.262
DPC4	0.793				2.023
DPC5	0.810				2.180
DPC6	0.796				1.984
Digital Resilience					
DR1	0.705				1.611
DR2	0.773				1.961
DR3	0.838				2.645
DR4	0.796	0.894	0.917	0.611	2.142
DR5	0.785				1.982
DR6	0.785				2.140
DR7	0.785				2.170
Digital Transformation Performance					
DTP1	0.722				2.248
DTP2	0.773				2.952
DTP3	0.805				2.918
DTP4	0.782				2.470
DTP5	0.752				2.444
DTP6	0.815	0.944	0.952	0.621	2.996
DTP7	0.835				3.331
DTP8	0.785				2.586
DTP9	0.761				2.317
DTP10	0.844				3.357
DTP11	0.812				2.998
DTP12	0.764				2.283
Technological Disruption					
TD1	0.722				1.918
TD2	0.811				2.435
TD3	0.634				1.675
TD4	0.772	0.890	0.913	0.568	2.492
TD5	0.793				2.310
TD6	0.766				2.028
TD7	0.798				2.436
TD8	0.716				1.919

***Note(s):** AVE: Average Variance Extracted, VIF: Variance Inflation Factor.* ***Source(s):** Authors` own creation*

Table 3. Heterotrait-Monotrait Ratio

Constructs	(1)	(2)	(3)	(4)	(5)
(1) Big Data Analytic Capabilities					
(2) Digital Platform Capabilities	0.864				
(3) Digital Resilience	0.872	0.870			
(4) Digital Transformation Performance	0.869	0.850	0.894		
(5) Technological Disruption	0.800	0.769	0.824	0.874	

***Source(s):** Authors` own creation*

4.3 Structural Model Assessment

The structural model's explanatory power was assessed through R^2 values, which quantify the proportion of endogenous construct variance explained by structural predictors (Pumjaroen, 2025). Digital resilience achieved an R^2 of 0.682, as shown in Table 4, indicating that DPCs and BDACs explain 68.2% of its variance, which supports their mediating role. DTP demonstrated substantial explanatory power, with an R^2 of 0.774, as shown in Table 4, indicating that digital resilience and technological disruption account for 77.4% of the variance in performance. The minimal differences between R^2 and adjusted R^2 values confirm model parsimony and stability (Becker et al., 2023).

Table 4. Coefficient of Determination

Constructs	R^2	R^2 adjusted
Digital Resilience	0.682	0.680
Digital Transformation Performance	0.774	0.771

Source(s): *Authors` own creation*

In order to increase the sample size, bootstrapping employs a replacement technique in which each observation is chosen from the population and substituted with other elements, guaranteeing that each element has an equal selection probability (Becker et al., 2023). An observation may be selected multiple times or excluded entirely from the sample. Modern methodological guidelines suggest 5000 subsamples to improve accuracy, even if the minimal bootstrapping sample size should match the actual sample size (Hair Jr et al., 2020). This study employed bootstrapping using 5000 subsamples in accordance with these known guidelines to provide more accurate estimations, addressing what (Becker et al., 2023) identified as one of the most critical areas where researchers require guidance: "bootstrapping and significance testing." The bootstrapping procedure returns all specified model relationships, showing their significance and strength. Table 5 displays the path coefficients for direct, indirect, and moderating effects in the conceptual model. These results confirm the significance of all proposed direct relationships and align with the reporting standards highlighted by (Guenther et al., 2023) for comprehensive structural model assessment.

A positive, statistically significant effect was observed between DPCs and digital resilience, with a path coefficient of $\beta = 0.434$, a T-value of 5.949, and $p < 0.001$, as shown in Table 5. This indicates that organizations with stronger digital platforms are more likely to develop digital resilience. Similarly, BDAC exhibited a significant positive effect on digital resilience ($\beta = 0.444$, T-value = 6.764, $p < 0.001$). Data-driven decision-making capabilities play a crucial role in enhancing resilience. The findings confirm that digital resilience significantly influences DTP (b = 0.479, T-value = 8.644, $p < 0.001$). This strong statistical evidence supports the idea that resilient organizations are more likely to achieve digital transformation goals.

