Frontiers in Business, Economics and Management
ISSN: 2766-824X | Vol. 22, No. 3, 2026

Construction of Enterprise Operational Resilience for Sustainable Development: Data Perspective and Practical Implications

Yubing Su

School of business, University of Leeds, Leeds LS2 9JT, UK

Abstract: Under the multiple backgrounds of global geopolitical conflicts, supply chain fluctuations and the deepening of the "dual carbon goals", the coordinated promotion of enterprise operational resilience and sustainable development has become the key to survival and development. As a new production factor, data provides technical support and practical pathways for the deep integration of the two. From the perspective of data, this paper analyzes the internal relationship between enterprise operational resilience and sustainable development, reveals the core logic of data-driven resilience construction, combs the practical directions such as supply chain collaboration, production optimization, and ecological linkage, analyzes the practical obstacles such as data silos, compliance costs, and talent gaps, and extracts implications from the real practice of the industry. Research shows that data-lifecycle management can effectively improve enterprise risk resistance and resource utilization efficiency, provide feasible solutions for enterprises to achieve the dual goals of "risk resistance" and "green transition or green development", and provide references for the transformation of enterprises of different sizes and industries.

Keywords: Enterprise operational resilience, sustainable development, data-driven, practical pathways, data governance.

1. Introduction

At present, the global economic environment is complex and changeable, geopolitical conflicts exacerbate the fragmentation and uncertainty of the global supply chain, extreme weather events occur frequently, regional trade barriers intensify, further amplify operational risks, raw material prices fluctuate violently, environmental regulations continue to strengthen and other multiple pressures are intertwined and superimposed, from the shortage of chips in the manufacturing industry, the energy crisis to the inventory backlog and demand iteration in the retail industry, the survival and development of enterprises are facing an all-round and multi-dimensional survival test. Enterprises should not only have the resilience to resist sudden risks and quickly resume operations, but also practice the sustainable development responsibility of energy conservation and emission reduction and ecological protection. The balance between the two has become a key indicator to measure the core competitiveness of enterprises. The two are not separated from each other, but a unity of mutual support and synergy - sustainable development provides long-term value guidance for resilience construction, and operational resilience builds a solid foundation for sustainable development [1]. In this context, it is difficult to deal with complex challenges simply relying on traditional empirical management. Data-driven has become the key path to solve the problem of synergy between resilience and sustainable development. As the core link to break information barriers and optimize resource allocation, data plays an increasingly important role in building resilience. According to the Report on the Development of Digital Transformation of the Manufacturing Industry issued by the Ministry of Industry and Information Technology (MIIT) in 2023, only 31.5% of China's manufacturing enterprises have realized the digital collaborative management of operational resilience and sustainable development, while the risk recovery cycle of data-driven enterprises is 38.7% shorter than that of traditional enterprises on average. The efficiency of resumption of work and production after the epidemic is 35% higher in the manufacturing industry and 28% higher in the service industry [2]. Based on the real practice of enterprises and authoritative industry data, this paper systematically discusses the implementation path and practical challenges of the construction of operational resilience from the perspective of data, and provides practical reference for enterprises of different sizes and industries to balance short-term risk response and long-term sustainable development.

2. Internal Relationship and Data Value Between Enterprise Operational Resilience and Sustainable Development

Enterprise operational resilience focuses on the ability of rapid recovery and dynamic adjustment under sudden disturbances, covering a variety of risk response scenarios such as supply chain disruption, sudden changes in market demand, and extreme disaster shocks. Sustainable development takes efficient recycling of resources, minimization of environmental impact, and collaborative symbiosis of social value as its long-term goals. The two are not isolated development dimensions [3]. The core of the synergy between the two is to promote enterprises to steadily promote green and low-carbon transformation and achieve a balance between short-term survival and long-term development on the basis of resisting short-term sudden risks and ensuring operational continuity. At the moment when the digital transformation is in-depth promoted, data, as a new type of production factor, has its penetrating enabling characteristics, making it a key bridge connecting the two, providing accurate support for the implementation of collaborative goals. The core value of data is embodied in three dimensions: first, the value of situational awareness,

