Original Research Article

How can the differentiation of the resource orchestration process help manufacturing enterprises achieve the corresponding green transformation model? ——Based on the fsQCA qualitative analysis method

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Abstract: Based on the fsQCA qualitative analysis method, this study explores how the differentiation of resource scheduling process can promote the green transformation of China's manufacturing enterprises to achieve different paths, and the results show that there are three paths that can enable manufacturing enterprises to achieve green transformation, namely: (1) a coordinated supply chain green integration model with external recognition as the core condition; (2) the multi-response green butterfly transformation model with value realization as the core condition; (3) The green integration model of the industrial chain with the incentive level and R&D intensity as the core conditions. In summary, this study not only enriches the research on the green transformation of enterprises by adopting different resource allocation methods in production activities and makes enterprises realize green transformation, but also provides some useful enlightenment for the upgrading of the green transformation of China's manufacturing enterprises under the current goal of "further deepening reform and promoting Chinese-style modernization".
Keywords: resource arrangement theory; green transformation; qualitative analysis; manufacturing enterprise

1. Introduction

On August 11, 2024, China issued the "Opinions on Accelerating the Comprehensive Green Transformation of Economic and Social Development," setting 2030 and 2035 targets for green development. Manufacturing enterprises face a dilemma: while green transformation is essential, many lack sustained motivation due to low technology levels, high costs, and resource constraints. However, some leading firms have successfully transformed through green innovation. Existing research largely follows the "environmental regulation–green innovation–performance" framework, focusing on institutional isomorphism rather than organizational heterogeneity or dynamic processes. Little attention has been paid to how firms' internal resource orchestration drives green transformation. To address this gap, this paper uses fuzzy-set qualitative comparative analysis (fsQCA) on 26 top Chinese manufacturing enterprises, examining dimensions such as incentive level, R&D intensity, external recognition, and value realization. Three pathways for achieving green transformation are identified, offering practical guidance for manufacturing firms seeking to leverage resource orchestration for green and high-quality development.

2. Literature review

Integrating the resource-based view and dynamic capabilities view, resource orchestration theory emphasizes the interaction between static resources and dynamic capabilities. Through three sub-processes—Structuring, bundling, and leveraging—Firms achieve value creation and competitive advantage. This theory also incorporates interactions with external stakeholders and provides an internal logic of "characteristics–capabilities–actions" for green transformation. Green transformation refers to a development model guided by green concepts, balancing economic and environmental performance through green innovation to achieve high-quality development. Existing research mainly focuses on the promoting or inhibiting effects of environmental regulation policies (e.g., green subsidies, credit, low-carbon pilot cities) as well as the models and value-added paths of green transformation. However, most studies are confirmatory and lack in-depth exploration of process mechanisms in specific contexts, especially micro-level evidence from Chinese enterprises. To address

this gap, this study adopts resource orchestration theory and focuses on the core question: how differences in resource orchestration processes enable manufacturing enterprises to achieve green transformation. Using fuzzy-set qualitative comparative analysis (fsQCA), it explores the internal mechanisms behind green transformation, aiming to overcome existing research limitations and provide theoretical and practical guidance for manufacturing enterprises.

3. Research design

This study adopts a configurational perspective based on resource orchestration theory, which comprises three co-evolving sub-processes—Resource structuring, bundling, and leveraging—To explain the "resources–capabilities–actions" transformation mechanism underlying green transformation. Fuzzy-set Qualitative Comparative Analysis (fsQCA) is employed because it examines combinations of factors (rather than individual ones) as conditions for outcomes, identifies necessity and sufficiency, and handles complementarity or substitutability among conditions, making it suitable for exploring complex, multi-factor phenomena. Four antecedent conditions are considered: incentive level, R&D intensity, external recognition, and value realization. To answer how manufacturing enterprises achieve green transformation, 26 enterprises were randomly selected from the 2023 Top 500 Chinese Manufacturing Enterprises list, meeting three criteria: (1) classified as manufacturing according to China's national standard; (2) have at least one certification from the Ministry of Industry and Information Technology's "Green Manufacturing System" (e.g., National Green Factory); (3) enterprises with more detailed information disclosure are prioritized. These cases span different industries, reflecting diverse greening pathways. Data sources include annual financial reports (2020–2022), enterprise technology center application materials, official websites, CNKI literature, and the Comprehensive Intellectual Property Information Service Platform for patent data. The outcome variable "green transformation" is measured based on corporate environmental performance, following the Ministry of Environmental Protection's guidelines. Using the four-point calibration method, membership scores of 0, 0.33, 0.67, and 1 are assigned to the fuzzy set according to corresponding criteria. This fsQCA approach, with 10–50 recommended cases, enables robust causal analysis combined with qualitative case insights, helping to reveal the deep mechanisms driving green transformation in Chinese manufacturing enterprises.