Table 5. Hypothesis Testing

Hypothesized Relationships		B	SD	T-stat	P	Decision
H_1	DPC → Digital Resilience	0.434	0.073	5.949	0.000	Supported
H_2	BDACs → Digital Resilience	0.444	0.066	6.764	0.000	Supported
H_3	Digital Resilience → DTP	0.479	0.055	8.644	0.000	Supported
H_4a	DPC → Digital Resilience → DTP	0.208	0.045	4.644	0.000	Supported
H_4b	BDACs → Digital Resilience → DTP	0.213	0.039	5.481	0.000	Supported
H_5	Technological Disruption x Digital Resilience → DTP	-0.059	0.018	3.285	0.001	Supported

Source(s): *Authors` own creation*

Beyond direct effects, the study examined the mediating impact of digital resilience using established PLS-SEM procedures of mediation analysis (Sarstedt et al., 2020). The indirect effect of Digital Platform Capabilities (DPC) on Digital Transformation Potential (DTP) via digital resilience (b = 0.208, T-value = 4.644, $p < 0.001$), as shown in Table 5, was statistically significant. Likewise, a significant direct effect was found between BDAC and DTP through digital resilience (b = 0.213, T-value = 5.481, $p < 0.001$). These results collectively demonstrate that digital resilience serves as a key driver of translating core digital capabilities into enhanced transformation performance. The study further investigated the moderating effect of technological disruption on the relationship between digital resilience and DTP. The analysis produced a statistically significant interaction term (b = -0.059, T-value = 3.285, $p = 0.001$), as shown in Table 5, following rigorous methodological guidance on the analysis of interaction effects in PLS-SEM (Becker et al., 2018). The positive influence of digital resilience on transformation performance is attenuated when technological disruption is high. This significant discovery underscores the necessity for organizations not only to create digital resilience but also to develop strategies that actively mitigate the overwhelming effects of intense technological change. Figure 2 presents the structural model estimation of the study.

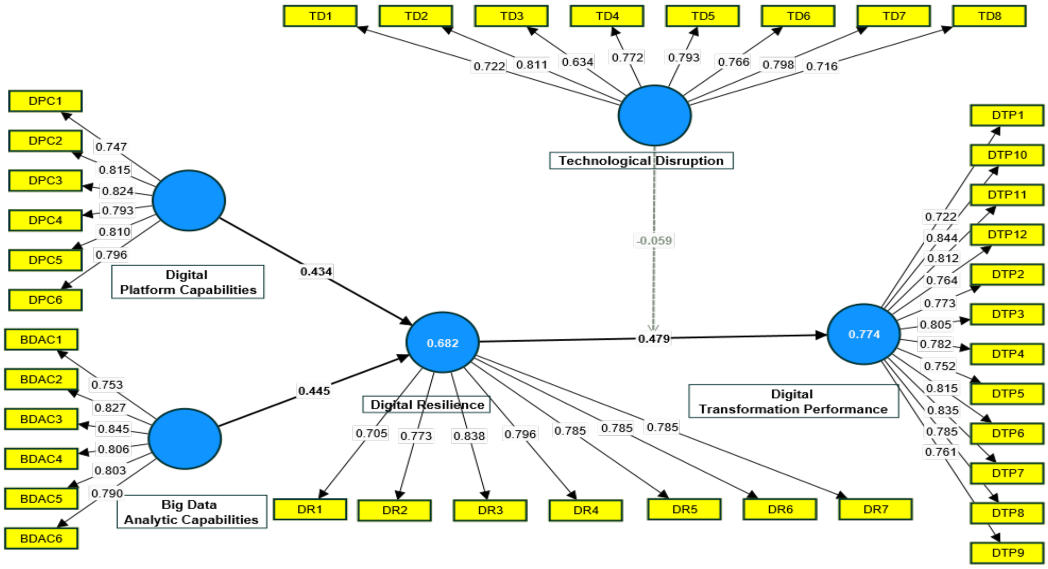

Figure 2. Structural Model Estimation

Source(s): Authors' Own Work.

