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Quantitative Analysis of the Impact of Digital-Based Business Capability Mechanisms on the Resilience of Online Businesses Based on Structural Equation Modeling

Asiyeh. Lotfi[1], Ahmad Reza. Kasraee[2*], Mohammadali. Keramati[2]

[1] Department of Information Technology Management, CT.C., Islamic Azad University, Tehran, Iran
[2] Department of Industrial Management, CT.C., Islamic Azad University, Tehran, Iran

*** Corresponding author email address**: ah.kasraee1349@iau.ac.ir

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A B S T R A C T

The present study aimed to quantitatively analyze the impact of digital-based business capability mechanisms on the resilience of online businesses using Structural Equation Modeling (SEM) and the Partial Least Squares (PLS) approach. To this end, the collected data were analyzed using SmartPLS software, and the relationships between digital variables and the business resilience construct were evaluated. Prior to testing the structural model, the quality of the measurement model was assessed through the examination of reliability, validity, and multicollinearity. The results indicated that all Variance Inflation Factor (VIF) values were below 5, demonstrating that the model was free from multicollinearity issues. Reliability analysis showed that Cronbach's alpha coefficients and Composite Reliability (CR) values for all constructs exceeded 0.70, indicating satisfactory internal consistency of the measurement instrument. Furthermore, the Average Variance Extracted (AVE) values were greater than 0.50, confirming the convergent validity of the constructs. In the structural section, all paths were significant at the 95% confidence level, and the t-statistic values were outside the ±1.96 range. The coefficient of determination (R^2 = 0.393) for the endogenous constructs, according to the criteria proposed by Chin and Hair, indicated a moderate and acceptable model fit in explaining the resilience of online businesses, such that 39% of the variance in the dependent variables was explained by digital-based business capability mechanisms. The findings further demonstrated that components such as information and communication technology infrastructure, data management and predictive analytics, cybersecurity, scalability capability, digital collaboration, and business model innovation play a significant role in strengthening the flexibility and resilience of online businesses. Overall, the research model demonstrated adequate validity and reliability, and the findings can provide effective guidance for managers seeking to enhance digital competitive advantage.

Keywords: *Digital, Business Capability, Online Business Resilience, Structural Equation Modeling (SEM)*

1. Introduction

The rapid expansion of digital technologies has fundamentally transformed the operational structure, competitive dynamics, and strategic orientation of modern businesses. In recent years, online businesses have emerged as one of the most influential sectors within the global economy, reshaping traditional patterns of production, marketing, customer interaction, and supply chain management. The increasing integration of digital infrastructures into organizational processes has created new opportunities for innovation, agility, and market expansion, while simultaneously exposing firms to unprecedented levels of uncertainty, disruption, and technological complexity. In such an environment, organizational resilience has become a strategic necessity rather than a purely defensive capability. Business resilience refers to the ability of organizations to anticipate, absorb, adapt to, and recover from environmental shocks while maintaining operational continuity and long-term competitiveness. The COVID-19 pandemic accelerated this transformation by forcing organizations to rapidly digitalize their operations and adopt technology-driven business models to survive in turbulent market conditions (Khlystova et al., 2022; Petropoulou et al., 2024; Santos et al., 2023). Digital transformation has therefore become closely associated with organizational resilience, especially among online businesses and small and medium-sized enterprises (SMEs), where flexibility and adaptability determine survival and growth. Studies have demonstrated that digital technologies significantly enhance operational continuity, strategic responsiveness, and market resilience in dynamic business environments (Datti & Kuppusamy, 2023; Hokmabadi et al., 2024; Li et al., 2023). The transition toward digitally enabled business ecosystems has also intensified the importance of organizational capabilities such as data analytics, cybersecurity, digital marketing, and technological innovation, all of which contribute to strengthening business resilience under uncertain conditions (Patinah, 2024; Yao, 2023).

The emergence of e-commerce and digital business platforms has redefined the relationship between organizations, consumers, and supply networks. Businesses increasingly rely on digital infrastructures to manage customer relationships, facilitate online transactions, optimize logistics, and coordinate supply chain activities across geographical boundaries. The adoption of online business platforms has been identified as a major driver of competitiveness and market sustainability in both developed and emerging economies (Bernal & Matriano, 2025; Leogrande, 2024). Furthermore, technological advancements in e-commerce systems have significantly improved supply chain visibility, communication efficiency, and operational integration, thereby enhancing organizational responsiveness during crises and disruptions (Brown et al., 2024; Zhang, 2023). The resilience of online businesses is therefore strongly connected to the effectiveness of their digital business capability mechanisms, including technological infrastructure, digital collaboration, and agile supply chain systems. In highly volatile environments, digitally capable firms demonstrate superior adaptability and are more capable of sustaining customer engagement, operational continuity, and financial performance (Grant, 2024; Onjewu et al., 2022). Consequently, digitalization is no longer viewed merely as a technological trend but rather as a strategic capability that enables firms to maintain resilience and competitive advantage in uncertain market conditions. Research has shown that enterprises with advanced digital integration are more capable of mitigating disruptions, optimizing decision-making, and achieving sustainable performance outcomes compared to firms with limited digital readiness (Kouam, 2025; Mehedinţu & Șoavă, 2022).

