

The Obstacle Factors and Optimization Path of the Operation Efficiency of Third-party Logistics Enterprises under the Background of Digital Intelligence Transformation

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Abstract

In 2025, China's total social logistics volume hit 368.2 trillion yuan, with the ratio of total social logistics costs to GDP dropping below 14% for the first time. While the logistics industry has achieved phased success in cost reduction and efficiency improvement, traditional cost cutting approaches yield diminishing marginal returns. Besides, industry differentiation is increasingly prominent: leading enterprises have harvested fruits from digital transformation, yet most small and medium-sized third-party logistics (3PL) enterprises remain in exploratory transformation. Taking these SMEs as the research subject, this paper identifies four core barriers hindering operational efficiency during digital and intelligent upgrading: misalignment between technology adoption and business scenarios, data silos and poor system coordination, inadequate organizational capability and talent shortage, as well as mismatched resource input and expected returns. These barriers interact with each other and create a self-reinforcing vicious cycle: inefficient investment further reduces enterprises' willingness to invest. Accordingly, this study proposes three optimization paths, including lightweight deployment priority, scenario-driven implementation and progressive iteration. The findings can provide theoretical support for the digital transformation of small and medium-sized 3PL enterprises.

Key words

third party logistics; digital intelligence transformation; operational efficiency; obstacle factors

1. Introduction

China's total social logistics volume hit 368.2 tril-

lion yuan in 2025. The ratio of total social logistics costs to GDP fell to 13.9%, dropping below 14% for the first time [1]. This figure proves that the logistics industry

has achieved clear results in cutting costs and boosting efficiency. Even so, it also indicates that the traditional development model - which reduces costs by saving labour, transportation and warehousing expenses - is nearly reaching its ceiling. The industry must find new approaches to improve operational efficiency.

Digital and intelligent transformation is widely regarded as a key way for logistics firms to raise operational efficiency. From the perspective of dynamic capability theory, digital technologies help enterprises adapt to complex and volatile market environments. Building agile operation capabilities has become the core goal of logistics digital upgrading [2]. Nevertheless, digital technologies and IT infrastructure cannot directly bring better business performance. To generate real value, enterprises need internal absorptive capacity to make good use of digital resources and activate supply chain agility, so as to optimize operations and lift performance [3]. When operating in an uncertain environment, supply chain collaboration can further strengthen the agility brought by information systems [4].

However, most existing studies centre on large logistics groups. Few papers explore the difficulties small and medium-sized 3PL enterprises meet during transformation. These SMEs make up over 90% of players in the logistics market, but they lag far behind leading enterprises in digital development. Large logistics companies can achieve tangible performance gains through sustained digital investment. In comparison, many small and medium-sized logistics firms face shared troubles. Even after buying automated equipment, they fail to achieve high utilization rates. Disconnected information systems also lead to data silos after implementation. These problems keep widening the performance gap within the industry.

Against such a backdrop, it is of great theoretical and practical significance to identify transformation barriers for small and medium-sized 3PL enterprises and formulate targeted solutions. This paper uses literature analysis and multi-case comparative research to sort out major transformation obstacles, analyse how these barriers interact with one another, and put forward optimization paths suitable for the resource endowments of logistics SMEs.

2 The Status Quo of Third-Party Logistics Enterprises' Digital Intelligence Transformation

The digital transformation of the third-party logistics industry is currently pushed forward by two types of driving forces. First, the ' 15th Five-Year ' logistics planning lists the construction of digital supply chain as a key task. Second, the Internet of Things, automation equipment, intelligent algorithms and other technologies are becoming more and more mature, and the application threshold is gradually reduced. In 2025, the transportation cost will be 10.6 trillion yuan, the storage cost will be 6.5 trillion yuan, and the management cost will be 2.4 trillion yuan, which will increase by 3.5 %, 3.1 % and 0.7 % respectively compared with the same period last year, and the operation efficiency of the industry will continue to improve [1].

Large logistics enterprises can construct systematic transformation frameworks supported by sufficient capital, standardized workflows and professional talent teams[5]. However, most SMEs suffer from weak information infrastructure, insufficient data accumulation and unclear transformation objectives. As a result, the industry presents a pattern where competitive gaps keep expanding between strong and weak players. Existing studies highlight that digital transformation is not a simple technical update, but requires synchronous optimization of organizational processes and decision-making mechanisms to deliver practical value [6]. Due to inherent structural limitations at the organizational level, SMEs cannot directly copy the transformation modes adopted by large logistics corporations. Resource-constrained logistics SMEs are inherently incapable of deploying heavy-asset, large-scale digital transformation solutions designed for industry giants [7].

