

Research on Evaluation and Improvement of Campus Take-out Delivery Efficiency in Universities

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Abstract: With the continuous expansion of university campus take-out market, the pressure borne by terminal in-campus delivery is increasing. This paper takes delivery efficiency as the main research object and incorporates five analytical dimensions into the efficiency evaluation: coverage capacity, delivery efficiency, service quality, cost-benefit, capacity boundary and resilience. Referring to the SERVQUAL and LSQ models, this study constructs an evaluation system consisting of 15 specific indicators. Drawing on the hierarchical idea of the Analytic Hierarchy Process (AHP), the mean normalization weighting method is adopted to determine the weight of each indicator, and the fuzzy comprehensive evaluation method is applied for quantitative measurement. Taking a university in Chengdu as an empirical case for investigation and calculation, the results show that the comprehensive delivery efficiency score of take-out services in this university is 3.10 points, merely at a medium level. Among all dimensions, coverage capacity scores 3.61 points with relatively satisfactory performance; capacity boundary and resilience only reach 2.73 points, which represents the most prominent shortcoming and offers the greatest room for improvement. Delivery efficiency (2.98 points) and service quality (2.95 points) also show considerable room for improvement. In view of various practical problems exposed by the university, corresponding optimization countermeasures are proposed from four perspectives: flexible capacity allocation, process optimization and information empowerment, pick-up experience improvement, and establishment of a continuous improvement closed-loop. A cyclically-operated improvement mechanism of "evaluation-diagnosis-optimization-re-evaluation" is constructed.

Keywords: University campus take-out; delivery efficiency; capacity boundary and resilience; mean normalization weighting method; fuzzy comprehensive evaluation.

1. Introduction

Take-out services have become an essential part of college students' campus life. According to industry statistics, more than 60% of take-out platform users are post-95s, and the number of full-time university students nationwide exceeds 40 million. At present, campus take-out orders keep rising year by year, and contradictions in terminal delivery are emerging. Against this backdrop, how to scientifically evaluate campus take-out delivery efficiency and accurately identify system shortcomings has become a vital issue for university logistics governance.

Domestic scholars have conducted localized adaptation of the SERVQUAL, SERVPERF [5] and LSQ [6] models and applied them to studies related to campus take-out. Based on the SERVPERF model, Teng Mufan and Wang Caijun built an evaluation framework with 5 primary indicators and 15 secondary indicators to measure college students' satisfaction with take-out services [1]. Combining the SERVQUAL and LSQ models, Yuan Wenkai and Cui Bin established an evaluation system containing 6 dimensions and 29 specific indicators, focusing on consumers' subjective experience [2]. Fan Linan et al. adopted genetic algorithm and TSP model to calculate relatively reasonable delivery routes under campus scenarios [3]. With the hub-and-spoke model, Cai Tingting et al. explored the layout of campus take-out delivery networks [4].

A review of existing literature reveals three deficiencies in current studies. First, most studies focus on student satisfaction surveys or delivery route algorithm optimization, while few conduct holistic assessment of the accommodation capacity and anti-shock resilience of delivery systems. Second, an effective connection is lacking between evaluation

work and improvement countermeasures. Many studies merely finish indicator scoring and result ranking without constructing a complete cyclic improvement process. Third, realistic characteristics of universities such as closed-campus management, sharp surge of orders within short periods and operation of multiple take-out platforms have not been fully incorporated into evaluation frameworks.

2. Current Situation of Campus Take-out Delivery in Universities

Semi-closed universities in China generally face huge demand for campus take-out services. Such universities have large student populations and numerous dormitory buildings, together with well-developed commercial facilities surrounding campuses, which generate robust take-out consumption demand. Restricted by semi-closed campus management rules, off-campus couriers are usually not allowed to deliver meals directly to dormitory buildings. Most take-out meals require secondary in-campus transshipment to accomplish terminal delivery.

In terms of general delivery procedures, most semi-closed universities set up take-out sorting points around campus walls. After off-campus couriers deliver meals to sorting points, sorters classify orders by dormitory zones. Then in-campus delivery staff conduct centralized transshipment by zones and deliver take-out meals to pick-up points of each dormitory area.

