

Digital Transformation and Innovation Performance of Selected Manufacturing Firms: A Policy Guide for Accelerating Innovation Performance

Wei Liu

Adamson University, Philippines

Abstract: This study investigates the relationship between digital transformation and innovation performance in selected manufacturing enterprises, with a particular focus on the mediating role of dynamic capabilities. Regression and correlation analyses reveal that digital transformation significantly enhances innovation performance, particularly in technological advancement, service innovation, and management innovation. The findings indicate that enterprises investing in digital technologies achieve enhanced innovation outcomes, enabling them to better respond to market demands and stay competitive. Additionally, the study reveals that dynamic capabilities—specifically opportunity perception, opportunity grasping, and resource integration—partially mediate the relationship between digital transformation and innovation performance. This suggests that while digital transformation directly drives innovation, its impact is amplified through the development of dynamic capabilities, enabling firms to adapt more effectively to changing environments. The study underscores the importance of fostering both digital transformation and dynamic capabilities for sustainable innovation and long-term competitiveness in the manufacturing sector.

Keywords: Digital Transformation, Innovation Performance, Dynamic Capabilities, Technological Progress, Service Innovation, Manufacturing Enterprises, Resource Integration.

1. Background of the Study

China, the world's second-largest economy, has rapidly developed a digital economy, contributing 45.5 trillion yuan or 39.8% of its GDP, as highlighted in the "China Internet Development Report 2022." The integration of information technology with the real economy positions the digital economy as a key pillar of China's high-quality economic growth. Enterprises play a central role in driving digital innovation and applications, leveraging data and technology to gain competitive advantages.

In the digital era, innovation is critical for businesses to secure a first-mover advantage, aligning with China's innovation-driven development strategy. The 2021 Government Work Report emphasized using innovation to enhance the high-quality development of the real economy and upgrade manufacturing enterprises' capabilities. Dynamic capability, identified as a crucial factor for adapting to complex environments, is essential for maintaining competitive advantages and improving performance.

Studies show that digital transformation strengthens dynamic capabilities, fostering creativity, reducing supply chain vulnerabilities, and enabling agile adaptation to market changes. Despite its recognized benefits, the mechanisms through which digital transformation enhances business performance remain underexplored, particularly in manufacturing firms. While prior research focused on industries like retail, this study addresses the gap by analyzing how digital transformation, mediated by dynamic capability, impacts the performance of manufacturing enterprises. With manufacturing firms representing 60% of China's listed companies, this research is vital for advancing the literature and supporting the digital transformation of the manufacturing sector amid globalization and post-COVID challenges.

2. Hypotheses

This study intended to utilize dynamic capability theory as a mediating variable to facilitate digital transformation and to improve innovation performance in manufacturing enterprises, while also comprehensively evaluating the impact pathway of digital transformation on the performance of these enterprises.

The following hypotheses were tested against the stated problem:

H01: No significant link exists between digital transformation and the innovation performance of industrial enterprises.

H02: No significant link exists between digital transformation and the dynamic capabilities of the selected industrial enterprises.

3. Related Literature

3.1. Digital Transformation

Scholars, both local and international, examine digital transition from many research approaches and content areas. Some representative views are listed below.

Udovita (2020) argued that digital transformation should be viewed as a central and holistic concept and proposed the importance of these four dimensions in the digital transformation process, namely go-to-market, engagement, operations, and organizational factors.

According to the information supplied by publicly traded firms in the industrial sector, Liu Fei (2020) proposed several key dimensions in the process of digital transformation, namely, digital investment dimension, business model transformation dimension, and digital technology application as a key dimension.

Wu Songqiang et al. (2019) indicated that the impact of

digital technologies and tools, organizations with strong perception could easily access rich data and resources. Gao and Sarwar (2022) point out that organizations implement digital transformation activities with the help of digital technologies. By cultivating strong absorption capabilities, organizations could accelerate the process of digital innovation and further demonstrate digital transformation to the level of results and outputs. Yang and Yee (2022) point out that organizations could take advantage of digital opportunities outside the system to consolidate and reorganize resources.

3.2. Enterprise Innovation Performance

At present, most academic research on organizational innovation performance focus on one or more directions, and generally discuss the pre-factors that affect organizational innovation performance, that is, innovation performance appears as an outcome variable in the field of enterprise management in most studies.