The specific assignment criteria for the condition variables are as follows:

Variable Name	Variable Measurement
Incentive Level	Government subsidy * 100 / Total assets. Government subsidy is calculated as non-operating income minus VAT refunds, and can also be obtained from the company's annual financial report (refer to Liu Tingting et al., 2019).
R&D Intensity	Technological innovation is mainly measured based on the research outcomes of Zou Caifen et al. A firm's R&D intensity reflects its level of technological innovation. R&D intensity = R&D investment / Operating revenue (both R&D investment and operating revenue are obtained from the company's annual financial report).
External Recognition	External recognition is measured by the degree of investor recognition (refer to Li Dong, Su Jianghua et al.). External recognition (investor recognition) = Paidin capital (LN).
Value Realization	Value realization (RN) = Net profit / Total assets.

Based on the above assignment criteria for outcome variables and condition variables, the raw data for each enterprise can be obtained. By using "variable → compute → calibrate" in fsQCA, the initial table is obtained as shown below:

name	Incentive Level	R&D Intensity	External Recognition	Value Realization	Green Transformation
Jinan Iron and Steel Group	0.01	0.28	0.41	0.5	0.67
Wanxiang Group	0.42	0.06	0.81	0.35	0.67
Haier Smart Home	0.5	0.04	0.42	0.23	1
ZHONGDA GROUP	0.06	0.96	0.57	0.35	0.67
Aluminum Corporation of China Limited (CHALCO)	0.65	0.34	0.28	0.35	0.67
Jiangxi Copper Corporation	0.94	0.94	0.7	0.43	0.67
Hangzhou Iron and Steel Group	0.91	0.45	0.81	0.59	0.33
Dongfeng Motor Corporation	0.29	0.11	0.91	0.5	0.67

Continuation Table

name	Incentive Level	R&D Intensity	External Recognition	Value Realization	Green Transformation
China Huaneng Group	0.29	0.8	0.08	0.84	1
Shanghai Construction Group	0.04	0.11	0.43	0.95	0.33
HBIS Group	0.08	0.26	0.23	0.87	0.33
China National Building Material Group (CNBM)	0.06	0.11	0.26	0.35	0.67
Shougang Group	0.96	0.67	0.84	0.95	0.67
Transfar Group	0.7	0.5	0.85	0.5	0.33
Nanshan Group	0.23	0.17	0.95	0.45	0.33
Sichuan Huaxi Group	0.08	0.96	0.93	0.82	0.67
Hailiang Group	0.81	0.94	0.14	0.38	0.67
Muyuan Industrial Group	0.01	0.67	0.5	0.15	0.67
Yuntianhua Group	0.29	0.85	0.92	0.04	0.33
Huatai Group	0.08	0.26	0.95	0.43	0.67
Sinochem Holdings Corporation Ltd.	0.93	0.94	0.04	0.89	0.67
Aviation Industry Corporation of China (AVIC)	0.93	0.11	0.01	0.72	0.67
China Nonferrous Metal Mining (Group) Co., Ltd. (CNMC)	0.5	0.89	0.97	0	0.67
China Information and Communications Technology Group (CICT)	0.65	0	0.37	0.72	1
Fujian Energy and Petrochemical Group	0.65	0.85	0.37	0.96	0.33
Baotou Iron and Steel (Group) Co., Ltd.	0.96	0.8	0.29	0.64	0.67

4. Results and findings

Focusing on the core issue of how local manufacturing enterprises, based on resource orchestration theory, achieve green transformation through self-adjustment in the process of development, as well as the pathways and typical models for achieving green transformation, the fsQCA software was used to perform fuzzyset operations on the data obtained from the 26 enterprises in the above initial table. The statistical results are as follows.

4.1. Necessary condition analysis

Conduct a necessary condition analysis with "green transformation" as the outcome variable.

Analysis of Necessary Conditions Outcome variable:Green transformation

Conditions tested	Consistency	Coverage
Incentive level	0.577043	0.768911
~Incentive level	0.635683	0.729420
R&D intensity	0.623830	0.765111
~R&D intensity	0.625078	0.774942
External recognition	0.640674	0.731481
~External recognition	0.625078	0.837793
Value realization	0.681223	0.782235
~Value realization	0.650655	0.866279

Conduct a nonnecessary condition analysis with "green transformation" as the outcome variable.

Analysis of Necessary Conditions Outcome variable: ~Green transformation

Conditions tested	Consistency	Coverage
Incentive level	0.620863	0.514461
~Incentive level	0.721164	0.514748
R&D intensity	0.708225	0.540203
~R&D intensity	0.691976	0.533607
External recognition	0.805416	0.571896
~External recognition	0.621866	0.518438
Value realization	0.838616	0.598797
~Value realization	0.694985	0.575642

Necessary condition analysis shows all consistency values <0.9, indicating no single condition (incentive, R&D, recognition, value) is necessary for green transformation.