Among the most critical dimensions of digital business capability is the development of digital supply chain management agility. Agile digital supply chains allow organizations to rapidly respond to changing customer demands, supply disruptions, and market uncertainties through the use of interconnected digital technologies and real-time information systems. The integration of e-commerce technologies, cloud-based communication systems, and predictive analytics into supply chain processes has improved operational flexibility and responsiveness across industries (Brown et al., 2024; Zhang, 2023). Digital connectivity and collaboration further strengthen resilience by enabling organizations to coordinate activities with suppliers, customers, and strategic partners more effectively. Such collaborative digital ecosystems improve information sharing, resource optimization, and collective problem-solving during crises (Grant, 2024; Jiaqi, 2023). The growing role of supplier relationship management in ensuring supply chain resilience has also been highlighted in recent literature, particularly within online commerce environments where supply continuity and customer satisfaction are highly interdependent (Grant, 2024). Additionally, digital transformation has significantly

influenced the structure of entrepreneurial ecosystems by enabling businesses to expand into new markets and develop innovative operational models that transcend geographical boundaries (Irfan et al., 2023; Li et al., 2023). Consequently, organizations that effectively integrate digital supply chain capabilities into their strategic frameworks are more likely to achieve resilience and long-term sustainability.

Another essential component of digital business resilience is the role of information and communication technology (ICT) infrastructure. ICT infrastructure forms the technological backbone of digital organizations by supporting communication networks, information processing, cloud computing, and online service delivery. Strong ICT infrastructure enables organizations to manage digital operations efficiently and maintain business continuity during disruptions. Studies have emphasized that firms with advanced ICT capabilities exhibit greater flexibility, innovation capacity, and resilience in uncertain business environments (Arias et al., 2024; Mehedinţu & Șoavă, 2022). The effectiveness of ICT systems also influences the success of digital marketing strategies, customer interaction mechanisms, and online business platforms. Organizations increasingly depend on digital marketing technologies to improve customer engagement, personalize services, and strengthen brand competitiveness in online markets (Johnson et al., 2024; Nichifor et al., 2022). The role of e-marketing in improving SME performance has become particularly significant in post-pandemic economies where online consumer behavior has expanded rapidly (Diandra et al., 2023). Similarly, digital finance and online payment technologies have enhanced the resilience of local and international business ecosystems by improving financial accessibility, transaction efficiency, and economic adaptability (Yao, 2023). Therefore, ICT infrastructure and digital marketing capabilities collectively contribute to improving organizational resilience by facilitating strategic adaptation, customer retention, and operational stability.

Cybersecurity and data management have also become increasingly important determinants of organizational resilience in digital environments. As online businesses become more dependent on digital technologies and interconnected systems, they face growing exposure to cyber threats, privacy breaches, and technological vulnerabilities. Cybersecurity resilience therefore plays a vital role in protecting organizational assets, maintaining customer trust, and ensuring operational continuity. Research indicates that organizations with effective cybersecurity systems and adaptive organizational cultures demonstrate stronger resilience and more sustainable business performance outcomes (Al-Somali et al., 2024; Benjamin et al., 2024). Cybersecurity risks are particularly critical for SMEs undergoing digital transformation, as limited resources and technological expertise may increase vulnerability to cyberattacks and data breaches (Benjamin et al., 2024). In addition, the management of digital data and predictive analytics capabilities has become a strategic necessity for enhancing decision-making accuracy, market forecasting, and organizational adaptability. Predictive analytics enables firms to identify emerging market trends, anticipate disruptions, and optimize resource allocation through data-driven insights. Businesses capable of leveraging data management technologies can improve responsiveness and maintain competitive resilience in rapidly changing digital markets (Li et al., 2023; Patinah, 2024). The increasing dependence on big data analytics, artificial intelligence, and predictive modeling has therefore transformed data management into a core mechanism of business resilience and strategic agility.