5 DISCUSSION AND CONCLUSIONS

The empirical results support all hypothesized relationships and highlight the importance of smart dynamic capabilities in enhancing DTP. The findings demonstrate that DPCs and BDACs contribute to the development of digital resilience, thereby improving DTP. These results provide a deeper understanding of how organizations can navigate digital transformation challenges in dynamic technological environments. The positive relationships among DPCs, BDACs, and DR are consistent with prior studies and further extend the DCV. For example, prior research (Bhatti et al., 2025) showed that big data analytics, digital platforms, and networks improve organizational performance through innovation, while another study (Bronzo et al., 2024) found that BDACs strengthen supply chain resilience. Extending these findings, the present study demonstrates that these capabilities enhance digital resilience, a critical mechanism for improving digital transformation outcomes. While previous studies have primarily focused on the direct effects of digital capabilities on organizational performance, this study identifies digital resilience as an important intervening mechanism that enables organizations to convert digital capabilities into transformational success (Aghazadeh et al., 2024). Furthermore, the findings reveal that technological disruption intensity weakens the positive relationship between digital resilience and DTP. This result suggests that the effectiveness of resilience strategies depends on the surrounding technological environment. Consistent with a study (Browder et al., 2024), digital transformation initiatives do not automatically generate resilience benefits under conditions of extreme technological turbulence. In conclusion, this study contributes to the digital transformation literature by demonstrating that smart dynamic capabilities, represented by DPCs and BDACs, enhance digital transformation performance through digital resilience. Empirically, the study provides evidence for the mediating role of digital resilience and the moderating effect of TD intensity. Theoretically, it advances the DCV by integrating digital resilience as a key mechanism linking smart dynamic capabilities to transformation outcomes. Practically, the findings suggest that managers in pharmaceutical firms could invest in DPCs and BDACs while continuously adapting their strategies to cope with technological disruptions. By integrating smart dynamic capabilities, digital resilience, and technological disruption intensity within a unified framework, this study contributes to a more comprehensive understanding of digital transformation processes in dynamic technological environments.

5.1 Theoretical Contribution

This study theoretically contributes in the following ways: First, by combining DPCs and BDACs into a single framework and emphasizing their synergistic significance, this study expands the application of DCV. Second, this study adds to the body of knowledge on dynamic capabilities and digital transformation by highlighting Smart Dynamic Capabilities as a facilitator of DTP and digital resilience. Prior research has mostly examined DPCs and BDACs as distinct dynamic capabilities rather than a single capability set that provides businesses with all-encompassing digital resilience (Bahrami and Shokouhyar, 2022; Guo et al., 2025; Liu et al., 2022). Third, by merging these capabilities into a single Smart Dynamic Capability that improves pharmaceutical companies' DTP, our work adds to the body of knowledge on BDAC and DPC. Fourth, this study's findings clarify the varied functions of digital resilience as a mediator of the relationship between a firm's DTP and Smart Dynamic Capabilities. Fifth, this study explores the function of DTP as a result of digital resilience, reveals the varied nature of digital resilience, and clarifies that digital resilience cannot always be viewed as a firm's dynamic capability. This is one of its most important contributions to the literature. The success of digital resilience may frequently result from environmental factors, especially the degree of technological disruption, according to another important finding of this research.

5.2 Managerial Implications

Organizations in the pharmaceutical sector could strategically invest in smart dynamic capabilities, particularly digital platforms and big data analytics, to strengthen digital resilience and improve transformation outcomes. In this context, digital platforms can enhance end-to-end supply chain visibility and traceability, enabling firms to monitor product movement, reduce counterfeiting risks, and ensure regulatory compliance. Big data analytics capabilities can further support data-driven quality control systems, allowing firms to detect anomalies in production processes, improve pharmacovigilance, and enhance decision-making accuracy in real time. Together, these capabilities enable firms to respond more effectively to regulatory audits and quality assurance demands. Managers could also prioritize regulatory compliance management systems supported by integrated digital infrastructures, ensuring alignment with evolving pharmaceutical regulations and standards. Strengthening interdepartmental coordination through shared digital platforms can further enhance operational transparency and responsiveness across the supply chain. Additionally, fostering a culture of continuous learning and digital readiness is essential to maintaining resilience in highly regulated, technologically dynamic environments. Regular investment in employee training and predictive analytics tools can help firms anticipate disruptions and maintain consistent product quality.

5.3 Policy Implications

This study has the following policy implications: First, policymakers may require organizations to build Smart Dynamic Capabilities, especially in the pharmaceutical industry. Grants, tax incentives, or funding for workforce training and technology can reinforce digital resilience. These measures help companies transform and respond quickly to technological change. Second, governments and regulators may encourage the issuance of clear guidelines for addressing technological disruption. Policymakers can support structured digital transformation by offering precise frameworks. These guidelines help prioritize dynamic capabilities and maintain direction amid technological changes. Third, foster industry-academia collaboration to drive digital resilience. Policymakers may enable partnerships that apply academic insights, such as those from this study, to advance industry outcomes. This ensures organizations remain current with emerging technologies and are adaptable to change.

5.4 Practical Implications

This study has the following Practical implications: First, organizations may establish continuous training programs to build Smart Dynamic Capabilities among employees. By equipping staff with skills in BDACs and DPCs, companies enhance digital resilience and innovation. Regular workshops and hands-on training help ensure teams are prepared to use new technologies effectively. Second, firms could adopt agile management practices to enhance flexibility and rapid adaptation. Creating cross-functional teams and fostering collaboration help organizations respond to technological change. Agile practices enable quicker decisions and iterative improvements, strengthening digital transformation initiatives. Third, organizations may create a structured feedback loop to capture lessons from digital transformation. Analyzing successes and setbacks reveals strategies and areas for improvement. These drives learning and help refine resilience and adaptation approaches for ongoing technological changes.