Cong Hao and Zhang Chunyu (2022) pointed out that enterprise innovation performance is measured by innovation output, which can be roughly divided into four aspects: the quantity of innovation output, the adoption rate of innovation output, the quality level of innovation output and the degree of market leadership. Yang Xuejuan and Yuan Ke (2022) divided innovation indicators into two dimensions: process indicators and output indicators. According to the degree of innovation, Hurtado et al. (2022) divided enterprise innovation performance into two dimensions: progressive innovation performance and breakthrough innovation performance. Based on the degree of innovation, Li Ruixue et al. (2019) divided its dimensions from two aspects: exploitative innovation dimension and exploratory innovation dimension.

3.3. Digital Transformation and Dynamic Capabilities

The very nature of digital transformation was one of changes itself, and the introduction of an ongoing adaptation mechanism to cope with the change would be the key to the successful transformation of enterprises. Dynamic capability played a core role in enhancing the digital maturity of enterprise design mechanisms in leveraging digital technology to attain adaptability (Vial, 2019). In the context of digital economy, Dynamic capability denotes the capacity of enterprises to make use of digital devices in sensing digital opportunities, analyzing data and information, and responding rapidly to customer needs (Rialti et al., 2019; Zhang Xiao et al., 2019). Digital transformation enterprises could sense change information from the environment with dynamic capabilities, establish data interconnection with users through digital devices (Warner, 2019), and analyze and evaluate market change trends through big data (Vial, 2019).

3.4. Dynamic capability and enterprise innovation performance

Gao Huisheng (2020) examined the dynamic capacities of physical retail firms and concluded that digital transformation mostly enhanced integration capabilities, hence improving the coordination of internal and external resource integration to identify an appropriate development trajectory. Extensive research has explored the relationship between dynamic capabilities and innovation performance. Jiao Hao (2021) speculated that the success of firms in digital transformation

mostly stemmed from the organization's dynamic capability, which catalyzed the data-driven effect and delineated a clear pathway for business restructuring and process innovation. The role of dynamic capability in enterprise digital transformation was evident in the real-time sensing of external environmental changes, timely adjustments, and the realization of organizational innovation through the integration and reconstruction of internal and external resources (Tan Yunqing et al., 2013; Lin and Wu, 2014). Su Jingqin and Liu Jing (2013) examined that in the context of organizational change within the digital economy, dynamic capability significantly enhanced innovation performance. Wu Jiang (2021) developed a research model centered on digital transformation, dynamic capability, and innovation performance as key variables, outlining the process of improving an enterprise's capabilities and innovation performance via digital transformation in three stages: perception, acquisition, and transformation.

4. Research Result

4.1. Relationship of Digital Transformation and Innovation Performance

Table 1 presents the relationship between digital transformation and innovation performance. Take digital transformation as the independent variable and creative performance as the dependent variable.

Table 1. Regression Result of Digital Transformation versus Innovation Performance

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.511a	.261	.259	.643
a. Predictors: (Constant), Digital Transformation				

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	48.650	1	48.650	117.553	.000b
	Residual	137.400	332	.414		
	Total	186.049	333			
a. Dependent Variable: Innovation Performance						
b. Predictors: (Constant), Digital Transformation						

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.880	.177		10.623	.000
	Digital Transformation	.510	.047	.511	10.842	.000
a. Dependent Variable: Innovation Performance						

The regression analysis results in Table 1 reveal a significant relationship between Digital Transformation and the Innovation Performance of manufacturing enterprises. The model summary shows that the R-value is 0.511, indicating a moderate positive correlation between digital transformation and innovation performance. Additionally, the R² value of 0.261 suggests that digital transformation explains

approximately 26.1% of the variance in innovation performance. This means that a considerable portion of the improvement in innovation performance can be attributed to the level of digital transformation within the enterprise.

The ANOVA analysis further supports this finding, with an F-value of 117.553 and a p-value of 0.000, confirming that the overall model is statistically significant. This result indicates that digital transformation plays a substantial role in influencing innovation performance. As for the coefficients, the unstandardized coefficient (B) for Digital Transformation is 0.510, implying that for every one-unit increase in digital transformation, innovation performance increases by 0.510 units. The t-value of 10.842 and the p-value of 0.000 further confirm the significant positive impact of digital transformation on innovation.

Given these results, we reject the null hypothesis H₀₃, which stated that there is no significant relationship between digital transformation and innovation performance. The findings clearly demonstrate that digital transformation significantly enhances innovation performance within manufacturing enterprises. This conclusion is consistent with recent studies that emphasize the critical role of digital transformation in driving innovation. For instance, digital technologies enable firms to streamline processes and foster innovation through better resource utilization and market responsiveness (Jin & Li, 2020). Similarly, the adoption of digital platforms not only improves operational efficiency but also accelerates product and service innovation (Wang et al., 2021). Furthermore, digital transformation can lead to more effective collaboration and knowledge-sharing within firms, enhancing overall innovation outcomes (Chen & Zhang, 2022).

