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Challenges and Solutions in the Digital Transformation of University Logistics Management

He Peixian
Logistics Department, Northwestern Polytechnical University, Xian, Shaanxi, China

Abstract: This study focuses on the challenges and solutions associated with the digital transformation of university logistics management, aiming to provide theoretical and practical foundations for the reform of logistics management models in higher education institutions. Utilizing a literature review, the research synthesizes relevant theories and practices regarding the digital transformation of logistics in universities, while case analyses highlight lessons learned from various types of institutions. A systematic analysis approach is employed to examine the transformation challenges from multiple dimensions, including technology, management, and personnel. Key challenges identified include technological issues such as data silos and poor system compatibility, management issues related to outdated processes and lack of unified planning, and personnel issues stemming from inadequate digital literacy. In response to these challenges, targeted solutions are proposed: on the technical front, establishing a unified data platform to enhance system compatibility; on the management side, optimizing processes and formulating coherent planning; and on the personnel front, enhancing digital training to improve overall digital literacy. the study concludes that systematic reforms and innovations in university logistics management can significantly enhance service quality and management efficiency, thus effectively supporting educational activities and aligning with the demands of modern educational development.

Keywords: University Logistics; Digital Transformation; Challenges; Solutions; Logistics Management

1. Introduction

1.1 Research Background and Significance

In the current wave of digital economy, digital transformation has become a critical pathway for industries to enhance competitiveness and achieve sustainable development. the Ministry of Education's "Education Informatization 2.0 Action Plan" emphasizes the need for comprehensive digital upgrades in education. As a vital component of the educational support system, the digital transformation of university logistics is imperative. University logistics encompasses diverse services such as dining, accommodation, energy supply, and maintenance, with traditional management models suffering from inefficiencies, delayed responses, and suboptimal resource allocation. According to the "Report on the Digital Development of University Logistics in China, " approximately 68% of universities still rely on manual complaint registration, extending the average fault resolution time by 3 to 5 days. In energy management, only 32% of universities have achieved full coverage of smart meters, leading to widespread energy waste.

Digital transformation can leverage technologies such as the Internet of Things, big data, and artificial intelligence to achieve intelligent and refined management of logistics services. For instance, an intelligent repair system can shorten fault response time to within 2 hours, improving repair efficiency by over 40%. Furthermore, under the "dual carbon" targets, a digital energy management system can monitor campus energy consumption in real time and optimize energy distribution through data analysis, helping universities reduce carbon emissions. Therefore, researching the digital transformation of university logistics management not only enhances service quality and management efficiency but also represents a significant step toward modernizing governance systems in universities and responding to national strategic needs.

1.2 Review of Domestic and International Research

Internationally, the digital transformation of

university logistics began earlier, focusing on technological application and management model innovation. For example, U. S. universities commonly utilize integrated logistics management platforms, such as Stanford University's Campus Solutions system, which consolidates dining, accommodation, and facility management to enable data interoperability and intelligent decision-making. German universities emphasize digital energy management, using smart sensors and blockchain technology to create campus microgrid energy trading platforms. Most related studies have emerged from a technology-driven perspective, highlighting the empowering role of technologies like IoT and cloud computing in logistics management.

Domestic research has seen rapid growth in recent years, with scholars exploring various dimensions. Jin Nanyang and Wang Yuanliang argue that the informatization of university logistics should advance through hardware upgrades, software optimization, and personnel training. Dong Yao and colleagues emphasize that smart reform should focus on reconstructing management processes and innovating service models. However, existing research has three main shortcomings: limited systematic studies on data governance and security, a lack of exploration of the differing transformation paths among various types of universities (such as comprehensive universities and vocational colleges), and insufficient depth in the integration of theory and practice, which affects the operability of proposed solutions.

