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How Digital Transformation Affects Small Auto Manufacturers in China's Supply Chain

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Abstract: ***This dissertation examines how digital transformation (DT) shapes the performance and positioning of small and medium-sized enterprises (SMEs) in China's automotive supply chain. While large assemblers and tier-1 suppliers rapidly adopt ERP, IoT, cloud platforms, and data analytics, many SMEs face structural disadvantages that slow or fragment adoption. Building on the Resource-Based View (RBV) and Supply Chain Power Theory, the study uses a mixed-methods design: a survey of 72 SMEs and 30 semi-structured interviews. Quantitative analysis shows a strong positive association between digital readiness and reported performance benefits (r = 0.88) (Jia, Shafie & Kasim, 2025). Size and age moderate readiness: larger and older SMEs exhibit higher scores and more extensive integration. However, capability gaps are widespread. Fifty-eight percent of firms report no clear digital roadmap; 67 percent cite skills shortages, and 72 percent cite investment cost as a major barrier (Restrepo-Morales et al., 2024). End-to-end integration is uncommon: only 39 percent link finance, sales, and logistics systems (Wamba et al., 2017). Qualitative findings enrich these patterns. Firms that sequence implementation, budget for training, and involve staff in process redesign report faster decision cycles, lower operating costs, and improved flexibility (Teece, 2007). Where tools are installed without governance or change management, benefits are partial and brittle. Externally, collaborative buyer governance and policy support (subsidies, training hubs) help SMEs cross adoption thresholds, while coercive mandates without onboarding exacerbate dependence (Cox, 2001). Empirically, this dissertation contributes one of the first sector-focused portraits of digital adoption among Chinese automotive SMEs. Theoretically, it integrates RBV and power-based perspectives to show that internal capabilities and external dependence jointly condition DT outcomes (Barney, 1991; Vial, 2019).***

Keywords: Digital Transformation; Small and Medium-sized Enterprises; Resource-Based View; Supply Chain Power Theory; China Automotive Supply Chain.

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1. Introduction

Digital transformation has moved from optional modernization to strategic necessity in manufacturing supply chains. In the Chinese automotive sector, digital tools promise shorter lead times, improved inventory visibility, and faster exception handling (Wamba et al., 2017). Since the disruptions of 2020–2022, firms across tiers have faced demand swings, logistics bottlenecks, and component shortages (Lin, Zhang & Hu, 2025). These pressures exposed the value of traceability and agile re-planning. Large OEMs and tier-1 suppliers responded by accelerating the use of enterprise systems and analytics, while many smaller suppliers lag behind. Policy has amplified this push through initiatives like Made in China 2025 and provincial incentives promoting digital and green manufacturing (Chen & Guo, 2024). Yet, many SMEs lack the resource base assumed by these policies. Interviews reveal that funding access is limited and vendor ecosystems prioritize large accounts. As a result, SMEs digitalize piecemeal: one plant deploys sensors, another adopts an ERP module—but systems rarely interconnect. The economic stakes are significant. SMEs contribute the majority of China's auto parts output and employ millions. Their performance affects not only their own survival but the resilience of the national supply chain (Yan, Wang & Liu, 2021). Digitally connected suppliers synchronize better with OEMs, while disconnected ones introduce inefficiencies (Masood & Sonntag, 2020). This dissertation addresses four questions: (1) Which digital tools are SMEs adopting, and how deeply are they integrated? (2) What barriers constrain adoption? (3) What benefits emerge from DT? (4) How do internal resources and power dynamics shape outcomes? Empirically, this study fills a major gap in SME-level data for China's auto sector. Conceptually, it integrates capability and power-based theories to explain why access and incentives matter as much as technology (Barney, 1991; Cox, 2001).

2. Literature Review

Digital transformation is the pervasive integration of digital technologies into processes, products, and business models to create value (Vial, 2019). In manufacturing, core technologies include ERP for integrated planning, IoT sensors for condition monitoring, cloud platforms for shared data access, analytics for forecasting, and blockchain for traceability (Tan, Li & Zhou, 2023). Studies link these tools with improved delivery reliability and shorter cycle times (Wamba et al., 2017). In SMEs, adoption is often incremental and fragmented (Masood & Sonntag, 2020). Firms typically start with basic ERP or cloud inventory tools; advanced modules like predictive analytics or automated supplier portals require resources and expertise. Major barriers include uncertainty about ROI, limited digital literacy, and lack of leadership support (Restrepo-Morales et al., 2024). Relational and ecosystem factors also shape SME digitalization. Large buyers may mandate EDI or dashboard integration. When paired with onboarding support, such mandates accelerate diffusion; when not, they overload suppliers (Cox, 2001). Collaborative governance—shared testbeds, phased rollouts, and co-funded systems—improves outcomes (Chen & Guo, 2024). Capability building is equally crucial. Skills in data interpretation, process mapping, and change management determine whether tools yield insight (Teece, 2007). Leadership commitment and clear roadmaps ensure alignment (Barney, 1991). Supply-chain research adds a power dimension: information visibility confers bargaining strength (Cox, 2001). When SMEs manage accurate data, they negotiate better terms; yet, if access is buyer-controlled, dependence persists. Overall, DT outcomes hinge on multi-level interactions between technology, capability, and governance (Vial, 2019; Yan, Wang & Liu, 2021).

