

AI Empowerment in University Logistics Management: The Collaborative Path of Technological Innovation and Service Upgrades

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Abstract: With the deep integration of artificial intelligence (AI) technologies, university logistics management is undergoing a paradigm shift from traditional experience-driven to data-intelligent-driven models. Based on practical cases of AI applications in university logistics, this paper systematically analyzes the operational logic of AI in core scenarios such as facility operation and maintenance, energy management, safety monitoring, and service optimization. It reveals the intrinsic mechanisms through which AI technologies drive efficiency improvements, cost structure optimization, and service quality upgrades in logistics management via data integration, predictive analytics, and automated decision-making. the study finds that the key to AI empowerment in university logistics lies in constructing a closed-loop system of "perception-analysis-decision-feedback," while addressing challenges such as data silos, technological adaptability, and organizational transformation. Future developments will see university logistics management evolving toward full-scenario intelligence, personalized services, and ecological sustainability through deeper integration of AI with technologies like IoT and digital twins.

Keywords: Artificial Intelligence; University Logistics Management; Smart Campus; Data-Driven; Service Upgrade

1. Introduction: Transformation Needs and Technological Empowerment in University Logistics Management

1.1 Practical Dilemmas of Traditional Logistics Management

As a foundational component ensuring teaching and research order, university logistics management has long faced challenges including

inefficiency, resource waste, and lagging services. Under traditional models, facility maintenance relies on manual inspections with fault response times extending to several hours; energy management lacks dynamic regulation mechanisms, leading to significant water and electricity waste; and the mismatch between service demand and supply keeps faculty-student satisfaction around 70%. Taking a "Double First-Class" university as an example, its logistics system handles over 50,000 maintenance requests annually, yet the duplicate report rate due to inefficient information transmission reaches 23%, with maintenance costs accounting for 35% of total operational expenditures.

1.2 Empowerment Value of AI Technologies

The introduction of AI technologies provides new solutions to these logistics management challenges. Through machine learning algorithms that deeply mine historical data, equipment failures can be predicted 14 days in advance; computer vision-based intelligent monitoring systems can identify over 20 types of abnormal behaviors on campus in real time, reducing safety hazard detection time from minutes to seconds; and natural language processing-driven intelligent customer service can automatically handle 80% of routine inquiries, freeing human resources for high-value services. Tsinghua University's AI-powered energy management system deployed in 2024 demonstrates an 18% annual electricity savings through dynamic regulation of air conditioning and lighting systems, equivalent to reducing carbon emissions by 320 tons.

2. Core Application Scenarios of AI Technologies in University Logistics Management

2.1 Facility Operation and Maintenance:

From Passive Response to Proactive Prevention

AI technologies construct equipment health status models by deploying sensor networks that continuously collect over 50 parameters including vibration, temperature, and current. For instance, Wuhan University's elevator fault prediction system monitors motor current fluctuations and door operation frequencies, achieving 92% fault prediction accuracy through LSTM neural network algorithms and improving maintenance response efficiency by 65%. More advanced practices appear in predictive maintenance, where Shanghai Jiao Tong University analyzes laboratory equipment operation logs to predict centrifuge bearing wear risks 30 days in advance, avoiding unplanned downtime-related research losses.

2.2 Energy Management: Dynamic Optimization and Cost Reduction

AI-driven energy management systems achieve precise matching between demand forecasting and supply regulation through minute-level data collection of water and electricity consumption, combined with external variables like weather, class schedules, and crowd density. Zhejiang University's "Logistics Brain" platform utilizes XGBoost algorithms to model a decade of catering data, reducing food waste rates from 15% to 6% while implementing peak-valley electricity price response mechanisms that automatically initiate hot water supply during low-demand periods, saving over one million yuan in annual electricity costs. More cutting-edge explorations involve digital twin applications, where Nanjing University's virtual campus system simulates equipment loads under extreme weather conditions to predict drainage system bottlenecks, reducing maintenance costs by 18%.

2.3 Safety Monitoring: Omnidirectional Perception and Risk Prevention

AI technologies reconstruct campus safety protection systems through deploying over 5,000 IoT sensors that establish omnidirectional perception networks covering teaching areas, dormitories, and laboratories. A university in Beijing employs reinforcement learning algorithms enabling patrol robots to autonomously plan optimal routes based on real-time crowd flows, reducing monitoring blind spots by 92%. In fire safety, Fudan University's

pilot intelligent smoke detection system analyzes smoke concentration and temperature changes combined with historical fire case databases, achieving 99% fire warning accuracy with a false alarm rate below 0.5%.