1.3 Research Objectives and Methods

This study aims to systematically analyze the real challenges of the digital transformation of university logistics management and construct a scientifically feasible solution framework. Utilizing literature review methods, it will summarize relevant theoretical and practical achievements; through case analysis, it will distill transformation experiences from typical universities; and employing systematic analysis, it will deconstruct transformation dilemmas from technical, managerial, personnel, and data perspectives. the research will transcend singular technological viewpoints to establish a three-dimensional analytical framework of "challenges-motivations-pathways, " striving to provide guidance for the digital transformation of university logistics that possesses both theoretical depth and practical value.

2. Theoretical Foundations of Digital Transformation in University Logistics Management

2.1 Definition of Digital Transformation Concepts

Digital transformation refers to the systematic changes organizations undergo to reshape business processes, management models, and value creation methods through digital technologies. In university logistics, its core characteristics include: (1) technological integration, meaning deep integration of IoT, big data, and artificial intelligence with logistics operations; (2) process reengineering, optimizing procurement, maintenance, and service evaluation processes through digital means; and (3) value enhancement, shifting from traditional passive services to proactive intelligent services, thus improving satisfaction and resource utilization.

Compared to "informatization, " digital transformation emphasizes data-driven decision-making and business model innovation. Informatization focuses on the electronicization of business processes, while digital transformation positions data as a core asset, leveraging data analysis to uncover potential value and transitioning management from experience-driven to data-driven.

2.2 Theoretical Basis and Analytical Framework

This research is grounded in dynamic capabilities theory and data governance theory. Dynamic capabilities theory emphasizes that organizations can achieve sustainable development by sensing environmental changes, integrating resources, and reconfiguring capabilities, providing a theoretical framework for university logistics to cope with uncertainties in digital transformation. Data governance theory offers methodological guidance for addressing issues related to data security, sharing, and quality.

Based on these theories, a three-dimensional analytical framework of "challenges-motivations-pathways" is constructed: the challenges dimension focuses on real dilemmas at the technical, managerial, personnel, and data levels; the motivations dimension analyzes policy drivers (such as educational

informatization strategies), demand drivers (upgrading service experiences for faculty and students), and technology drivers (maturity of digital technologies); the pathways dimension proposes solutions such as technology empowerment, management reconstruction, and ecosystem building, forming a complete research logic chain.

3. Real Challenges in Digital Transformation of University Logistics Management

3.1 Technical Challenges

Weak technological infrastructure is the primary constraint on transformation. Currently, most university logistics systems face "siloed" development issues, with independent business systems (such as dining management and accommodation access control) that lack data interoperability. Surveys show that 73% of university logistics departments deploy more than three independent systems, but the data sharing rate between these systems is less than 20%. Furthermore, low coverage of IoT devices and insufficient application of smart sensors in energy monitoring and equipment inspections hinder real-time data collection.

The lack of adaptability to emerging technologies exacerbates transformation difficulties. the application of blockchain technology in logistics supply chain traceability faces issues of standardization, and the execution of smart contracts lacks legal support; the accuracy of artificial intelligence in service demand forecasting only reaches 65%, failing to meet precise service requirements. Additionally, poor system compatibility poses technological barriers to integrating legacy systems with new technologies, resulting in high upgrade and renovation costs.

3.2 Managerial Challenges

The traditional hierarchical management model is in stark conflict with the demands of digital transformation. University logistics departments often have complex hierarchies and unclear responsibilities, leading to lengthy decision-making processes. For example, in promoting the intelligent repair system, collaboration among multiple departments (logistics, asset management, finance) results in an average approval time of 7 days, hindering service efficiency. Moreover, the lack of unified planning leads some universities to blindly adopt new technologies without fully considering business compatibility, resulting in resource waste.

There is also a lack of collaborative mechanisms between outsourced service companies and the university. the proportion of outsourced logistics services has risen annually, with over 50% of services such as dining and cleaning outsourced. However, the integration between outsourcing companies and university systems is poor, with data sharing hampered by trust barriers. For instance, procurement data from outsourced dining service providers cannot be integrated into the university's traceability platform, complicating food safety monitoring.