which realizes real-time monitoring of risks and environmental impacts through full-chain data collection. For example, a new energy vehicle enterprise monitors the battery operation status in real time through the connected vehicle data, and early warns the failure risk, which not only reduces the probability of product recall, but also reduces the waste of resources; The second is the value of resource optimization. With the help of data analysis, the precise allocation of production, logistics, energy consumption and other links can be achieved. By establishing a carbon emission data statistics and assessment system, CNPC reduced COD emissions by 12.8% in 2023 compared with the previous year, and the general industrial solid waste recycling volume reached 96,000 tons [4]; The third is collaborative linkage value, which breaks down the barriers of the industrial chain through data sharing and forms a resilient ecosystem across enterprises and industries. From the perspective of industry practice, enterprises with excellent performance in the environmental dimension (E) of ESG rating generally have stronger operational resilience. With the continuous green transformation practice, China's Big Three Oil Companies (PetroChina, Sinopec and CNOOC) have all obtained ESG AA or above ratings, showing stronger resilience in the supply chain fluctuations in recent years, further confirming the deep synergy effect of the two under the data drive [5, 6].

3. The Core Logic of Data-Driven Enterprise Operational Resilience Construction

The empowerment of data on operational resilience is not simply the superposition of technical tools, but a systematic change deeply integrated into the whole process of operation [7]. Through the closed-loop management of the whole life cycle of "acquisition-analysis-application", the core decision logic of enterprise risk response and resource allocation is reconstructed. In the data collection link, it is necessary to take the business scenario as the guidance, rely on the Internet of Things (IoT), RFID and other sensing technologies to achieve full-chain and gap-free data coverage. The networking rate of intelligent factory equipment of Ningxia DaBeiNong Technology Group is more than 95%, and has accurately built the full-chain data collection system of "raw and auxiliary material procurement - production and processing - warehousing and logistics", so as to lay a solid data foundation for the construction of resilience. In the data analysis section, algorithm models are used to deeply mine the data value to achieve accurate risk early warning and dynamic optimization of resources. The steam turbine plant of Shanghai Electric Power Station uses the digital production system to analyze the equipment operation data and generate the optimal processing path, which reduces the waiting time of equipment by 41% and the production energy consumption by 16% [8]; Hongbulin, a second-hand e-commerce platform, built a dynamic pricing algorithm through user behavior and market supply and demand data, which increased the commodity circulation rate by 38%, significantly improving its resistance to market demand fluctuations. The data application link focuses on real-time response and continuous iterative optimization. Zara, a fast fashion brand, quickly adjusts its product design and production plan based on store trial and sales data, reducing the new product development cycle from 90 days in the traditional industry to 45 days, realizing the agile response of the supply chain; CNOOC has optimized the layout of clean energy by integrating the operation data of wind power and carbon capture and storage (CCS) projects. The annual carbon reduction in 2023 is more than 80000 tons [4], taking into account both the improvement of operational resilience and the goal of green development. These three links are linked and dynamically iterated to form a complete enabling closed loop, enabling enterprises to quickly adjust their operation strategies and adhere to the long-term bottom line of sustainable development in the face of various sudden disturbances.

4. Practice Direction of Resilience Construction from The Perspective of Data

4.1. Supply Chain Resilience: Data Collaboration Breaks Link Barriers

By building an industrial chain data sharing platform, the demand docking, inventory linkage and risk sharing of upstream and downstream enterprises are enabled. The steel industry chain collaboration platform built by Nanjing Iron and Steel Group and China Mobile has integrated more than 6100 data resource tables and more than 900000 industrial sensor data points to achieve full-link collaboration, reducing the overall operating cost of the industry chain by 2.8% and improving the order response speed by 18%(National Data Administration, 2025, Typical Case of Nangang & China Mobile Steel Industrial Chain Collaborative Smart Operation Platform, https://www.nda.gov.cn/sjj/zhuanti/ztsjysx/ds/0103/20250103134417146345286_pc.html); Alibaba International Station analyzed the global logistics and market demand data through AI algorithm, optimized the overseas storage layout, reduced the cross-border delivery time from an average of 15 days to 7 days, reduced logistics costs by 19%, and significantly enhanced the anti-disturbance ability of the cross-border supply chain.