Business model innovation and scalability capability represent additional dimensions of digital resilience that have gained significant scholarly attention. Business model innovation refers to the redesign of organizational value creation, delivery, and capture mechanisms in response to environmental changes and technological opportunities. During periods of turbulence and economic disruption, firms often pivot their business models to adapt to changing consumer behavior, technological developments, and market conditions. Digital technologies facilitate such transformations by enabling flexible operational structures, platform-based business models, and scalable online services (Balta et al., 2023; Yustian & Ratnapuri, 2025). The ability of organizations to scale digital operations rapidly has become especially important in e-commerce and online service industries where customer demand fluctuates significantly. Scalability capability enables businesses to expand operations efficiently without substantial increases in operational costs, thereby improving both resilience and competitive sustainability. Research has demonstrated that digital entrepreneurship and innovation contribute significantly to organizational adaptability and economic recovery during periods of crisis (Santos et al., 2023; Yadav et al., 2023). Moreover, digitalization has enabled SMEs and entrepreneurial firms to maintain resilience through the adoption of flexible technologies, innovative marketing strategies, and digitally integrated business ecosystems

(Nichifor et al., 2022; Rochayatun, 2022). Such findings indicate that innovation-oriented digital capabilities are fundamental drivers of organizational resilience in the modern digital economy.

Despite the growing body of literature on digital transformation and organizational resilience, several conceptual and empirical gaps remain regarding the integrated role of digital-based business capability mechanisms in strengthening the resilience of online businesses. Many existing studies have focused on isolated dimensions such as digital marketing, cybersecurity, or e-commerce adoption without providing a comprehensive structural analysis of how these mechanisms collectively influence organizational resilience (Leogrande et al., 2024; Onjewu et al., 2022). Furthermore, although previous studies have emphasized the importance of digital transformation in enhancing SME performance and adaptability, limited research has quantitatively examined the interrelationships among digital capability components using advanced structural modeling approaches (Kouam, 2025; Yawised et al., 2022). The increasing complexity of digital business ecosystems requires multidimensional analytical frameworks capable of capturing the interconnected effects of ICT infrastructure, cybersecurity, supply chain agility, predictive analytics, digital collaboration, and business model innovation on organizational resilience. Additionally, regional and industrial disparities in digital adoption continue to influence the effectiveness of resilience strategies among firms operating in online environments (Bernal & Matriano, 2025; Leogrande et al., 2024). Therefore, a comprehensive examination of digital business capability mechanisms is necessary to better understand how online businesses can achieve sustainable resilience and competitive advantage under conditions of technological disruption and environmental uncertainty.

Accordingly, the present study aims to quantitatively analyze the impact of digital-based business capability mechanisms on the resilience of online businesses.

2. Methods and Materials

The data collection method in the qualitative section was based on a library research approach. In this study, a questionnaire was used for data collection. The statistical population in the quantitative section consisted of experts and managers. Considering the target statistical population, the sampling method was non-probability random sampling, and the sample size was determined to be 291 participants using G*Power software. In the quantitative section, data were collected through a field survey, and a researcher-developed questionnaire was designed based on the criteria obtained from the qualitative phase. Furthermore, in this study, a questionnaire was employed to evaluate the research variables and collect data. The questionnaire was developed according to the indicators derived from the characteristics of the influential factors and was distributed online to participants. After establishing validity (construct validity using factor analysis) and reliability (calculation of Cronbach's alpha coefficient), the questionnaire was provided to respondents, who were asked to answer the questions voluntarily if they were willing and interested.

3. Findings and Results

Before evaluating structural relationships, collinearity must be examined to ensure that the regression results are unbiased.

Table 1

Multicollinearity Test (VIF)

Variable	VIF
Digital Supply Chain Management Agility	2.750
Information and Communication Technology Infrastructure	2.373
Digital Connectivity and Collaboration	2.101
Cybersecurity and Privacy	2.293
Data Management and Predictive Analytics	1.192
Digital Marketing and Customer Interaction	1.363
Scalability Capability	1.620
Business Model Innovation	1.302

The Variance Inflation Factor (VIF) assesses the severity of multicollinearity in ordinary least squares regression analysis. The severity of multicollinearity can be analyzed by examining the magnitude of the VIF value. In fact, this index indicates the extent to which variations in estimated coefficients have increased due to collinearity. If the VIF

value exceeds 5, the inflation level is considered critical, while the ideal VIF value is 3 or lower.

Considering that the highest VIF value in the table is 2.750 (related to the variable Digital Supply Chain Management Agility), which is significantly lower than the critical threshold of 5 and also below the ideal value of 3, it can be concluded that the level of multicollinearity in this regression model is acceptable and non-critical. Overall, all VIF values are below 5, indicating the absence of serious multicollinearity issues in this dataset and model. This ensures that the regression coefficients have been estimated more accurately and that the analysis results are more reliable.