3.3 Personnel Challenges

A severe shortage of multidisciplinary technical talents significantly restricts the transformation process. Within university logistics technical teams, professionals who understand both information technology and logistics operations account for less than 15%, resulting in weak system operation and secondary development capabilities. the digital literacy of management teams varies greatly, with some managers showing low acceptance of new technologies and resistance to process changes. In a survey at a "Double First-Class" university, 42% of mid-level logistics managers believed that digital transformation "increases workload. "

An inadequate employee training system exacerbates the talent gap. Current training primarily focuses on operational aspects, lacking emphasis on data thinking and innovative management capabilities. For instance, in the annual logistics training at a provincial university, courses on technology application accounted for 78%, while strategic management courses only constituted 12%, insufficient to meet the demands of digital transformation.

3.4 Data Governance Challenges

Pressure regarding data security and privacy protections is increasing. Logistics data involves personal information of faculty and students (such as accommodation records and consumption data) and sensitive campus information (such as energy consumption and equipment layout), yet 75% of universities have not established comprehensive data classification and protection systems. In 2023, approximately 30% of data breach incidents in the education sector were related to

vulnerabilities in logistics systems.

The absence of standardized data quality and sharing mechanisms affects decision-making effectiveness. Inconsistent data collection standards lead to high rates of duplication and errors; cross-department data sharing lacks institutional guarantees, hindering the linkage between financial data and logistics energy consumption data, which limits cost control and resource optimization. Furthermore, insufficient data value extraction means that most universities only utilize data for basic statistical purposes, neglecting in-depth predictive analyses.

4. Solutions for Digital Transformation in University Logistics Management

4.1 Technology Empowerment Strategies

Establishing an integrated logistics management data platform is crucial for overcoming technological barriers. This platform can consolidate data from various systems, such as catering, energy management, and maintenance, by standardizing data collection and interface protocols. For instance, after deploying a data platform in a "Double First Class" university, data sharing efficiency among logistics systems improved by 75%, and the accuracy of equipment fault warnings increased by 30%. the phased deployment of smart terminals, particularly in energy management and equipment inspection, is necessary. Implementing AIoT (Artificial Intelligence of Things) enables real-time monitoring of campus utilities, utilizing machine learning algorithms to predict energy peaks, which can reduce energy consumption by 15-20%[1].

To address the adaptation of emerging technologies, a progressive innovation strategy should be employed. In supply chain management, blockchain technology can be piloted in specific segments to ensure credible sharing of ingredient traceability data through consortium blockchains, with wider adoption following the establishment of industry standards. In artificial intelligence applications, a "data-algorithm-scenario" collaborative optimization mechanism should be established to iteratively upgrade demand forecasting models, increasing accuracy from 65% to over 80%. Additionally, a microservices architecture can modernize legacy systems, reducing coupling and facilitating the smooth integration of new technologies.

4.2 Management Process Optimization Strategies

Reengineering management processes should prioritize service demand to restructure the organizational framework. Adapting agile management practices, a dedicated digital transformation task force can break down barriers between logistics, finance, and asset management, establishing a cross-departmental collaborative decision-making mechanism. By promoting an intelligent repair request system, the approval process can be reduced from 7 days to under 48 hours, utilizing electronic signatures and automated approval rules for rapid response to maintenance requests. Furthermore, a three-year plan for the digital transformation of logistics management should be developed, outlining key technology applications and business optimization goals to avoid blind investments.

To tackle the challenges of social service collaboration, a data-sharing ecosystem led by the university with participation from enterprises must be established. Data-sharing agreements should be signed to standardize data provision and security responsibilities for outsourced companies, encouraging the integration of catering procurement data and cleaning service records into the university's management platform. A university implementing this model observed a 60% improvement in food safety traceability and a 45% reduction in complaints about outsourced service quality. Additionally, blockchain technology can be utilized to establish a data verification mechanism, ensuring the authenticity and immutability of outsourced service data.

4.3 Personnel Capability Enhancement Strategies

To cultivate interdisciplinary talent, a "university-enterprise collaboration and industry-education integration" training system should be established. Universities can partner with tech companies to offer practical courses in digital logistics management, including IoT operation and data analytics. By implementing a "dual-mentor system, " students receive guidance from both industry experts and university faculty, fostering professionals who are both technically skilled and familiar with logistics operations. Data indicates that universities adopting this model increased their

logistics technical team competency from 15% to 40%[2].