For the layout of pick-up points, universities arrange multiple take-out pick-up locations in dormitory zones. Some are centralized pick-up sites serving multiple dormitory buildings, while others are independent points for a small number of buildings. Universities also install several

intelligent take-out lockers at school gates, dormitory clusters and other areas to make up for shortages of terminal storage facilities.

There exists no unified standard for campus access and delivery rules across different take-out platforms. Platforms differ significantly in couriers' campus access permission and meal storage conditions. Some platforms permit couriers to enter campus and place meals directly on take-out shelves; some grant campus access yet only allow couriers to stack meals on the ground; others forbid couriers from entering campuses, so all meals have to be stored in take-out lockers at school gates for students to collect by themselves.

From the perspective of hardware supporting facilities, open-style take-out shelves equipped with rain shelters are widely adopted at dormitory-zone pick-up points. Nevertheless, many shelves lack clear labels for dormitory division and pick-up code signs. Take-out meals from various platforms are mixed together, which easily leads to troubles in locating meals, mis-taking and missing orders.

3. Construction of Evaluation Model for Campus Take-out Delivery Efficiency

3.1. Evaluation Indicator System

Drawing on the SERVQUAL and LSQ models and combining with the characteristics of campus take-out delivery scenarios, this paper constructs an evaluation indicator system for university campus take-out delivery efficiency through the procedure of "theoretical tracing-scenario adaptation-theoretical verification", including 5 criterion layers and 15 indicator layers.

Coverage capacity (B1) serves as the fundamental dimension for efficiency evaluation, reflecting the spatial scope covered by delivery networks and the time span of service provision.

Delivery efficiency (B2) refers to the responsiveness concept in the SERVQUAL model, representing how fast the whole delivery system responds to external demands.

Service quality (B3) is assessed around key links where students have the deepest perceptions in service usage.

Cost-benefit (B4) evaluates the operation status of the whole delivery system from the perspective of long-term

economic sustainability.

Capacity boundary and resilience (B5) examines the pressure resistance of delivery systems facing massive orders during dining rush hours or adverse conditions such as bad weather.

Specific indicators corresponding to each dimension are shown in Table 1.

3.2. Determination of Indicator Weights

This paper borrows the hierarchical idea of Analytic Hierarchy Process and adopts the mean normalization weighting method to determine indicator weights. A hierarchical structure of target layer-criterion layer-indicator layer is established. Respondents are invited to score indicator importance with a 1-5 Likert scale, where higher scores stand for higher importance.

Weight formula for criterion-layer indicators:

$$W_i = \frac{\bar{x}_i}{\sum_{i=1}^n \bar{x}_i}$$

Where $\bar{x}_i$ denotes the average score of the i criterion-layer indicator, and n is the number of criterion-layer indicators.

Weight formula for indicator-layer indicators:

$$W_{ij} = \frac{\bar{x}_{ij}}{\sum_{j=1}^m \bar{x}_{ij}}$$

Where $\bar{x}_{ij}$ represents the average score of the j indicator under the i criterion layer, and m is the number of indicators under this criterion layer.

Combined weight formula:

$$W_{ij}^c = W_i \times W_{ij}$$

Where W_i is the weight of criterion-layer indicator, W_{ij} is the weight of indicator-layer indicator. Combined weight reflects the contribution of bottom-level indicators to the overall target.

Taking a university in Chengdu as the case, questionnaires for indicator weight investigation were distributed to on-campus students and logistics administrators. 33 questionnaires were collected in total. After eliminating invalid questionnaires with too short filling time or highly identical answers, 27 valid questionnaires were obtained. Weights of criterion-layer and indicator-layer indicators calculated through above procedures are shown in Table 1.