The coefficient of determination is a criterion used to connect the measurement and structural components in Structural Equation Modeling (SEM) and indicates the extent to which changes in each dependent variable are explained by independent variables. A critical point here is that R^2 is calculated only for endogenous (dependent) constructs of the model, while its value for exogenous constructs is zero. The higher the R^2 value for endogenous constructs, the better the model fit. Chin (1998) identified the values of 0.19, 0.33, and 0.67 as weak, moderate, and strong, respectively. In addition, Henseler (2009) and Hair et al. (2011) defined the values of 0.25, 0.50, and 0.75 as benchmarks for weak, moderate, and strong fit of the structural model based on the coefficient of determination.

$$R^2 = 0.393$$

The second category of findings in this study examined the structural model test. After confirming validity and reliability, the structural model of the research was evaluated. Using this model, the research hypotheses could be examined. Figure 1 presents the results obtained from the output of SmartPLS2 software. According to this model, factor loadings were significant at the 95% confidence level, and all t-statistic values were outside the range of −1.96 to +1.96.

Figure 1

Structural Model of the Research in the Significance State

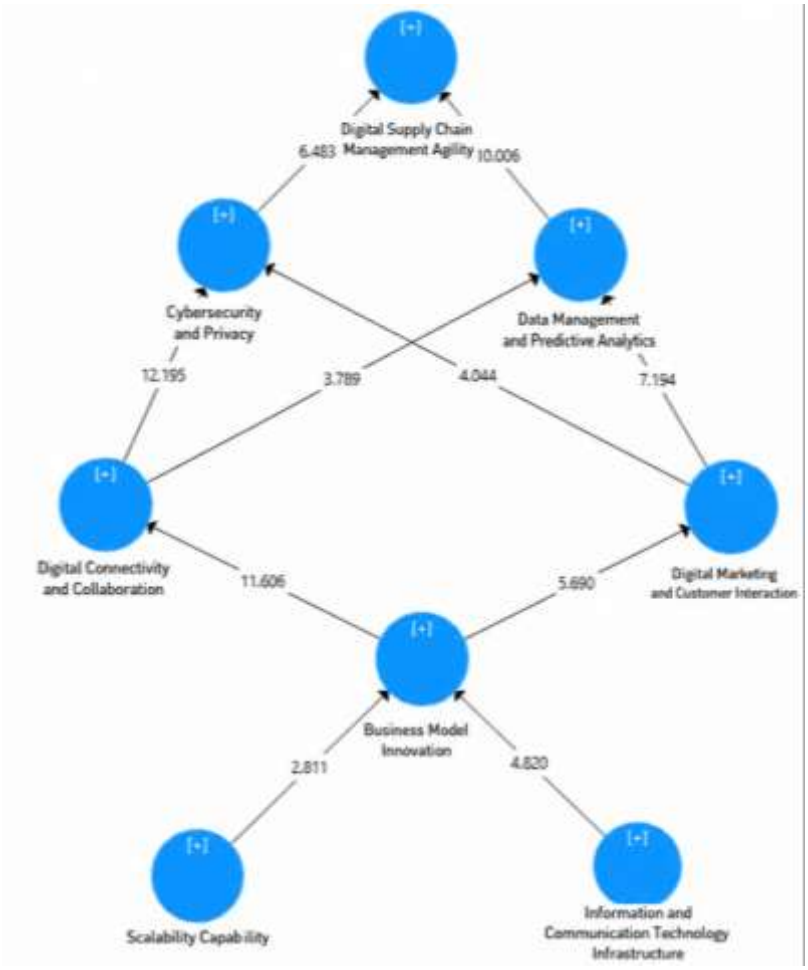


Figure 2

Structural Model of the Research in the Standardized State

In the quantitative section, the research model was analyzed using SmartPLS software. This analysis included the identified variables, the relationships among them, and comparisons with previous studies. Based on the obtained results, all factor loadings and path coefficients were reported as significant at the 95% confidence level. Specifically, the t-statistic values associated with all model paths were outside the critical range of −1.96 to +1.96, indicating the significance of relationships among the latent variables of the study at the 5% error level.

To examine variable reliability, another key factor evaluated in assessing the internal consistency reliability of the model is Cronbach's alpha. The value of this coefficient ranges from 0 to 1, where values above 0.70 are considered acceptable, while values below 0.70 are considered undesirable.