4.2. Production and Operational Resilience: Data Optimization Gives Consideration to Efficiency and Green

The data monitoring and optimization module is implanted in the production process to achieve the dual goals of improving quality and efficiency and energy conservationand emission reduction. Guangming Dairy optimized the pasteurization process by deploying Artificial Intelligence (AI) temperature control system, and accurately adjusted the sterilization temperature from 85 ℃ to 75 ℃. On the premise of ensuring product quality, the production energy consumption decreased by 8.7%, while retaining more milk active substances(Guangming Dairy Co., Ltd., 2023, "2023 Sustainable Development Report", disclosed by the Shanghai Stock Exchange, https://www.sse.com.cn/disclosure/listedinfo/announcement/c/new/2024-04-29/600597_20240429_0W10.pdf); Black Lake Technology's "digital factory customization solutions" aimed at the pain points of small and medium-sized manufacturing enterprises, optimized the production process through data integration, and shortened the process preparation time by 58%. A food processing enterprise realized cross-workshop capacity scheduling with the help of this solution, and the response speed of sudden orders increased by 2.8 times, which not only improved the

production flexibility, but also reduced the idle resources [9].

4.3. Ecological Synergy Resilience: Data Circulation to Build a Symbiotic Network

Relying on the data platform to promote the collaborative linkage of industrial chains and regional ecology, and form a resilient ecology of "prosperity for all". The "Digital Intelligence Building Revitalization" Project in Suqian City, Jiangsu Province integrates the data of enterprise settlement, energy consumption, logistics supporting facilities and other data of 57 commercial buildings, builds a regional industrial data platform, guides the clustering of upstream and downstream enterprises in the industrial chain, increases the occupancy rate of idle buildings to 95%, and constructs a virtuous cycle of "data guiding industry and industry nourishing data"; Through the supplier collaboration platform [10], DaBeiNong Group brings local raw material suppliers and logistics service providers into the digital ecosystem, realizes real-time sharing of supply and demand data, reduces inventory backlog and logistics waiting time, and promotes the upgrading of enterprise resilience to industrial chain resilience.

5. Realistic Obstacles to The Construction of Data Enabled Resilience

5.1. Prominent Data Silos

IDC's global data management trends report in 2023 shows that 71% of China's small and medium-sized enterprises (SMEs) have the problem of data silos, and the data integration rate of financial, production, inventory and other business systems is less than 38% [11, 12]. The formation of this problem is closely related to the lack of overall planning for the early informatization construction of enterprises and the independent deployment of various systems. A small and medium-sized hardware-accessory manufacturing enterprise failed to realize data linkage between production and inventory systems, resulting in the backlog of unsalable products of more than 900,000 yuan, and the shortage rate of popular accessories reached 14%, seriously weakening the operational resilience. Even for large enterprises, there are problems such as business fragmentation caused by departmental parochialism, inconsistent data standards and incompatible formats, which make it difficult to carry out cross-link data integration and analysis effectively.

5.2. Double Pressure of Compliance Cost and Safety Risk

Since the implementation of The Data Security Law and The Personal Information Protection Law, the data compliance requirements of enterprises have been continuously improved, and the expenditures for technology system upgrading, compliance system construction, professional training and so on constitute a significant operational burden. The deployment cost of encryption, security audit and other systems in data-intensive industries can reach millions of yuan. Due to the weak financial strength of SMEs, the proportion of compliance costs in revenue is higher; According to the 2023 data security risk report of the China Academy of Information and Communications Technology (CAICT), 36.8% of enterprises listed data security as the main concern of digital transformation. Data leakage not only caused direct economic losses, but also damaged brand reputation and customer trust [13, 14].

