The Impact of Digital Capability on Firms' Environmental Performance: Evidence from China

Yihui Wu, Chuanqin Feng, Tiansen Liu*

Harbin Engineering University, Harbin Heilongjiang 150001, China
*tiansen0328@hrbeu.edu.cn

Abstract. In the context of digitalization, firms are facing many chances and challenges brought by digital transformation, all of which have an impact on their production and operation. This paper aims to delve into the impact of digital capabilities on environmental performance and explore the mediating effect of green innovation by analyzing the service-oriented manufacturers with 341 firms with some key findings. Digital collaboration capability significantly improves firms' environmental performance, while digital transformation and stakeholder pressure do not significantly improve environmental performance. Digital transformation, stakeholder pressure, and digital collaboration capability all enhance environmental performance by enhancing firms' green innovation. We suggest service-oriented manufacturers developing an in-depth digital transformation, enhancing digital collaboration capabilities, and establishing the digital channels for stakeholders.

Keywords: Digital transformation, Digital collaboration capability, Green innovation, Environmental performance, Service-oriented manufacturers

1 INTRODUCTION

The deterioration of ecological environment would not only influence human health and well-being, but also produce negative impacts on the economic and social spheres. In addition, society's environmental requirements for firms and their products are increasing, and consumers would consider the possible environmental pollution that may occur during the production and use of products. Against the backdrop of the 4th Industrial Revolution, the rapid development of technology has opened a new window for firms to achieve at green innovation through the application of digital technology. In today's booming digital economy, the academic research around the impact of digital transformation on firm performance mainly focuses on economic effects, with few perspectives on its impact on environmental performance. Thus this paper delves into the impact of digital transformation, digital collaboration capability, and stakeholder pressure on environmental performance at the firm and stakeholder levels, and explores the mediating role of green innovation. We aim to respond to the government's green call and then provide effective suggestions around alleviating environmental problems caused by service-oriented manufacturers and thus improve their environmental performance.

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2 LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

2.1 The Impact of Digital Transformation on Firm's Environmental Performance

From the technical perspective, the application of digital technology is the main feature of digital transformation, and digital technology itself is a clean technology [1]. Through this technology integration, firms can achieve efficient resource matching and channel optimization in multiple key links such as procurement, marketing, and logistics, and significantly reducing operating costs. From the perspective of environmental performance, by optimizing resource allocation and reducing operating costs, firms reduce unnecessary energy consumption and waste emissions, thereby reducing their impact on the environment. Thus we propose the following hypothesis:

H1: Digital transformation improves firms' environmental performance.

2.2 The Impact of Digital Collaboration Capability on Firm's Environmental Performance

Digital collaboration capability can accelerate the speed of knowledge flow and is one of the hierarchical approaches to promote digital transformation of small and medium-sized firms [2-3]. Its success factors include interdependence, trust, control, and leadership [4]. Digital collaboration capabilities help firms identify potential environmental risks more quickly through digital platforms and take corresponding measures to intervene, thereby reducing environmental pollution and resource waste. Within the framework of digital collaboration, firms can cross organizational boundaries and collaborate with other firms in the industry to develop green R&D and innovation activities. Thus we propose the following hypothesis:

H2: Digital collaboration capability improves firms' environmental performance.

2.3 The Impact of Stakeholder Pressure on Firms' Environmental Performance

Improving environmental performance by firms is actually in response to the growing demand for environmental legitimacy from external stakeholders [5]. In order to meet the pressure demands of stakeholders, improving environmental performance has become a key means for firms to showcase a good image and reputation. By actively improving environmental performance, firms can send positive signals to the outside world, thereby enhancing the positive perception and evaluation of their image by stakeholders. Thus we propose the following hypothesis:

H3: Stakeholder pressure improves firms' environmental performance.

2.4 The Mediating Effect of Green Innovation

In the early stages of green innovation, a large amount of cost investment is required, which makes many firms, especially small and medium-sized firms, hesitant due to the uncertainty of market prospects [6]. As for-profit institutions, firms often tend to enter the green innovation market based on reality rather than potential demand [7]. However, to avoid market loss, improve financial performance, and maintain firms' reputation, implementing green practices that can meet customer environmental expectations has become crucial [8]. Prior literature saw that digital transformation of firms mainly improves environmental performance by enhancing green technology innovation and firms' governance level [9]. The investment in digital infrastructure has driven the transformation of digital business models, induced firms to undergo adaptive changes, and thus improved their level of green technology innovation. Prior literature perceived the importance of stakeholders as one of important factors driving firms to adopt the green innovation strategy [10]. Thus we propose the following hypotheses:

H4a: Green innovation plays a mediating role in digital transformation and firms' environmental performance.

H4b: Green innovation plays a mediating role in digital collaboration capability and firms' environmental performance.

H4c: Green innovation plays a mediating role in stakeholder pressure and firms' environmental performance.

