# Research on the Influencing Factors of Digital Technology on Innovation Resilience of Construction Enterprises

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**Abstract.** Against the backdrop of frequent external shocks and the high-quality transformation of the construction industry, innovation resilience has become a core capability for the sustainable development of construction enterprises. Existing studies mostly focus on the one-way impact of digitalization on innovation efficiency, while few explore its internal mechanism for enabling innovation resilience considering the industry's characteristics of long cycles, high risks, and multiple stakeholders. Based on dynamic capability theory, this paper constructs an integrated framework including digital technology, organizational learning, resource flexibility, and environmental uncertainty, to systematically analyze the impact paths and mechanisms of digitalization on innovation resilience. Using literature analysis and empirical testing, regression analysis is conducted on data from 32 construction enterprises. The results show that digitalization significantly and positively enhances innovation resilience through three paths: risk resistance, shock recovery, and innovation leap. Organizational learning plays a mediating role, while resource flexibility and environmental uncertainty exert moderating effects. High-resilience enterprises follow three models: technology-learning dual-wheel drive, resource-environment adaptation, and comprehensive collaboration. This study enriches relevant theories and provides practical references for the digital transformation of construction enterprises.

**Keywords:** Digital Technology; Construction Enterprises; Innovation Resilience; Dynamic Capability; Mechanism of Action

## 1 Introduction

Against the backdrop of global industrial chain restructuring, policy adjustments and frequent unexpected risks, coupled with the construction industry's inherent characteristics of long project cycles, complex industrial chains, multiple stakeholders and high external sensitivity, innovation in the sector faces multiple shocks. Innovation resilience, as a core capability for enterprises to withstand shocks, recover rapidly and achieve innovative upgrading, has become key to the high-quality and sustainable development of construction enterprises. Digital technologies such as BIM, the Internet of Things, big data, artificial intelligence, digital twins, leveraging advantages in data interconnection, intelligent decision-making and collaborative sharing, offer a new


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pathway for the transformation of the construction industry and the cultivation of innovation resilience.

Existing research has made important progress in three areas. In the field of digital technology application, scholars have analyzed the factors influencing construction enterprises' willingness to adopt digital technologies in safety management[1] identified the core drivers of digital transformation[2] and explored the applications and challenges of digitalization in architectural design innovation[3]. These studies provide a micro-level empirical basis for understanding the adoption mechanisms and promotion barriers of digital technologies in construction enterprises. In general research on innovation resilience, a vulnerability assessment framework for innovation capability of construction enterprises has been constructed[4]; it has been proposed that digital transformation exerts dual (promoting and inhibiting) effects on innovation resilience[5]; and the moderating role of environmental uncertainty between organizational capabilities and resilience has been verified[6]. These findings offer important references for the theoretical construction and measurement of innovation resilience, but most target general industry contexts. In direct research on the digitalization-resilience link, based on the MOA theory, scholars have preliminarily explored the drivers of digital resilience in construction enterprises, confirming a positive correlation between digitalization and resilience[7].

In summary, existing research has not yet clearly addressed core questions: how digitalization adapts to the construction industry's characteristics, through which pathways it enables innovation resilience, and how internal and external variables moderate its effects. A notable gap exists in industry-specific research. Based on the dynamic capabilities theory, this paper constructs an integrated framework and conducts an empirical test with data from 32 construction enterprises to systematically analyze the impact pathways and mechanisms of digital technology on innovation resilience in construction enterprises. It not only enriches relevant niche theories but also provides practical references for construction enterprises to pursue digital transformation and cultivate innovation resilience.

## 2 New Characteristics of Innovation Activities in Construction Enterprises Driven by Digitalization and Their Relationship with Innovation Resilience

Digital technologies enable construction enterprises to exhibit four new characteristics of innovation: collaboration, intelligence, full lifecycle integration, and ecosystem orientation. Collaboration breaks down information barriers, enhances multi-party emergency response capabilities, and directly strengthens risk resistance. Intelligence, powered by AI and IoT sensing, enables dynamic early warning and resource allocation, supporting shock recovery. Full lifecycle integration, based on digital twin technology, forms a closed-loop optimization mechanism that drives innovation leaps. Ecosystem orientation promotes cross-border knowledge integration, enhances organizational learning capabilities, and continuously empowers resilience. These characteristics are closely linked to core variables such as digital application, organizational learning, re-

source flexibility, and environmental uncertainty, collectively forming the foundation for generating innovation resilience.