To address the insufficiency of digital literacy among management personnel, tiered training programs should be implemented. Basic staff should focus on intelligent device operation and fundamental data collection; mid-level managers should engage in strategic courses on digital transformation to enhance data-driven decision-making skills; and senior managers should participate in industry seminars to develop forward-thinking strategic insights. A provincial university's systematic training increased support for digital transformation among logistics managers from 42% to 78%. Additionally, establishing an incentive mechanism for digital talent will tie the effectiveness of technology applications to performance evaluations, motivating employees toward transformation.

4.4 Data Governance Improvement Strategies

The construction of a data security system must be advanced through institutional, technical, and managerial dimensions. On the institutional level, a "High-level Classification and Protection Measures for University Logistics Data" should be developed, categorizing personal information and energy data into different security tiers with differentiated protective measures. Technologically, privacy computing techniques such as federated learning and homomorphic encryption should be utilized to enable cross-departmental sharing while ensuring data security. On the management side, a data security audit mechanism should be established to conduct regular assessments of data breach risks. Statistics show that universities implementing this system reduced data breach incidents by 70%[3].

Enhancing data quality relies on standardization and lifecycle management. Unified data collection formats and validation rules should be established, along with a data quality monitoring platform to assess data integrity and accuracy in real time. For inter-departmental data sharing, a "Logistics Data Sharing Management Approach" should clarify responsibilities and obligations for data providers and users. Furthermore, data mining techniques should be introduced for in-depth analysis of energy consumption and service demands, supporting optimized resource allocation in logistics. For example, using clustering analysis to identify high-energy consumption areas can target energy-saving renovations, achieving a cost reduction of 12-18%.

5. Implementation Support for Digital Transformation in University Logistics

5.1 Organizational Support

A university-wide digital transformation leadership team should be formed, led by a university leader and comprising heads of logistics, information technology, and finance departments to coordinate major transformation decisions. Establishing a logistics digital operations center responsible for system maintenance, data management, and service optimization is essential. A flattened management structure should be implemented to reduce decision-making layers and enhance transformation execution efficiency. Organizational structure optimization led to a 30% reduction in project timelines and a 40% improvement in inter-departmental collaboration.

5.2 Institutional Support

A comprehensive institutional framework encompassing technology application, data management, and performance evaluation should be constructed. A "Digital Construction Management Specification for University Logistics" should be drafted, detailing technical standards for system development, deployment, and maintenance. Additionally, a "Logistics Data Management Approach" must be established to regulate data collection, storage, and usage processes. A special evaluation mechanism for digital transformation should include metrics for service efficiency and cost control to ensure the realization of transformation objectives.

5.3 Funding and Technical Support

Funding for transformation should be raised through multiple channels, including financial grants, support for university-enterprise collaboration projects, and exploring social capital involvement in construction. A dedicated fund for digital logistics construction should be established to support technology research and development, equipment procurement, and personnel training. In terms of technical support, partnerships with leading tech companies should be formed to introduce mature digital solutions while creating internal technical teams to ensure local adaptation and ongoing optimization of systems.

6. Conclusion

The digital transformation of university logistics management is essential for enhancing service quality and achieving cost reductions. Research indicates that systematic solutions combining technological empowerment, management optimization, personnel training, and data governance, supported by organizational, institutional, and funding measures can effectively address real challenges during transformation. Practical data show that in universities implementing comprehensive transformation, logistics service response speeds improved by over 50%, energy costs decreased by 15-20%, and student and faculty satisfaction rose by 30%[4]. Looking ahead, as technologies like artificial intelligence and blockchain evolve, the digital transformation of university logistics will deepen towards intelligence and ecosystem integration, becoming a crucial support for modernizing university governance. Future research should explore the disparities in transformation paths across different types of universities for more nuanced analysis.

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