5.5 Limitations and Future Recommendations

The findings of this study are subject to certain limitations. First, the study is based in a single country (Pakistan) and focuses on the pharmaceutical industry. While this setting provides a controlled environment to examine the proposed relationships, it also limits the generalizability of the findings to other industries and geographical contexts due to differences in regulatory environments and market dynamics. Second, the study relies on survey data collected from 301 pharmaceutical employees, which may constrain the broader applicability of the results. Future research should extend this work by incorporating more diverse samples across industries such as manufacturing, finance, and retail to enhance external validity. Third, the cross-sectional research design provides a snapshot of relationships at a single point in time. As a result, the findings should be interpreted as associations rather than causal relationships, and any causal inferences should be made with appropriate caution. Future studies should adopt longitudinal designs to better capture how digital capabilities and resilience evolve over time and to more robustly examine causal dynamics under technological disruption. Fourth, reliance on self-reported data may introduce common method bias, as respondents may overestimate organizational capabilities and performance. Additionally, constructs such as digital resilience and smart dynamic capabilities may vary across contexts, potentially affecting measurement validity. Future research should therefore consider mixed-method approaches, including qualitative interviews, to refine construct definitions and strengthen measurement robustness.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES

As non-native English speakers, the authors relied on linguistic enhancement tools, including Grammarly, Quill Bot, and ChatGPT, to rectify grammatical deficiencies, improve fluency, and refine readability during manuscript preparation. However, rather than blindly depending on these automated systems, the authors rigorously scrutinized, revised, and restructured the content to ensure academic precision and intellectual rigor. They take full and unequivocal responsibility for the accuracy, authenticity, and scholarly integrity of this publication.

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APPENDIXES

Questionnaire statements

1. Digital Platform Capability

1. We have built databases that contain information about consumers and their behaviors that businesses can use to reach a target group.
2. We have developed digital platforms to launch direct digital marketing programs for businesses
3. We have developed digital platforms that make it easier or more affordable for businesses to reach their prospects.
4. We have built databases that contain extensive local information that consumers need for everyday life decision
5. We have developed digital platforms for consumers to share prior experiences, knowledge, and expertise.
6. We have developed digital platforms for consumers to share news and information and engage in community dialogue and conversation

2. Big Data Analytics Capabilities (BDAC)

1. We have advanced tools (analytics and algorithms) to extract values from the big data.
2. Our capability to discover relationships and dependencies from the big data is
3. Our capability to perform predictions of outcomes and behaviors from the big data is
4. Our capability to discover new correlations from the big data to spot market demand trends and predict user behavior is
5. Our capability to discover new correlations from the big data to spot market demand trends and predict user behavior is
6. Our big data analytics staff has the right skills to accomplish their jobs successfully

3. Digital Resilience

1. People are given appropriate access to online services.
2. People are encouraged to recognize risk.
3. People are encouraged to differentiate between varying types of risk.
4. People are encouraged to use varying reporting mechanisms.
5. People are encouraged and supported to adopt behaviors where possible to reduce future harm.
6. People are encouraged to seek recovery services should severe harm be suffered.
7. People are provided opportunities and encouraged to inform/review/co-create the system to reduce risk or improve opportunities for others.

4. Technological Disruptions

1. The company has used cyber-physical systems (CPS) in its operations actively.
2. The company has used internet of things (IoT) in its operations actively.
3. The company has used artificial intelligence in its operations actively
4. The company has used autonomous robots in its operations actively
5. The company actively has used big data analytics in its operations.
6. The company has used blockchain technology in its operations actively.
7. The company has used simulation technology in its operations actively.
8. The company has used 5G technology in its operations actively.

5. Digital Transformation Performance (DTP)

1. Digital transformation is a natural part of our business.
2. Customer experience, Business process maturity, and People are critical prerequisites for achieving digital business success.
3. Digital transformation leads to increased revenue, increased productivity, and improved customer experience.
4. The DT was driven by Customer Experience, Cost reduction, Competitive advantage, and Innovation opportunity.
5. Digital transformation has become an important part of our business operations.
6. The management supports the utilization of DT.
7. The company is familiar with DT tools.
8. Digital transformation enhances our business.

9. The management has a clear vision for utilizing DT in the future.
10. The company routinely seeks cost reductions through digitalization.
11. The company is digitally mature.
12. There is a strategy to build a digital culture