5.3. Talent and Ability Gaps Constraining Implementation

According to the statistics of the Ministry of Industry and Information Technology (MIIT) in 2023, the talent gap of data analysts, data operators and other related professionals in China reached 2.1 million, and the shortage of talents in SMEs was particularly prominent [2]. 67% of SMEs lack professional data management and analysis talents, 53% of the core operation processes still rely on manual decision-making, and the error rate of data processing is 14%; Some enterprise managers' digital cognition is insufficient. 64% of small and medium-sized enterprise managers are still accustomed to empirical decision-making, and their cognition of data value is not deep enough. In addition, the talent training cycle is long, which further restricts the implementation and promotion of data-driven operational resilience system [15].

6. Practical Implications from Typical Practice

6.1. Enterprise Level: Build A "Lightweight, Scenario-Based" Data Application System

SMEs can learn from the "modular data platform" mode of DaBeiNong Group, without the need to completely rebuild the digital system. Combined with their own business pain points, they can choose core scenarios such as intelligent warehousing, quality traceability, energy consumption monitoring, and implement them step by step to reduce the threshold and cost of transformation [15]; Large enterprises should focus on the whole-chain data integration, such as the lake-warehouse integrated data platform of Nanjing Iron and Steel Group, to achieve the unified management of 83% of the core business data, and shorten the data application development cycle by more than 48%. At the same time, the data application needs to be deeply bound with the business scenario. For example, Guangming Dairy focuses on the full-chain data traceability of "pasture breeding - production processing - logistics distribution", which not only improves the resilience of the supply chain, but also ensures the green safety of products.

6.2. Industry Level: Relying on "Chain Leader Enterprises" to Create Collaborative Data Ecology

Encourage core enterprises in the industrial chain to open data capabilities and technical resources, and drive the digital transformation of small and medium-sized supporting enterprises. Haizhi Online, an industrial Internet platform, connects 700000 factories and 280000 global buyers online, analyzes supply and demand data through the Artificial Intelligence (AI) matching system, which improves the sourcing efficiency of enterprises by 13 times and provides low-cost data services for SMEs; Steel, retail, logistics and other industries can refer to the practice of Nanjing Steel and Alibaba International Station to build an industry-level data sharing platform, formulate unified data standards, and realize risk prevention, resource sharing and collaborative development within the industry.

6.3. Policy Level: Strengthen Data Element Guarantee and Support

Further improve the data property rights system and data security compliance guidelines, clarify the data circulation boundary and rules, and reduce the institutional cost of enterprise data circulation [16]; In view of the shortage of funds and talents for the digital transformation of SMEs, special skills training plans and financing support policies were launched, echoing 53.7% of the policy communication needs of SMEs and 51.9% of the financing demands [16]; Promote Suqian "Digital Intelligence Building Revitalization" Project and other public data application cases, promote the safe and orderly sharing of public data and enterprise data, and provide public data support for the construction of enterprise operation resilience.