4.2. Sufficiency condition analysis

In fsQCA, a sufficiency condition is a combination enabling green transformation. With frequency threshold 3 and consistency 0.8, three solutions are generated: complex, parsimonious, and intermediate. The intermediate solution, balancing reasonableness and complexity, is preferred for identifying pathways (core/peripheral conditions) to green transformation. Pathways for enterprises to achieve "green transformation".

Model	1	2	3
Condition Variables			
Incentive Level	⊗	⊗	●
R&D Intensity	⊗	●	⊗
External Recognition	●	⊗	⊗
Value Realization	⊗	●	⊗
Consistency	0.918133	0.860545	0.89029
Raw coverage	0.230755	0.0462258	0.13849
Unique coverage	0.419775	0.250218	0.263256
Solution coverage:	0.627573		
Solution consistency:	0.85038		

Note:● = presence of the condition (core condition in the intermediate solution)

⊗= absence of the condition (core absence in the intermediate solution)

The fsQCA analysis shows overall solution coverage of 0.63 and consistency of 0.85, indicating three valid pathways for manufacturing enterprises to achieve green transformation.Coordinated Supply Chain Green Integration Model: Driven by external recognition, enterprises integrate supply chain actors via green R&D and empowerment, achieving green process and product innovation.Multi-Response Green Metamorphosis Model: Driven by value realization (with incentive, R&D, recognition as peripheral), enterprises align with government and customer demands, building green manufacturing and value co-creation capabilities.Industrial Chain Green Integration Model: Driven by incentive level and R&D intensity, enterprises pursue deep industrial chain integration through coupled resource orchestration, enabling process, product, and collaborative innovation. Managers increasingly recognize that green strategy shapes overall business models, critical under China's dual-carbon goals.

5. Conclusion and implications

This study examines how Chinese manufacturing enterprises achieve green transformation under dual-carbon goals. Using fsQCA with four conditions (incentive level, R&D intensity, external recognition, value realization), three pathways are identified: (1) coordinated supply chain green integration (external recognition as core), (2) multi-response green metamorphosis (value realization as core), and (3) industrial chain green integration (incentive and R&D as core). The configurational approach overcomes fragmented findings from single-dimension studies and integrates resource orchestration theory ("structuring–bundling–leveraging") to reveal the "resource–capability–action" mechanism. Practical implications: managers should adopt diversified green innovations, coordinate stakeholder co-creation, and value smart manufacturing; policymakers should accelerate green manufacturing systems, provide differentiated support, and build information platforms. Limitations include measurement difficulties, sample restrictiveness (top 500 enterprises), and limited generalizability, calling for future large-sample empirical testing.

References

[1] Liu, X. (2014). Research on Chadwick's Internet political thought [Master's thesis]. Liaoning University.

[2] Jia, Y., Su, J. (2024). How does the strategic logic of hidden champion enterprises evolve in dynamic contexts? A longitudinal case study based on attention allocation perspective. Science of Science and Management of S.& T., 45(9), 104-121.

[3] Su, J., Jia, Y. (2018). Current status, application prospects and contextual depth of business administration case studies in China. Chinese Journal of Management, 15(6), 791-802.

[4] Zuo, Q. (2023). Su Taoyong: The "Student+" model of Tongji SEM. Manager, (8), 42-45.

[5] Zhu, J., Qu, X., Han, H., et al. (2024). Digital transformation and financial control innovation: An exploratory case study based on State Grid. Management World, 40(2), 172-192.

[6] Liu, H., Liu, Y., Huang, T. (2023). The process mechanism of digital technology driving high-end disruptive innovation: An exploratory case study. Management World, 39(7), 63-81,99,82.

[7] Du, Y., Liu, Q., Chen, K., et al. (2022). Business environment ecology, total factor productivity and multiple patterns of high-quality urban development: A configurational analysis based on complex systems perspective. Management World, 38(9), 127-145.

[8] Cheng, J., Liu, Q., Du, Y. (2023). Entrepreneurial ecosystem and national entrepreneurial growth aspiration: A mixed study based on NCA and fsQCA methods. Science of Science and Management of S.& T., 44(3), 80-97.

[9] Lan, S. (2025). Research on the influence mechanism of corporate innovation ecosystem environment shaping strategy on key core technology breakthroughs [PhD dissertation]. Xi'an University of Technology.

[10] Tu, J. (2022). Research on the motivation and outcomes of corporate green innovation [PhD dissertation]. Wuhan University.

[11] Zhi, Y., Qin, T. (2025). The impact of green credit on corporate green transformation: From the perspective of long-term and short-term effects. Jiangsu Commercial Forum, (12), 83-87,109.

[12] Yin, J., Gao, X. (2025). The relationship between corporate digital transformation and green innovation: A meta-analysis based on the TOE framework. Journal of Technology Economics, 44(11), 49-65.