On the other hand, Composite Reliability (CR) is regarded as a more accurate and reliable criterion than Cronbach's alpha in structural models. This is because Cronbach's alpha assumes equal importance for all indicators within a construct, whereas composite reliability assigns greater importance to indicators with higher factor loadings, making CR values more realistic and precise compared to Cronbach's alpha. Similar to Cronbach's alpha, the CR coefficient also ranges from 0 to 1, with values above 0.70 considered acceptable and values below 0.60 considered undesirable. Furthermore, convergent validity was calculated. When one or more characteristics are measured through two or more methods, the correlation among these measurements provides important validity indicators. If the correlation between test scores measuring the same construct is high, the questionnaire possesses convergent validity. The existence of such correlation is essential to ensure that the instrument measures what it is intended to measure. Average Variance Extracted (AVE) is used to assess convergent validity. The AVE value also ranges from 0 to 1, and values above 0.50 are considered acceptable (Hair et al., 2019).

Table 2

Convergent Validity and Reliability of Research Variables

Variable	Cronbach's Alpha	AVE	CR
Digital Supply Chain Management Agility	0.885	0.634	0.736
Information and Communication Technology Infrastructure	0.813	0.620	0.840
Digital Connectivity and Collaboration	0.794	0.628	0.793
Cybersecurity and Privacy	0.773	0.670	0.812
Data Management and Predictive Analytics	0.835	0.611	0.845
Digital Marketing and Customer Interaction	0.710	0.536	0.833
Scalability Capability	0.934	0.623	0.825
Business Model Innovation	0.737	0.551	0.883

According to the results presented in the table above, the Cronbach's alpha values for all variables exceeded 0.70; therefore, all variables were confirmed in terms of reliability. The Average Variance Extracted (AVE) values were all greater than 0.50, confirming convergent validity. Furthermore, Composite Reliability (CR) values were higher than both AVE and 0.70, indicating that each construct in the model possessed appropriate validity and reliability.

The most important main criteria of the present study include digital supply chain management agility, information and communication technology infrastructure, digital connectivity and collaboration, cybersecurity and privacy, data management and predictive analytics, digital marketing and customer interaction, and scalability capability. Several sub-criteria were identified for each of these criteria. In total, eight criteria were examined as influential factors in developing the online business resilience model based on the role of digital-based business capability mechanisms. The criteria and sub-criteria of the study are presented in Table 3.

Table 3

Main Indicators and Related Sub-Criteria

Symbol	Variable
C1	Digital Supply Chain Management Agility
C2	Information and Communication Technology Infrastructure
C3	Digital Connectivity and Collaboration
C4	Cybersecurity and Privacy
C5	Data Management and Predictive Analytics
C6	Digital Marketing and Customer Interaction
C7	Scalability Capability
C8	Business Model Innovation

It should be noted that the criteria and sub-criteria of the study were assigned numerical indices to facilitate tracking and examination throughout the research process. In this study, the Fuzzy Analytic Network Process (FANP) technique was employed to determine the weights of criteria and model indicators.

The use of the FANP (Fuzzy Analytic Network Process) technique is considered a powerful and highly appropriate method for determining the weights of criteria and indicators in multi-criteria decision-making models, particularly in complex research contexts.

FANP is a combination of two methods:

ANP (Analytic Network Process): Unlike Analytic Hierarchy Process (AHP), which assumes that criteria and alternatives are independent and organized in a hierarchical, one-way structure, ANP removes this limitation by introducing a network structure. In this structure, dependencies and feedback relationships among criteria, sub-criteria, and even alternatives are considered. This makes the model more realistic because, in real-world situations, criteria often influence one another.

Fuzzy Logic: Classical methods such as AHP and ANP use definite numerical values (e.g., 1 to 9) for pairwise comparison judgments. However, human judgments are inherently vague, qualitative, and uncertain (e.g., "Criterion A is slightly more important than Criterion B"). Fuzzy logic addresses this uncertainty by employing fuzzy numbers (such as triangular or trapezoidal numbers) instead of crisp

values to model expert judgments. Consequently, research findings become more realistic and reliable.

Table 4

Defuzzification of Calculated Normal Weights of the Main Study Variables

Factors	Defuzzy	Normal	Rank
Digital Supply Chain Management Agility	20.28	0.266	1
Information and Communication Technology Infrastructure	8.66	0.114	6
Digital Connectivity and Collaboration	10.23	0.134	5
Cybersecurity and Privacy	5.29	0.069	8
Data Management and Predictive Analytics	10.37	0.136	4
Digital Marketing and Customer Interaction	15.16	0.199	2
Scalability Capability	6.22	0.082	7
Business Model Innovation	11.23	0.147	3

Based on the obtained eigenvector:

Digital Supply Chain Management Agility, with a normalized weight of 0.266, had the highest priority.