4.2. Relationship of Digital Transformation and Dynamic Capabilities

Table 2 examines the relationship between digital transformation and dynamic capabilities by analyzing how digital transformation influences a firm's ability to sense opportunities, make agile decisions, and integrate resources. In this model, digital transformation serves as the independent variable, while dynamic capability, as the dependent variable, reflects the firm's responsiveness to changes in the market and its capacity for innovation.

Table 24 explores the relationship between digital transformation and innovation performance, focusing on the mediating role of dynamic capability. It investigates whether dynamic capabilities mediate the effect of digital transformation on performance of innovation.

The regression analysis results show a significant positive relationship between Digital Transformation and Dynamic Capabilities. The R-value of 0.461 indicates a strong correlation, while the R² value of 0.212 shows that digital transformation explains 21.2% of the variation in dynamic capabilities. This underlines the power of digital transformation in influencing an enterprise's ability to respond to changed market conditions.

The ANOVA results confirm the overall significance of the model, with an F-value of 89.557 and a p-value of 0.000, which means that digital transformation significantly influences dynamic capabilities. From the coefficient of Digital Transformation, for every unit increase in the variable, dynamic capabilities increase by 0.461 units. The t-value of 9.463 with a p-value of 0.000 further reinforces the strength of this relationship.

Table 2. Regression Result of Digital Transformation versus Dynamic Capability

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.461a	.212	.210	.667
a. Predictors: (Constant), Digital Transformation				

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	39.813	1	39.813	89.557	.000b
	Residual	147.592	332	.445		
	Total	187.405	333			
a. Dependent Variable: Dynamic Capability						
b. Predictors: (Constant), Digital Transformation						

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.994	.183		10.871	.000
	Digital Transformation	.461	.049	.461	9.463	.000
a. Dependent Variable: Dynamic Capability						

Table 3. Regression Result between Digital Transformation and Innovation Performance with Dynamic Capability (as mediate variable)

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.547a	.299	.295	.628
a. Predictors: (Constant), Dynamic Capability, Digital Transformation				

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	55.660	2	27.830	70.647	.000b
	Residual	130.390	331	.394		
	Total	186.049	333			
a. Dependent Variable: Innovation Performance						
b. Predictors: (Constant), Dynamic Capability, Digital Transformation						

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.446	.201		7.189	.000
	Digital Transformation	.409	.052	.411	7.918	.000
	Dynamic Capability	.218	.052	.219	4.218	.000
a. Dependent Variable: Innovation Performance						

So, the null hypothesis H₀₄ is rejected. It justifies that digital transformation would effectively enhance the positive impact of digital transformation on dynamic capabilities,

proving the fact from recent works that digital transformation enhances firm capability to adapt and integrate their resources in dynamic environments (Teece, 2020; Wang et al., 2021).

Table 3 elucidates the mediating function of Dynamic Capability in the correlation between Digital Transformation and Innovation Performance. The model indicates that Dynamic Capability exerts a substantial positive influence on innovation performance, evidenced by a standardized coefficient (β) of 0.218 ($t = 4.219, p < 0.001$). This signifies that an enhancement in dynamic capability correlates with an increase in innovation performance.

Furthermore, upon incorporating dynamic capability into the model, the influence of digital transformation on innovation performance continues to be substantial; however, the coefficient for Digital Transformation diminishes marginally from $\beta = 0.511$ (as shown in previous models) to $\beta = 0.411$ ($t = 7.918, p < 0.001$). The decrease in the coefficient indicates that dynamic capability partially mediates the connection between digital transformation and innovative performance.

In other words, Digital Transformation directly enhances innovation performance, with some of its effects being mediated by the improvement of dynamic capacities. This partial mediation indicates that Digital Transformation not only directly drives innovation performance but also improves a firm's dynamic capabilities, which in turn further promotes innovation performance.

The R^2 value of 0.299 indicates that the combined effect of digital transformation and dynamic capability explains 29.9% of the variance in innovation performance. The ANOVA

results, with an F-value of 70.647 ($p = 0.000$), confirm the overall model's significance.