2.4 Service Optimization: Demand Insight and Experience Upgrade

AI technologies drive the transformation of logistics services from "standardized supply" to "personalized delivery." Peking University's "Weiming Logistics Brain" platform integrates 200,000 pieces of faculty-student behavioral data including campus card transactions, WiFi trajectories, and book borrowing records to construct user profile models. The system recommends nutritious meals based on student physical conditions and automatically extends library power supply during exam periods, boosting service satisfaction to 92%. More innovative practices appear in unmanned delivery, where China University of Mining and Technology's autonomous vehicle matrix achieves 24/7 material transportation, compressing delivery times from 2 hours to 15 minutes.

3. Implementation Paths and Challenges of AI Empowerment in University Logistics Management

3.1 Technological Implementation Paths: From Point Solutions to System Integration

The deployment of AI technologies follows four stages: data collection, model training, system deployment, and continuous optimization. Taking Lanzhou Jiaotong University's "JTUT AI Data Inquiry" platform as an example, it first collects comprehensive data from logistics scenarios including dining and bathing through IoT devices, then constructs a domain-specific semantic model for natural language queries with 99% accuracy. Subsequently, dynamic knowledge graph technologies map entity relationships such as "cafeteria-consumption-students-time periods" to support cross-table associative queries. Finally, mobile data dashboards display key indicators in real time, reducing report generation cycles from 1 day to 10 minutes.

3.2 Practical Challenges and Countermeasures

Data Silos: University logistics systems involve

over 30 business systems across academic affairs, finance, and administration, with inconsistent data standards hindering integration. Electronic Science and Technology University of China addresses this by establishing a Chief Data Officer (CDO) position to coordinate data assets across 16 departments and build a unified data middleware platform enabling cross-system data flow.

Technological Adaptability: Some AI solutions exhibit "technology-centric rather than scenario-centric" tendencies. When introducing smart microgrid projects, China University of Mining and Technology required suppliers to provide customized development services ensuring system compatibility with campus-specific electrical load characteristics.

Organizational Transformation Resistance: the introduction of AI technologies inevitably leads to workflow reconstruction. Ocean University of China establishes human-machine collaboration standard procedures clarifying AI processing boundaries and manual intervention nodes, balancing service efficiency with humanistic care.

Ethical and Security Issues: the collection of faculty-student behavioral data must strictly comply with the Personal Information Protection Law. Fudan University employs blockchain technology to chain maintenance records and material circulation information, establishing tamper-proof quality traceability systems while implementing data anonymization to protect user privacy.

4. Future Prospects: Ecological Reconstruction of AI-Driven University Logistics Management

4.1 Technological Convergence Innovation Directions

The deep integration of AI with IoT, digital twins, and 5G technologies will spawn next-generation smart logistics systems. For example, AR-based remote maintenance guidance can simulate real fault scenarios through virtual environments, reducing on-site operational risks; while carbon footprint calculators integrated with environmental incentive systems can display real-time carbon emission data for each meal order, guiding faculty-students toward green consumption habits.

4.2 Service Model Upgrade Paths

Future university logistics services will feature "platformization+ecologicalization." Fudan University's "Smart Campus Service Cloud Platform" aggregates 83 suppliers and 120,000 faculty-student users, forming a demand-instant-matching service marketplace. This model shifts service response from "passive reception" to "proactive perception," and resource allocation from "administrative directives" to "market regulation."

4.3 Sustainable Development Goal Realization

AI technologies will become critical tools for universities to implement "dual carbon" strategies. The University of Copenhagen deeply couples its logistics system with the urban power grid, where its energy management center engages in real-time green electricity trading: storing excess wind power in backup cold storages during surplus periods and utilizing campus solar power during peak electricity price periods, generating annual revenues of 3 million yuan. This innovative model provides a demonstration for extending the social value of university logistics management.

5. Conclusion

AI technologies are reshaping the underlying logic of university logistics management by driving efficiency improvements, cost optimizations, and service upgrades through data intelligence. However, the success of technological empowerment depends on the comprehensive interaction of data foundations, technological adaptability, organizational transformation capabilities, and ethical security safeguards. Future developments will see university logistics management evolving toward "full-scenario intelligent perception, personalized service customization, and ecological value co-creation," ultimately achieving multiple objectives of supporting teaching and research, enhancing faculty-student experiences, and promoting sustainable development.

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