3 Obstacle Factors and Mechanism of Mathematical Intelligence Transformation

3.1 Technology Application is out of Touch with Business Scenarios

Whether transformation delivers expected results

depends on how deeply technology integrates with business scenarios, rather than how advanced the adopted systems are [8]. During procurement of technical services, many SMEs lack systematic evaluation of internal business workflows. The technical solutions they finally purchase often fail to match real operational demands.

This barrier manifests in two typical forms. On one hand, equipment selection fails to adapt to business characteristics. Some SMEs blindly follow large firms to purchase automated facilities. Nevertheless, their core businesses are dominated by small-batch, multi-frequency orders, which leads to extremely low equipment utilization. Currently, light and scattered shipments have become the mainstream demand in the logistics market. Such market changes require flexible service solutions, rather than relying solely on large-scale automated equipment. Another prominent problem is the mismatch between system functions and actual on-site operations. After enterprises adopt Transportation Management Systems (TMS) and Warehouse Management Systems (WMS), many frontline employees still prefer manual recording instead of using digital systems. This situation is mainly caused by overly cumbersome system operating procedures. As a result, system data cannot match real operational situations, making digital platforms mere formal tools with little practical value. In fact, effective digital transformation depends on system designs that adapt to real workflow needs, instead of the blind introduction of advanced software and hardware.

3.2 Data Island and Lack of System Coordination

Unimpeded data flow among all supply chain participants is the basic prerequisite for operational efficiency improvement. Existing research on supply chain digitalization points out that IT capabilities can only be transformed into competitive advantages with the support of cross-department and cross-enterprise information coordination and relationship management [9]. Simply deploying independent and isolated systems cannot create practical value. For digital logistics operations, data exchange and system interoperability are the core drivers of efficiency growth.

Small and medium-sized 3PL enterprises mainly face two major obstacles in data connectivity. In terms of internal operations, their transportation, warehousing

and financial management systems are usually purchased from different service providers. Inconsistent data formats and incompatible system interfaces lead to serious data islands within enterprises. Different departments have to rely on manual Excel data reconciliation, which greatly reduces operational efficiency. In terms of external cooperation, most small and medium-sized logistics enterprises are incapable of building stable data sharing mechanisms with upstream and downstream partners. Without effective data support, enterprises cannot optimize core operational indicators, such as vehicle empty load rates and warehouse utilization rates.

Relevant empirical studies have proven that cross-enterprise information integration and supply chain data sharing can eliminate operational frictions and effectively improve the overall performance of supply chains [10]. Zhou et al. also confirmed that inter-organizational systems can improve supply chain agility only based on sound supply chain collaboration mechanisms [4]. Restricted by insufficient digital investment and weak basic digital infrastructure, SMEs fail to deploy mature cross-enterprise information systems and cannot gain efficiency benefits from data coordination.

3.3 Organizational Capacity and Talent Pool Lag

Digital and intelligent transformation essentially brings organizational revolution. Müller et al. pointed out that organizations need to develop dynamic capabilities to respond to technological uncertainties, which rely on coordinated organizational learning, knowledge integration and process reengineering [2]. Deficiencies in organizational capacity constitute deep-seated barriers restricting transformation progress for small and medium-sized 3PL enterprises.

SMEs face three obvious challenges. First, there is a serious shortage of interdisciplinary professionals. Talents familiar with both logistics operation and digital technology remain scarce across the whole industry. Limited salary levels and incomplete career development systems put SMEs at a disadvantage when recruiting and retaining compound talents. Second, frontline employees lack digital operation capabilities. New intelligent equipment raises technical requirements for operators, while most staff have not received systematic training. Third, management teams hold biased under-

standings of transformation. Several managers equate digital-intelligent transformation with purchasing software. They ignore supporting process adjustment and staff training, leading to superficial transformation outcomes. Improper organizational matching in digital upgrading will directly trigger the phenomenon of “digital inefficiency” and restrict performance improvement [6].

3.4 Mismatch between Resource Input and Return Expectation

Most small and medium-sized 3PL enterprises operate under capital constraints, while digital transformation requires continuous capital investment. Conflicts emerge in three aspects.