Digital Marketing and Customer Interaction, with a normalized weight of 0.199, ranked second.

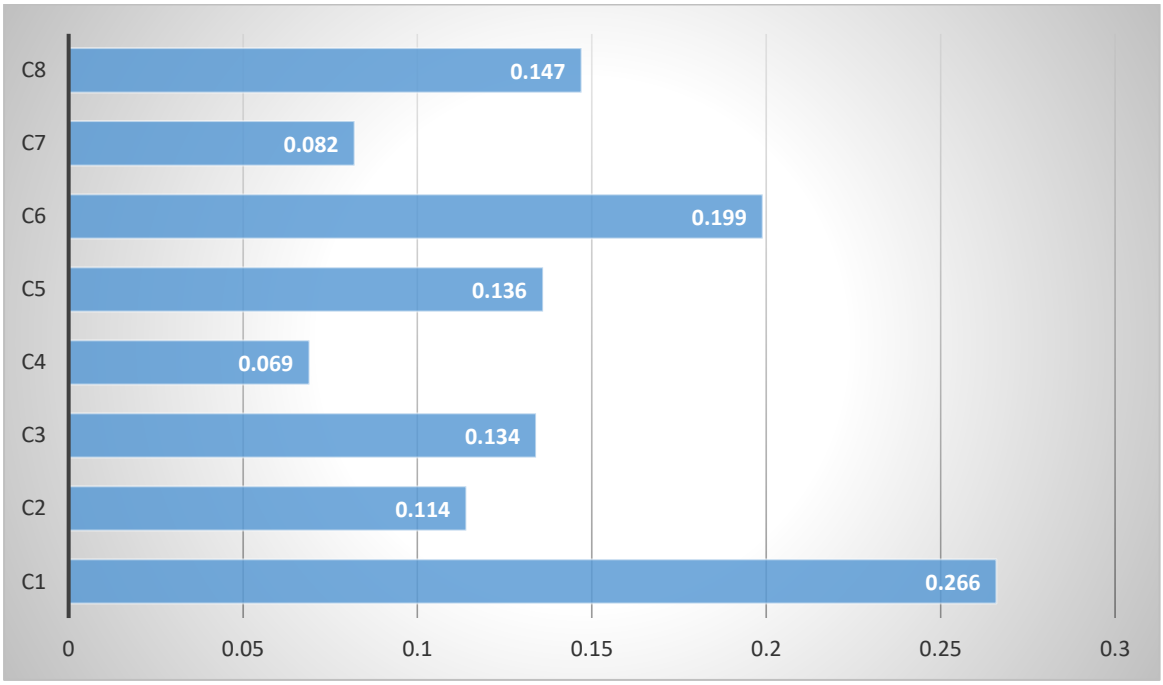
Business Model Innovation, with a normalized weight of 0.147, ranked third.

Data Management and Predictive Analytics, with a normalized weight of 0.136, ranked fourth.

Digital Connectivity and Collaboration, with a normalized weight of 0.134, ranked fifth.

Figure 3

Graphical Representation of the Prioritization of Main Criteria



The inconsistency rate of the performed comparisons was obtained as 0.073, which is smaller than 0.10; therefore, the conducted comparisons can be considered reliable.

4. Discussion and Conclusion

The findings of the present study demonstrated that digital-based business capability mechanisms exert a significant and positive influence on the resilience of online

businesses. The results obtained from Structural Equation Modeling (SEM) using the Partial Least Squares (PLS) approach confirmed that all proposed relationships among the research variables were statistically significant at the 95% confidence level. The coefficient of determination (R^2 = 0.393) indicated that approximately 39% of the variance in online business resilience was explained by the identified digital capability mechanisms, suggesting a moderate and acceptable explanatory power for the proposed model. Furthermore, the acceptable values of Cronbach's alpha, Composite Reliability (CR), and Average Variance Extracted (AVE) confirmed the reliability and convergent validity of the measurement model, while the Variance Inflation Factor (VIF) values verified the absence of multicollinearity problems. These findings collectively indicate that the proposed conceptual framework possesses strong analytical validity and can effectively explain the role of digital business capabilities in enhancing organizational resilience.

One of the most important findings of the study was the prioritization of digital supply chain management agility as the most influential factor affecting online business resilience. This result indicates that organizations capable of rapidly adapting their supply chain operations to market fluctuations, customer expectations, and external disruptions possess greater resilience and operational continuity. The significance of digital supply chain agility is consistent with prior studies emphasizing the role of digital technologies in enhancing supply chain flexibility and responsiveness during periods of uncertainty (Brown et al., 2024; Grant, 2024). The findings also align with the argument that digital transformation enables organizations to optimize logistics coordination, improve information transparency, and reduce operational vulnerability through real-time communication systems (Zhang, 2023). During turbulent environmental conditions, agile digital supply chains allow firms to reconfigure operational processes more efficiently and maintain stable customer service performance. This finding further supports the perspective that organizational resilience is not merely a reactive capability but rather a proactive strategic competency grounded in digital adaptability (Datti & Kuppusamy, 2023; Mehedinţu & Șoavă, 2022).