4.3. Proposed Policy Model to Accelerate Innovation Performance

The policy model of Table 4 provides a series of measures to promote the digital transformation of manufacturing enterprises, and makes specific recommendations for enterprise management, government departments, investors, and academics. The Figure 2 outlines key policy areas to support digital transformation across various sectors, detailing specific actions, objectives, and recommendations for stakeholders. It emphasizes promoting the adoption of advanced digital technologies such as IoT, AI, and cloud computing, supporting digital platform development for data sharing and collaboration, and providing financial resources for SMEs to ease their digital adoption. Additionally, it highlights the importance of skill development programs to equip employees with digital capabilities, strengthening firms' dynamic capabilities to respond to market changes, and fostering public-private partnerships to co-develop digital technologies. Finally, the figure addresses the need for regulatory support to ensure data privacy and security, while encouraging alignment with new digital transformation regulations. Recommendations target different stakeholders, including enterprises, government departments, investors, and scholars, to work collaboratively towards driving innovation and competitiveness in the digital age.

Table 4. Proposed Policy Model

Policy Area	Policy Action	Objective	Recommendations
1. Digital Technology and Product Adoption	Provide incentives for adopting advanced digital technologies, including IoT, AI, and cloud computing.	Enable firms to integrate digital tools into operations and products, enhancing innovation and competitive advantage.	Enterprise Management: Prioritize investment in technologies that align with strategic goals. Government Departments: Offer tax breaks and grants for tech adoption.
2. Digital Platform Development	Encourage investment in digital platforms for data sharing, collaboration, and decision-making.	Support knowledge-sharing, facilitate collaboration, and strengthen internal/external digital infrastructure.	Investors: Support companies that integrate robust digital platforms. Scholars: Investigate the impact of digital platforms on firm performance.
3. Financial and Resource Support for SMEs	Create dedicated funding and subsidies for SMEs to ease digital adoption.	Ensure that smaller firms can access essential digital technologies and participate in transformation.	Government Departments: Offer low-interest loans and subsidies. Investors: Prioritize investments in SMEs with digital transformation plans.
4. Skill Development and Training Programs	Partner with educational institutions to provide digital skills training in data analytics, AI, and IoT.	Equip employees with digital skills, fostering agility and readiness for transformation within firms.	Enterprise Management: Implement ongoing digital skills training. Government: Collaborate with institutions to fund training programs.
5. Dynamic Capability Building	Enhance firms' ability to sense opportunities, make agile decisions, and allocate resources effectively.	Strengthen dynamic capabilities to respond swiftly to market changes and leverage transformation for innovation.	Scholars: Explore links between dynamic capabilities and digital success. Enterprise Management: Integrate dynamic capability-building into strategic planning.
6. Public-Private Partnerships (PPP)	Foster collaboration between the government, industry, and academia for joint digital initiatives.	Drive co-development of digital technologies, share expertise, and create innovation hubs to promote sector-wide transformation.	Government Departments: Facilitate partnerships and create innovative hubs. Scholars: Study PPPs to derive best practices in digital transformation.
7. Regulatory Support and Data Security	Update regulations to support digital transformation while ensuring data privacy and security compliance.	Build a secure, enabling regulatory environment that fosters digital innovation while protecting stakeholders.	Government Departments: Ensure flexible but robust data protection laws. Enterprise Management: Align digital practices with new regulations.

5. Conclusions

This study explores the impact of digital transformation on the innovation performance of manufacturing enterprises, emphasizing the mediating role of dynamic capability. The findings reveal that digital transformation significantly enhances innovation performance, with regression results indicating a moderate positive correlation ($R = 0.511$) and accounting for 26.1% of the variance in innovation performance. Additionally, the analysis confirms the substantial role of dynamic capabilities in linking digital transformation to innovation, with dynamic capabilities partially mediating the relationship. This suggests that while digital transformation directly drives innovation performance, its influence is further amplified through improvements in dynamic capabilities.

Key insights include:

Digital Transformation and Dynamic Capabilities: Digital transformation positively impacts firms' ability to sense opportunities, make agile decisions, and integrate resources. This relationship explains 21.2% of the variance in dynamic capabilities, highlighting its importance in adapting to changing market environments.

Dynamic Capability as a Mediator: Incorporating dynamic capabilities into the model increased the explanatory power for innovation performance ($R^2 = 29.9\%$). Dynamic capabilities not only enhance firms' adaptability but also strengthen the link between digital transformation and innovation outcomes.

Policy Recommendations: A policy framework emphasizes promoting advanced technologies, financial support for SMEs, skill development programs, and public-private partnerships. It also underscores the importance of regulatory measures to safeguard data privacy and align with evolving digital transformation standards.

This research contributes to the literature by bridging gaps in understanding the mechanisms through which digital transformation influences innovation, particularly in manufacturing firms. By focusing on dynamic capabilities, it provides actionable insights for enterprises aiming to enhance competitiveness in the digital age. The proposed policy model offers a comprehensive approach for stakeholders, including businesses, governments, and investors, to collaboratively accelerate innovation and digital adoption in the manufacturing sector.

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