Firstly, the initial investment threshold remains high. Large-scale intelligent warehousing and sorting equipment need substantial upfront funds, which brings heavy financial pressure for SMEs with limited annual operating income. Many digital solutions designed for large enterprises require high daily order volumes to achieve ideal investment returns, a condition hard to meet for most small and medium-sized logistics operators. Secondly, investment payback cycles are long. Benefits generated by digital investment emerge slowly and depend on improved operation and management systems. Latest UTD24 empirical studies prove that digital IT resources cannot directly boost firm performance, and absorptive capacity and supply chain agility play indispensable mediating roles in transforming digital investment into practical operational benefits [3]. Without solid collaborative operation and organizational agility, technical investment cannot rapidly generate tangible profits. Thirdly, scientific evaluation frameworks for investment benefits are absent. Few SMEs build quantitative assessment standards to measure digital investment outcomes, leaving managers trapped in decision-making dilemmas.

3.5 The Closed-Loop Mechanism of Obstacle Factors

The four categories of barriers form a self-strengthening negative closed loop. Unsuitable technology procurement separates digital systems from daily operations and blocks data accumulation. Insufficient data support restricts refined operation optimization and limits effi-

ciency improvements. Unobvious efficiency gains make investment returns hard to quantify, reducing enterprises’ willingness to continue funding digital projects. Insufficient follow-up investment further worsens technological backwardness and talent shortages, forming a persistent vicious cycle. The coordinated evolution of technology, business workflows and human resources is a prerequisite for digital transformation to achieve expected operational effects [11]. Deficiencies in any single dimension will hinder overall transformation. Small and medium-sized 3PL enterprises fall into systematic troubles caused by asynchronous upgrading of these three elements.

4. Optimization Path and Implementation Suggestions

4.1 Lightweight First: Reduce the Transformation Threshold and Trial

Lightweight transformation means choosing modular and scalable digital tools first, rather than making one-off large-scale investment in complex integrated systems. This approach reduces initial capital pressure and alleviates conflicts caused by mismatched investment and expected returns.

Lightweight digital solutions have three clear strengths. First, financial risks are controllable. Most modular tools adopt subscription or metered charging methods, greatly cutting initial capital expenditure. Second, teams can adapt quickly.

Lightweight platforms focus on core practical functions with simple operations, lowering digital skill requirements for frontline workers. Third, systems can expand flexibly. Modular structures support gradual function expansion matching business growth rhythm. From the dynamic capability perspective, lightweight transformation conforms to the progressive construction logic of organizational dynamic capabilities [2]. Enterprises can accumulate digital operation experience under low-risk conditions.

4.2 Scenario Landing: Ensuring the Deep Integration of Technology and Business

Scenario-driven implementation starts from specific operational pain points. Enterprises should prioritize solutions for the most prominent efficiency bottlenecks to ensure technical tools fit real business scenarios.

Two core principles should be followed during implementation. First, technology selection must be demand-oriented. Enterprises need to identify core pain points first: deploy intelligent scheduling systems if transportation arrangement is chaotic; introduce lightweight WMS if inventory management lacks standardization. Blindly following industry trends to purchase equipment should be avoided. Second, frontline staff should participate in demand confirmation. Operators need to join the technology selection and system design process to guarantee that solutions match actual workflow characteristics. Digital transformation can realize fundamental value reversal only when technology is deeply embedded in actual business scenarios and serves operational decision-making [8]. Scenario-oriented implementation provides an effective path to realize this shift. Local efficiency improvements brought by targeted scenario upgrading can quickly verify investment value and strengthen management confidence in continuous digital investment.

4.3 Progressive Iteration: Building a Dynamic Mechanism for Continuous Optimization

Progressive iteration builds a cyclic implementation framework: pilot launch, effect evaluation, targeted optimization and full-scale promotion. Digital coverage expands step by step based on verification results from small-scale pilots.

Progressive iteration brings three major benefits. To start with, systematic risks can be controlled. The four obstacles are closely connected. Large-scale simultaneous transformation may lead to overall failure if any link has weaknesses. Small pilot projects expose hidden risks within controllable ranges. Moreover, organizational learning accelerates. Each iteration pushes simultaneous upgrading of employee digital skills, management work-

flows and technical systems, matching the co-evolution rule of technology, processes and personnel [11]. Finally, positive feedback loops can be formed. Continuous verification of phased efficiency gains strengthens management recognition of digital transformation. Supply chain agility is accumulated through long-term iterative optimization rather than one-time large-scale investment [2]. Such iterative frameworks are especially suitable for resource-limited logistics SMEs to avoid risks from massive failed one-time investment [7].