7. Conclusion

The essence of the construction of enterprise operational resilience for sustainable development is to realize the deep synergy and unity of risk resistance and long-term value growth through the efficient configuration and full-chain empowerment of data elements. Data can not only accurately improve the perception and response speed of enterprises to sudden disturbances such as market fluctuations and supply chain disruptions, but also become the core link between short-term resilience improvement and long-term sustainable development by optimizing the efficiency of resource recycling and reducing the pressure on the environment. This logic has been fully verified in the practice of steel, food, new energy and other industries. At present, although enterprises are faced with practical constraints such as low efficiency of collaboration, coexistence of compliance costs and security risks, and shortage of professionals caused by data silos, typical practices such as Nanjing Iron and Steel's industrial chain data collaboration, Bright Dairy's production data optimization, and DaBeiNong's modular transformation have proved that the above problems can be effectively solved by building a scenario data application system, creating an industrial chain collaborative ecosystem, and improving the data governance mechanism. In the future, enterprises need to deeply embed the data strategy into the core development plan. SMEs can use the industrial Internet platform to achieve lightweight transformation. Large enterprises play a leading role in the chain to lead ecological collaboration. With the support of the national data element marketization reform policy, a sustainable virtuous cycle of "data-driven resilience improvement, resilience-guaranteed sustainable development, and development nurtured data governance" will be formed. Only in this way can enterprises stand firm and grow steadily in the complex and volatile market environment, and inject lasting power into high-quality economic development and the implementation of "dual carbon goals".

References

[1] Duchek S. Organizational resilience: a capability-based conceptualization [J]. Business research, 2020, 13(1): 215-246.

[2] Ministry of Industry and Information Technology of the People's Republic of China. Report on the Development of Digital Transformation in the Manufacturing Industry [R]. Beijing: Ministry of Industry and Information Technology, 2023.

[3] Negri M, Cagno E, Colicchia C, et al. Integrating sustainability and resilience in the supply chain: A systematic literature review and a research agenda [J]. Business Strategy and the environment, 2021, 30(7): 2858-2886.

[4] China National Petroleum Corporation. 2023 Social Responsibility Report [R]. Beijing: China National Petroleum Corporation, 2024.

[5] Zhang M, Huang Z. The impact of digital transformation on ESG performance: The role of supply chain resilience [J]. Sustainability, 2024, 16(17): 7621.

[6] MSCI Inc. 2023 Global ESG Ratings Report [R]. New York: MSCI Inc., 2023.

[7] Zamani E D, Smyth C, Gupta S, et al. Artificial intelligence and big data analytics for supply chain resilience: a systematic literature review [J]. Annals of Operations Research, 2023, 327(2): 605-632.

[8] Vatankhah Barenji A, Liu X, Guo H, et al. A digital twin-driven approach towards smart manufacturing: reduced energy consumption for a robotic cell [J]. International Journal of Computer Integrated Manufacturing, 2021, 34(7-8): 844-859.

[9] Kim H. Performance from building smart factories of small- and medium-sized enterprises: The moderating effects of product complexity and company size [J]. International Journal of Operations & Production Management, 2022, 42(10): 1497-1520.

[10] Mishra R, Singh R K, Subramanian N. Impact of disruptions in agri-food supply chain due to COVID-19 pandemic: contextualised resilience framework to achieve operational excellence [J]. The International Journal of Logistics Management, 2022, 33(3): 926-954.

[11] Onoja, J. P., Hamza, O., Collins, A., Chibunna, U. B., Eweja, A., & Daraojimba, A. I. (2021). Digital transformation and data governance: Strategies for regulatory compliance and secure AI-driven business operations. J. Front. Multidiscip. Res, 2(1), 43-55.

[12] International Data Corporation (IDC). Smarter Data Management Playbook 2023 (Asia Pacific Edition) [R]. Needham, Massachusetts: International Data Corporation, 2023.

[13] Wang, P., D'Cruze, H., & Wood, D. (2019). ECONOMIC COSTS AND IMPACTS OF BUSINESS DATA BREACHES. Issues in Information Systems, 20(2).

[14] China Academy of Information and Communications Technology (CAICT). 2023 Data Security Risk Report [R]. Beijing: China Academy of Information and Communications Technology, 2023.

[15] Omrani N, Rejeb N, Maalaoui A, et al. Drivers of digital transformation in SMEs [J]. IEEE transactions on engineering management, 2022, 71: 5030-5043.

[16] Rupeika-Apoga R, Bule L, Petrovska K. Digital transformation of small and medium enterprises: Aspects of public support [J]. Journal of Risk and Financial Management, 2022, 15(2): 45.