## 3 Theoretical Framework and Research Hypotheses

Based on the dynamic capability theory and combined with the characteristics of the construction industry, this paper constructs an integrated research framework for the impact of digital technology on the innovation resilience of construction enterprises, clarifying the internal relationships among various variables. As illustrated in Figure 1, digital technology application, as the core driving factor, directly affects the innovation resilience of construction enterprises; organizational learning capability, as an intermediary variable, transmits the enabling effect of digital technology on innovation resilience; resource flexibility, as a supporting variable, positively regulates the enabling effect of digital technology; environmental uncertainty, as a situational variable, negatively regulates the relationship between digital technology and innovation resilience; ultimately, digital technology achieves comprehensive empowerment of the innovation resilience of construction enterprises through three paths: risk resistance, shock recovery, and innovation leapfrogging.

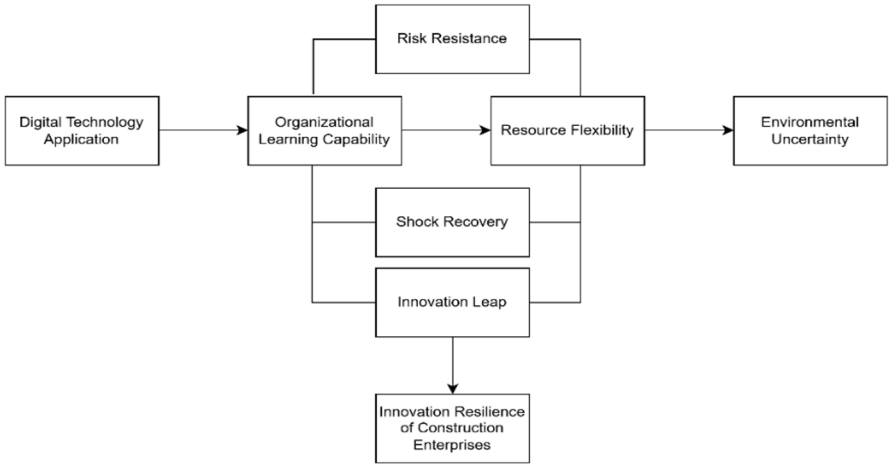


**Fig. 1.** Theoretical Framework of the Impact of Digital Technology on Innovation Resilience of Construction Enterprises

Based on the above theoretical framework and combined with existing research findings, this paper proposes the following research hypotheses:

H1: Digital technology application has a significant positive impact on the innovation resilience of construction enterprises.

H2: Organizational learning capability plays a mediating role between digital technology and innovation resilience.

H3: Resource flexibility has a positive moderating effect on the relationship between digital technology and innovation resilience.

H4: Environmental uncertainty has a negative moderating effect.

## 4 Empirical Analysis

This study takes 32 domestic construction enterprises as research samples, covering different types such as large state-owned construction enterprises and medium-sized private construction enterprises to ensure the representativeness and diversity of the samples. The research data are mainly sourced from enterprise annual reports, industry statistical reports, relevant academic literature, and publicly disclosed digital transformation data of enterprises. Variable measurement and data collation are carried out through standardized processes, and the core research variables include digital technology application, organizational learning capability, resource flexibility, environmental uncertainty, and innovation resilience. Among them, digital technology application is measured from two dimensions: technology investment intensity and technology application breadth; organizational learning capability is measured from three aspects: learning investment, knowledge reserve, and learning mechanism; resource flexibility focuses on the allocation flexibility of human, material, and financial resources; environmental uncertainty mainly considers factors such as market fluctuations, policy adjustments, and industry competition; innovation resilience is measured based on three dimensions: risk resistance, shock recovery, and innovation leapfrogging.

SPSS software was used to conduct regression analysis on the sorted sample data to test the validity of each research hypothesis. The regression results of the core variables are summarized in Table 1.