Another important result of the study was the significant influence of digital marketing and customer interaction on business resilience. The FANP prioritization analysis showed that digital marketing and customer interaction ranked second among the most influential variables. This finding suggests that organizations capable of maintaining effective communication with customers through digital channels are more likely to preserve market stability and sustain competitive advantage during environmental disruptions. The results are consistent with previous studies indicating that digital marketing technologies improve customer engagement, brand loyalty, and organizational responsiveness in online markets (Johnson et al., 2024; Nichifor et al., 2022). In modern digital economies, customer interaction mechanisms are no longer limited to promotional activities but have evolved into strategic tools for market intelligence, behavioral prediction, and relationship management. The positive role of e-marketing in improving SME performance and adaptability has also been emphasized in prior research (Diandra et al., 2023). Moreover, digital customer interaction contributes to resilience by enabling organizations to quickly identify changes in customer preferences and respond through personalized services and adaptive business strategies. This finding confirms that customer-centered digital capabilities are essential for ensuring sustainable performance in highly competitive online environments.

The findings also revealed that business model innovation plays a substantial role in strengthening organizational resilience. Business model innovation ranked third in the prioritization analysis, indicating that organizations capable of redesigning their value creation and delivery systems are better equipped to survive and grow under disruptive conditions. This result is highly consistent with previous studies emphasizing the importance of business model pivoting and digital entrepreneurship during economic crises and turbulent environments (Balta et al., 2023; Yadav et al., 2023). Digital technologies enable organizations to develop flexible operational structures, platform-based services, and scalable revenue mechanisms that improve organizational adaptability and long-term sustainability. The results additionally support the findings of studies indicating that digital transformation significantly enhances organizational resilience through innovation-oriented strategic change (Santos et al., 2023; Yustian & Ratnapuri, 2025). In the context of online businesses, innovative business models facilitate rapid adaptation to technological changes, shifting customer demands, and competitive pressures. Consequently, firms capable of continuously innovating their digital business models are more likely to sustain operational continuity and competitive resilience in uncertain environments.

Data management and predictive analytics were also identified as influential factors affecting online business resilience. The results demonstrated that organizations utilizing predictive analytics and data-driven decision-making mechanisms exhibit greater adaptability and strategic responsiveness. This finding aligns with prior literature emphasizing the strategic value of digital data management in improving forecasting accuracy, operational efficiency, and crisis preparedness (Li et al., 2023; Patinah, 2024). Predictive analytics enables organizations to anticipate disruptions, optimize resource allocation, and detect emerging market trends more effectively. The growing integration of artificial intelligence, machine learning, and big data analytics into organizational processes has transformed data management into a critical determinant of resilience and strategic agility. The findings further support the argument that digitally resilient firms are characterized by their ability to convert information into actionable strategic knowledge (Yao, 2023). Therefore, organizations that invest in advanced analytics infrastructures and data governance systems can significantly improve their capacity to manage uncertainty and sustain competitive performance.

Cybersecurity and privacy protection were found to have a meaningful influence on online business resilience as well. As organizations increasingly depend on digital technologies, the risks associated with cyber threats, data breaches, and technological vulnerabilities continue to intensify. The findings of this study support previous research demonstrating that cybersecurity resilience is essential for ensuring operational continuity, customer trust, and sustainable business performance (Al-Somali et al., 2024; Benjamin et al., 2024). Cybersecurity mechanisms not only protect organizational assets but also contribute to strategic stability by minimizing operational disruptions and reputational damage. This issue is especially important for SMEs and online businesses that often possess limited technological and financial resources for managing cyber risks. The positive relationship between cybersecurity capability and organizational resilience observed in this study confirms that digital resilience cannot be achieved without effective information security systems. Furthermore, the findings support the view that organizational culture and digital governance practices play an important mediating role in strengthening cybersecurity resilience and adaptive capacity (Al-Somali et al., 2024).