3. Theoretical Framework

The Resource-Based View (RBV) explains why firms with similar technologies achieve different results (Barney, 1991). Competitive advantage arises from valuable, rare, inimitable, and non-substitutable resources. In DT, these include IT infrastructure, analytics skills, and leadership able to reconfigure assets (Teece, 2007). Supply Chain Power Theory complements RBV by highlighting structural asymmetries in buyer–supplier relations (Cox, 2001). OEMs dictate standards and extract value; SMEs comply, bearing integration costs. Digitalization can both reinforce and reduce dependence. When collaborative, shared data enhances trust; when coercive, it deepens lock-in. Integrating both theories, this study proposes that internal capabilities and external governance jointly shape DT outcomes. SMEs benefit most when readiness meets partnership support (Wamba et al., 2017; Chen & Guo, 2024).

4. Methodology

This mixed-methods research combined surveys and interviews. The quantitative component surveyed 100 SMEs; 72 valid responses were collected. Questions covered digital readiness, resources, and performance (Jia, Shafie & Kasim, 2025). The qualitative component comprised 30 interviews across Guangdong and Jiangsu, exploring implementation histories and supply-chain relationships. Thematic analysis identified three themes: readiness, benefits, and barriers (Braun & Clarke, 2006). Triangulation ensured validity, supported by member checks and audit trails. Ethical approval followed standard academic protocols. Limitations include geographic concentration and cross-sectional data, though mixed methods strengthened reliability (Restrepo-Morales et al., 2024).

5. Findings

Adoption patterns show both progress and fragmentation. 71% of SMEs use at least one digital tool, mainly ERP and cloud systems (Wamba et al., 2017). Only 24% employ advanced IoT or AI. Larger and older firms exhibit higher readiness (Lin, Zhang & Hu, 2025). Barriers include cost (72%), skill shortages (67%), and lack of strategy (58%). Only one-third maintain real-time digital links with partners. Firms achieving higher integration report faster decisions, cost reductions, and improved flexibility (Teece, 2007). Quantitative analysis confirms a strong readiness–performance correlation ($r = 0.88$) (Jia, Shafie & Kasim, 2025). Interviews illustrate contrasts: a Jiangsu brake-pad maker that invested in ERP and training reduced inventory by 18% and late shipments by one-third, while another firm installing IoT sensors without workflow redesign saw minimal gains. Power dynamics persist: some buyers mandate digital adoption but provide no cost-sharing, deepening dependency (Cox, 2001). Collaborative programs, however, fostered trust and resilience (Chen & Guo, 2024).

6. Discussion

Results validate RBV: firms with robust internal resources realize greater digital benefits (Barney, 1991). Leadership commitment and learning culture predict sustained gains (Teece, 2007). Yet Supply Chain Power Theory explains continuing asymmetry—access and incentive gaps prevent equal participation (Cox, 2001). Digitalization narrows information asymmetry but cannot alone rebalance power. SMEs need both technical capability and fair governance. "Islands of digitization" remain a key issue: partial systems yield limited systemic value (Masood & Sonntag, 2020). A roadmap approach—stabilize ERP data, connect priority buyers, then expand analytics—proved most effective (Wamba et al., 2017). Cluster-level support magnifies these effects. Provinces offering training and subsidies show faster diffusion (BMWK, 2022). Internationally, SME competence centers reduce search costs and improve adoption (Restrepo-Morales et al., 2024). Ultimately, DT should be viewed as continuous capability building rather than one-off investment. Firms institutionalizing improvement routines sustain gains and resilience (Teece, 2007).

7. Conclusion and Recommendations

Digital transformation enhances efficiency and competitiveness for China's automotive SMEs, but outcomes remain uneven. Internally, readiness—skills, leadership, and strategy—is decisive (Barney, 1991; Teece, 2007). Externally, collaboration and policy incentives determine scalability (Chen & Guo, 2024). Aligning RBV and Power Theory reveals that success requires both internal capability and supportive ecosystem governance. Managers should create roadmaps, invest in training, and measure digital progress systematically. Policymakers should expand SME training centers and cost-sharing programs (BMWK, 2022). Future research should test causal mechanisms longitudinally and explore DT's intersection with sustainability goals (Lin, Zhang & Hu, 2025).

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