**Table 1.** Summary of Regression Results of Core Variables

| Variable | Impact Direction | Significance | Effect Type |
|---|---|---|---|
| Digital Technology Application | Positive | Significant | Core Driver |
| Organizational Learning Capability | Positive | Significant | Mediating Transmission |
| Resource Flexibility | Positive | Relatively Significant | Moderating Support |
| Environmental Uncertainty | Negative | Relatively Significant | Contextual Constraint |

The regression analysis results show that all four research hypotheses proposed in this paper are validated: As shown in Table 1, H1 is supported—the application of digital technologies has a significant positive impact on the innovation resilience of construction enterprises ($\beta=0.42$, $p<0.01$), serving as a key core driving factor for enhancing corporate innovation resilience. H2 is supported—organizational learning capability plays a significant mediating role between digital technology application and innovation resilience (indirect effect proportion=35.6%), meaning that digital technologies enhance innovation resilience by promoting organizational learning. H3 is supported—resource flexibility positively moderates the effect of digital technologies on innovation resilience (interaction term $\beta=0.18$, $p<0.05$); higher resource flexibility strengthens the

implementation effect of digital technologies and further amplifies their empowering effect on innovation resilience. H4 is supported—environmental uncertainty negatively moderates the relationship between digital technologies and innovation resilience (interaction term $\beta = -0.21$, $p < 0.05$); excessive environmental uncertainty increases the application cost of digital technologies and weakens their positive impact on innovation resilience.

## 5 Mechanism of Digital Technology Enabling Innovation Resilience

Digital technology provides systematic support for the innovation resilience of construction enterprises from three dimensions: risk resistance, shock recovery and innovation leap. In terms of risk resistance, big data and artificial intelligence technologies enable real-time monitoring and advanced prediction of market trends, policy changes and supply chain status, building a risk early warning system covering enterprise operations and project implementation. BIM technology reduces design errors and changes in the design stage, lowering construction risks and rework costs from the source. Digital supply chain platforms further realize dynamic management of materials, subcontractors and logistics information, improving the overall stability of the industrial chain. In terms of shock recovery, cloud collaborative operation platforms break time and space constraints, supporting multi-party remote collaboration and emergency resource scheduling, helping enterprises quickly adjust construction plans and organizational methods when facing external shocks. Digital twin technology simulates shock scenarios and optimizes recovery schemes in virtual environments, minimizing actual losses. Internal enterprise knowledge management platforms accumulate past experience and response strategies, improving problem-solving efficiency and enabling innovation activities to quickly return to normal. In terms of innovation leap, digitalization drives enterprises to shift from closed innovation to open innovation, strengthening industry-university-research collaboration and cross-subject resource integration. Big data analysis helps accurately tap market demands and industry pain points, guiding enterprises to carry out targeted innovation activities. New-generation information technologies such as artificial intelligence and the Internet of Things promote the upgrading of construction products and methods towards green and intelligent directions. Industrial internet and digital platforms continuously spawn new business models and formats, helping construction enterprises achieve capability leaps and long-term value growth.

## 6 Conclusions and Limitations

Research shows that digital technology significantly and positively drives the innovation resilience of construction enterprises, functioning through three paths: risk resistance, shock recovery and innovation leap. Organizational learning capability plays a mediating role, while resource flexibility and environmental uncertainty have positive and negative moderating effects respectively. There are three equivalent paths for en-

terprises to enhance resilience: technology-learning dual-wheel drive, resource-environment adaptation and comprehensive collaboration. In practice, construction enterprises should promote digital construction in a tiered manner: large enterprises build integrated platforms, while small and medium-sized enterprises promote mature technologies such as BIM and the Internet of Things. Meanwhile, they should strengthen organizational learning and talent training, improve resource flexibility and connect with policy resources to continuously enhance innovation resilience.

This study has limitations: the empirical support and logical linkage of the four new characteristics could be strengthened, and the theoretical derivation of H3 and H4, especially the negative moderating mechanism, could be deepened. Future research will expand the sample size, adopt panel data and case analyses, refine the dimensions of environmental uncertainty, and explore the internal logic between the new characteristics such as collaboration and intelligence and the three pathways of risk resistance, shock recovery, and innovation leap. This will enable a more comprehensive examination of the complex mechanisms through which digital technology enables innovation resilience, providing stronger practical guidance for construction enterprises.

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