The significance of digital connectivity and collaboration further highlights the importance of network-based organizational ecosystems in contemporary digital environments. The findings demonstrated that collaborative digital relationships among firms, suppliers, and customers significantly enhance resilience by improving communication efficiency, information sharing, and coordinated problem-solving. These results are consistent with previous studies emphasizing the role of digital collaboration in strengthening supply chain resilience and organizational adaptability (Grant, 2024; Jiaqi, 2023). In online business ecosystems, digital collaboration facilitates collective learning, technological integration, and rapid strategic adjustment during periods of instability. The findings also align with research suggesting that cross-border digital interactions and regional policy support mechanisms improve entrepreneurial resilience and international market adaptability (Irfan et al., 2023). Consequently, organizations operating within highly interconnected digital networks possess greater strategic flexibility and resilience compared to isolated firms.

Another notable finding of the study concerns the role of information and communication technology (ICT) infrastructure in improving online business resilience. Although ICT infrastructure did not rank among the top three priorities, its influence remained statistically significant and strategically important. This result confirms that technological infrastructure forms the foundational platform upon which all other digital business capabilities operate. The findings support prior studies demonstrating that strong ICT infrastructures improve organizational efficiency, innovation capability, and digital adaptability (Arias et al., 2024; Petropoulou et al., 2024). Organizations with advanced ICT systems are more capable of supporting cloud computing, digital communication, remote operations, and online service delivery, all of which contribute to operational continuity and resilience. The importance of ICT infrastructure became particularly evident during the COVID-19 pandemic when organizations with higher levels of digital readiness were able to adapt more effectively to market disruptions and changing consumer behaviors (Khlystova et al., 2022; Rochayatun, 2022). Therefore, investment in ICT infrastructure represents a strategic prerequisite for enhancing organizational resilience in digital business environments.

The study findings also reinforce the broader theoretical perspective that digital transformation and organizational resilience are deeply interconnected constructs. Digitalization enhances resilience not only by improving operational efficiency but also by enabling strategic

flexibility, innovation, and adaptive learning. Previous studies have consistently shown that organizations capable of integrating digital technologies into core business functions exhibit stronger resilience and long-term sustainability (Hokmabadi et al., 2024; Kouam, 2025). The present study extends this literature by providing a comprehensive structural model that simultaneously examines multiple dimensions of digital business capability mechanisms. Unlike previous studies that focused on isolated technological variables, this research demonstrates that organizational resilience emerges from the combined interaction of supply chain agility, digital marketing, cybersecurity, predictive analytics, collaboration, and innovation capabilities. The findings additionally support studies indicating that digital resilience contributes significantly to internationalization, export stability, and economic adaptability among firms operating in uncertain environments (Li et al., 2023; Onjewu et al., 2022). Overall, the results confirm that digital capability mechanisms function as strategic enablers of resilience and competitive sustainability in online businesses.

One limitation of the present study relates to the use of cross-sectional data, which restricts the ability to evaluate long-term causal relationships among the research variables. Since organizational resilience and digital transformation are dynamic phenomena that evolve over time, future longitudinal analyses may provide more comprehensive insights into how digital capabilities influence resilience under changing environmental conditions. Another limitation concerns the sample composition, as the study primarily focused on experts and managers involved in online business activities, which may limit the generalizability of the findings to other industrial sectors or organizational contexts. Additionally, the study relied on self-reported questionnaire data, which may introduce subjective bias or respondent interpretation errors despite the acceptable reliability and validity of the measurement instruments.

Future research could expand the present model by incorporating additional variables such as organizational culture, leadership style, technological readiness, digital innovation maturity, and environmental uncertainty. Comparative analyses across industries, countries, and organizational sizes may also provide deeper understanding regarding the contextual factors influencing digital resilience. Longitudinal studies could further investigate the evolving impact of digital transformation strategies on organizational sustainability and adaptive capacity over time. Future researchers may additionally employ mixed-method or qualitative approaches to explore the underlying mechanisms through which digital capabilities influence resilience and strategic decision-making in online business ecosystems.

From a practical perspective, the findings suggest that managers and policymakers should prioritize investment in digital supply chain agility, predictive analytics, cybersecurity systems, and customer-centered digital marketing strategies to enhance organizational resilience. Organizations should strengthen their ICT infrastructures and promote collaborative digital ecosystems that facilitate information sharing and operational flexibility. Developing innovation-oriented business models and scalable digital platforms can also improve organizational adaptability during periods of crisis and technological disruption. Furthermore, organizations should establish continuous digital training programs to improve employee competencies in data management, cybersecurity awareness, and digital strategic planning. Policymakers may also support SME resilience by providing technological incentives, digital infrastructure development programs, and cybersecurity support initiatives that facilitate sustainable digital transformation within online business environments.

Authors' Contributions

Authors contributed equally to this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethics Considerations

In this research, ethical standards including obtaining informed consent, ensuring privacy and confidentiality were considered.

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