3 EMPIRICAL ANALYSIS

3.1 Samples

We survey 642 service-oriented manufacturers located in Jiangsu, Shanghai, Zhejiang, Anhui, and Shandong in China, and 341 sets of valid responses are obtained with the effective response rate of 53.12%. All respondents are top managers, covering private firms, collective firms, state-owned firms, sino foreign joint ventures, and foreign-funded firms. The absolute values of kurtosis and skewness of variables are close to 0, meeting the assumed normal distribution requirement. To avoid the homogeneity bias, the anonymity and confidentiality of questionnaires are emphasized during the distribution, and it is explained that the data is only for scientific research use. The homologous bias test was performed using Harman's single factor test. The results showed that four factors with eigenvalues greater than 1 were obtained without rotation, and the variation explained by the first factor was 39.02% (<40%), indicating that homologous bias was not severe and did not have a significant impact on the results of this paper.

3.2 Variables

We have measured digital transformation, digital collaboration capability, stakeholder pressure, green innovation, environmental performance based on prior recognized researches with 12 items, 4 items, 4 items, 5 items, 4 items, respectively [11-15].

3.3 Reliability and Validity Analysis

Cronbach's for each variable in the questionnaire α Cronbach's with values greater than 0.7 and corresponding terms of each variable removed α The values did not increase, and the CITC values of all indicators were greater than 0.4, indicating that the questionnaire has good internal consistency and high quality variable data, which can be used for further analysis. The sample chi square degree of freedom is 1.462, which is less than 3. The RMSEA value is 0.037, less than 0.05; The GFI value is 0.957, which is greater than 0.9; The CFI value is 0.957, which is greater than 0.9; The IFI value is 0.957, which is greater than 0.9 and meets the standard, indicating that the model has passed the structural validity test. The AVE values of each dimension are all above 0.36 and the CR values are all above 0.7. The correlation between each dimension and the item is good, and it has good convergent validity. Using the method of model fitting comparison, the fitting degrees between the original five factor model and the four factor, three factor, two factor, and single factor models were compared. The results showed that the original five factor model had the best fit of data compared to other adjusted models, indicating that all five scales involved in this paper have good discriminant validity.

3.4 The Structural Equation Model Analysis

The model fitting results are obtained by running the AMOS24.0 software as Table 1.

Table 1. Model Path Analysis Results

Path coefficient			Unstd.	S.E.	C.R.	P	std.(β)	R^2
F4	<---	F1	0.406	0.127	3.187	0.001	0.450	
F4	<---	F2	0.088	0.108	0.820	0.412	0.093	0.877
F4	<---	F3	0.419	0.108	3.880	***	0.450	
F5	<---	F1	0.004	0.205	0.017	0.986	0.004	
F5	<---	F2	0.339	0.150	2.260	0.024	0.344	0.700
F5	<---	F3	-0.212	0.215	-0.985	0.325	-0.218	
F5	<---	F4	0.752	0.344	2.188	0.029	0.720	

It is usually stipulated that the p-value is less than 0.05 and C.R. When the value is higher than the minimum standard of 1.96, it can be considered that the path coefficient is significant. By analyzing the model path in Table 1, it can be seen that digital transformation and stakeholder pressure have a significant positive impact on green innovation, and green innovation has a very significant positive impact on environmental performance. Digital collaboration capability has no significant impact

on green innovation, while it produces a significant positive impact on environmental performance. However, digital transformation and stakeholder pressure have no direct significant impact on environmental performance.

3.5 Testing the Mediating Role of Green Innovation

This paper uses the process plugin in SPSS 26.0 to test the mediating effect of green innovation on digital transformation, digital collaboration capabilities, stakeholder pressure, and environmental performance, with 5000 bootstrap sample sizes and a 95% confidence interval setting with the results as Table 2. Further, a robustness test by adjusting the PRI threshold has been done with the finding that compared to the initial path, the new path and its intensity of action maintain an overall unchanged trend.

Table 2. Testing the mediating role of green innovation

Path	Effect	Value	S.E.	LLCI	ULCI
DT→GI→EP	Total effect	0.677	0.047	0.583	0.770
	Direct effect	0.423	0.069	0.288	0.559
	Indirect effect	0.253	0.063	0.142	0.386
DCC→GI→EP	Total effect	0.559	0.045	0.472	0.647
	Direct effect	0.321	0.052	0.220	0.423
	Indirect effect	0.238	0.047	0.152	0.339
SP→GI→EP	Total effect	0.508	0.049	0.412	0.605
	Direct effect	0.181	0.060	0.064	0.299
	Indirect effect	0.327	0.049	0.236	0.426

Note: DT means digital transformation. GI means green innovation. EP means environmental performance. DCC means digital collaboration capability. SP means stakeholder pressure.