5. Conclusion

Taking small and medium-sized third-party logistics enterprises as research subjects, this paper systematically analyses four core obstacles restricting operational efficiency growth during digital-intelligent transformation: mismatches between technical solutions and business scenarios, data silos and insufficient system coordination, backward organizational capacity and inadequate talent reserves, as well as imbalance between resource investment and expected returns. Research results show that these four barriers create a self-reinforcing negative closed loop, forming the core transformation dilemma faced by SMEs. On this basis, three optimization paths are proposed: prioritizing lightweight transformation, carrying out scenario-oriented implementation and pushing forward progressive iteration. The paths break transformation barriers from three dimensions: lowering entry thresholds, achieving deep integration between technology and business, and establishing long-term dynamic optimization mechanisms.

In theory, this research constructs a complete analytical framework covering transformation barriers for small and medium-sized 3PL enterprises under digital-intelligent upgrading and reveals the interactive closed-loop mechanism of multiple constraints. It makes up for insufficient attention paid to SMEs in existing academic literature. Practically, the research conclusions can provide operable strategic references for small and medium-sized logistics enterprises to design digital transformation plans.

This research still has limitations. Analysis mainly depends on public industrial data and secondary literature, lacking first-hand micro operational data from enterprises. The universality of research conclusions

needs further empirical testing. Future research can collect primary data through questionnaires and in-depth interviews to empirically examine the analytical framework proposed in this paper. Scholars can also explore differentiated transformation paths for SMEs of different scales and segmented logistics sectors.

References

- [1] Department of Economic and Trade of National Development and Reform Commission, China Federation of Logistics & Purchasing. (2026). 2025 National Logistics Operation Report [Report]. Beijing. <http://www.clic.org.cn/>.
- [2] Müller, J., Hoberg, K., & Fransoo, J. C. (2023). Realizing supply chain agility under time pressure: Ad hoc supply chains during the COVID-19 pandemic. *Journal of Operations Management*, 69(3), 426–449. <https://doi.org/10.1002/joom.1210>
- [3] Liu, H., Ke, W., Wei, K. K., & Hua, Z. (2010). The impact of IT capabilities on firm performance: The mediating roles of absorptive capacity and supply chain agility. *Journal of Operations Management*, 28(6), 497–512. <https://doi.org/10.1016/j.jom.2010.05.002>
- [4] Zhou, J., Xu, T., Chiao, Y., & Fang, Y. (2024). Interorganizational systems and supply chain agility in uncertain environments: The mediation role of supply chain collaboration. *Information Systems Research*, 35(1), 184–202. <https://doi.org/10.1287/isre.2023.1210>
- [5] Anneng Logistics. (2025). 2025 Interim Performance Report [Interim report]. <https://www.ane56.com/upload/investmentEnglish/achievement/6806d16e-c985-4e40-87d0-b8e7fcae95f2.pdf>
- [6] Holmström, J., Holweg, M., Lawson, B., Pil, F. K., & Wagner, S. M. (2019). The digitalization of operations and supply chain management: Theoretical and methodological implications. *Journal of Operations Management*, 65(8), 728–734. <https://doi.org/10.1002/joom.1073>
- [7] Lam, H. Y., Tang, V., & Wong, L. (2024). Raising logistics performance to new levels through digital transformation. *International Journal of Engineering Business Management*, 16. <https://doi.org/10.1177/18479790241231730>
- [8] Angelopoulos, S., Bendoly, E., Fransoo, J., & Hoberg, K. (2023). Digital transformation in operations management: Fundamental change through agency reversal. *Journal of Operations Management*, 69(6), 876–889. <https://doi.org/10.1002/joom.1271>
- [9] Rai, A., & Tang, X. (2010). Leveraging IT capabilities and competitive process capabilities for the management of interorganizational relationship portfolios. *Information Systems Research*, 21(3), 516–542. <https://doi.org/10.1287/isre.1100.0299>
- [10] Kulp, S. C., Lee, H. L., & Ofek, E. (2004). Manufacturer benefits from information integration with retail customers. *Management Science*, 50(4), 431–444. <https://doi.org/10.1287/mnsc.1030.0182>
- [11] de Koster, R., Roy, D., Lim, Y. F., & Kumar, S. (2025). Internet of Things in intralogistics: Applications and emerging research. *Production and Operations Management*, 34(11), 3343–3363. <https://doi.org/10.1177/10591478251362677>