As shown in the table, at a 95% confidence interval, the total effect value of "DT→EP" is 0.677, indicating a significant positive correlation between the two. The indirect effect of green innovation on digital transformation and environmental performance is 0.253, and the bias corrected confidence interval does not include 0, indicating the existence of a mediating effect. Hypotheses H1 and H4a are validated. The total effect value of "DCC→EP" is 0.559, indicating a significant positive correlation between the two. The indirect effect of green innovation on digital collaboration capability and environmental performance is 0.238, and the bias corrected confidence interval does not include 0, indicating the existence of mediating effect. Hypotheses H2 and H4b are validated. The total effect value of "SP→EP" is 0.508, indicating a significant positive correlation between the two. The indirect effect of green innovation on stakeholder pressure and environmental performance is 0.327, and the bias corrected confidence interval does not include 0, indicating the existence of a mediating effect. H3 and H4c are validated.

4 CONCLUSIONS

We builds a theoretical model about how digital transformation, stakeholder pressure, and digital collaboration capability influence firms' environmental performance through green innovation with following key results. Digital transformation and stakeholder pressure do not significantly improve firms' environmental performance. Digital collaboration capability significantly improves environmental performance. Green innovation plays a mediating role among digital transformation, stakeholder pressure, digital collaboration capability, and environmental performance. This paper reveals the role path of digital transformation on firms' environmental performance from the perspective of stakeholders, and proposes the following implications for firms to improve environmental performance.

First, firms can increase their investment in digital transformation by setting up dedicated funds for digital investment and establishing cooperation with financial institutions based on the expected returns of the investment. Second, firms should strengthen cooperation with universities and training institutions, and offer courses related to digital transformation. In addition, firms can establish an integrated digital management platform to uniformly manage and analyze data from various links such as supply chain, production, sales, and customer service, and enact the optimization of digital management processes.

Second, firms should establish a strong sense of environmental responsibility and incorporate environmental protection concepts into their culture and core values. Then, through publicity and education, employees should be trained to have environmental awareness and responsibility, and encouraged to actively assume social responsibility together. Firms should also build a transparent environmental information disclosure mechanism and disclose their environmental protection measures to stakeholders.

REFERENCES

1. Verhoef, P.C., Broekhuizen, T., Bart, Y., et al.: Digital transformation: A multidisciplinary reflection and research agenda. Journal of Business Research 122, 899-901 (2021).
2. Nasiri, M., Saunila, M., Ukko, J., et al.: Shaping digital innovation via digital-related capabilities. Information Systems Frontiers, 25(3), 1063-1080 (2023).
3. Garzoni, A., De Turi, I., Secundo, G., et al.: Fostering digital transformation of SMEs: A four levels approach. Management Decision, 58(8), 1543-1562 (2020).
4. Young, A.G., Wigdor, A.D., Kane, G.C.: The gender bias tug-of-war in a co-creation community: Core-periphery tension on Wikipedia. Journal of Management Information Systems, 37(4), 1047-1072 (2020).
5. Steadman, M.E, Zimmerer, T.W.: Pressures from stakeholders hit Japanese companies. Long Range Planning, 28, 29-37 (1995).
6. Singh, S.K., Del Giudice, M., Jabbour, C.J.C.: Stakeholder pressure, green innovation, and performance in small and medium-sized enterprises: The role of green dynamic capabilities. Business Strategy and the Environment, 31(1), 500-514 (2022).
7. Kim, E.H.: Deregulation and differentiation: Incumbent investment in green technologies. Strategic Management Journal, 34(10), 1162-1185 (2013).

8. Golicic, L.S., Smith, D.C.: A meta-analysis of environmentally sustainable supply chain management practices and firm performance. Journal of Supply Chain Management, 49 (2), 78-95 (2013).
9. Xu, P., Chen, L., Dai, H.: Pathways to sustainable development: Corporate digital transformation and environmental performance in China. Sustainability, 15(1), 256 (2022).
10. Eiadat, Y., Kelly, A., Roche, F.: Green and competitive? An empirical test of the mediating role of environmental innovation strategy. Journal of World Business, 43(2), 131-145 (2007).
11. Chwelos, P., Izak, B., Albert, S.D.: Research report: Empirical test of an EDI adoption model. Information Systems Research, 12(3), 304-321 (2001).
12. Srivardhana, T., Pawlowski, S.D.: ERP systems as an enabler of sustained business process innovation: A knowledge-based view. The Journal of Strategic Information Systems, 16(1), 51-69 (2007).
13. Maletič, M., Maletič, D., Gomišček, B.: The impact of sustainability exploration and sustainability exploitation practices on the organisational performance: A cross-country comparison. Journal of Cleaner Production, 138(2), 158-169 (2016).
14. Buer, S., Jo Wessel S., Marco S., et al.: The digitalization of manufacturing: Investigating the impact of production environment and company size. Journal of Manufacturing Technology Management, 32(3), 621-645 (2020).
15. Li, L., Zhu, W., Wei L., et al.: How can digital collaboration capability boost service innovation? Evidence from the information technology industry. Technological Forecasting and Social Change, 182, 121830 (2022).