Table 1. Indicator System and Weights for Evaluation of University Campus Take-out Delivery Efficiency

Criterion Layer	Criterion-layer Weight	Indicator Layer	Indicator-layer Weight	Combined Weight
Coverage capacity (B1)	0.23	Delivery range coverage rate (C1)	0.28	0.066
		Dormitory building direct-delivery rate (C2)	0.28	0.066
		Density of meal pick-up facilities (C3)	0.24	0.057
		Service time-slot coverage rate (C4)	0.20	0.044
Delivery efficiency (B2)	0.26	Average delivery duration (C5)	0.35	0.089
		On-time delivery rate (C6)	0.35	0.091
		Average waiting time in peak hours (C7)	0.30	0.076
		Meal intact rate (C8)	0.26	0.057
Service quality (B3)	0.22	Satisfaction with meal temperature retention (C9)	0.21	0.047
		Information accuracy rate (C10)	0.26	0.057
		Convenience of pick-up-point layout (C11)	0.27	0.061
Cost-benefit (B4)	0.15	Average delivery cost per order (C12)	0.61	0.089
		Facility turnover rate (C13)	0.39	0.057
Capacity boundary and resilience (B5)	0.14	Peak operational saturation (C14)	0.45	0.065
		Efficiency decline under abnormal conditions (C15)	0.55	0.078

Weight results indicate that delivery efficiency (0.26) and coverage capacity (0.23) possess the highest weights. The indicator with the maximum combined weight is on-time delivery rate (0.091), demonstrating that it acts as the most critical factor affecting comprehensive delivery efficiency.

3.3. Efficiency Scoring Method

On the basis of indicator weights, the fuzzy comprehensive evaluation method is applied for quantitative measurement to process ambiguous subjective evaluation information from questionnaires. The comment set is defined as $V = \{Excellent, Good, Medium, Poor, Very Poor\}$, corresponding to scores of 5, 4, 3, 2 and 1 respectively. Grade judgment criteria are as follows: comprehensive score ranging [4.5, 5.0] for Excellent, [3.5, 4.5) for Good, [2.5, 3.5) for Medium, [1.5, 2.5) for Poor, and [1.0, 1.5) for Very Poor.

Membership degrees are calculated based on 181 valid questionnaires to construct fuzzy matrices. Calculation formula for dimension-level scores:

$$S_i = \sum_{k=1}^5 R_{ik} \times V_k$$

Where S_i refers to the comprehensive score of the i

dimension, R_{ik} is the membership degree of this dimension for the k comment grade, and V_k is the score corresponding to the k comment grade.

Calculation formula for comprehensive efficiency score:

$$S = \sum_{i=1}^5 W_i \times S_i$$

Where W_i is the weight of criterion-layer indicator, and S_i represents the score of each dimension.

4. Evaluation Results and Problem Diagnosis

4.1. Scoring Results of Each Dimension

Efficiency evaluation questionnaires were distributed to students of the target university. 236 questionnaires were collected. After removing invalid samples, 181 valid questionnaires were obtained with an effective rate of 76.7%. Membership degrees of each indicator were counted based on these valid samples. Fuzzy synthetic computation combined with weights in Table 1 generates dimension-level scores presented in Table 2.

Table 2. Dimension-level Scores of Take-out Delivery Efficiency

Criterion Layer	Score (Full score: 5)	Evaluation Grade	Scoring Basis
Coverage capacity	3.61	Good	Pick-up points and intelligent lockers cover all student dormitory clusters
Delivery efficiency	2.98	Medium	Average delivery duration ranges from 40 to 50 minutes
Service quality	2.95	Medium	Meal intact rate is guaranteed, yet spillage and damage occur occasionally
Cost-benefit	3.08	Medium	Sorting and in-campus transshipment raise labor costs; facility utilization varies greatly across pick-up points with optimization potential
Capacity boundary and resilience	2.73	Medium	Processing capacity of sorting stations and in-campus couriers forms implicit bottlenecks; system congestion easily occurs amid concentrated peak-hour orders; efficiency drops sharply under severe weather
Comprehensive delivery efficiency	3.10	Medium	Output of multi-dimensional comprehensive evaluation

4.2. Problem Diagnosis

This university has a large number of teachers and students with vigorous take-out demand. The delivery workflow is as follows: off-campus meals are delivered to sorting points beside campus walls, sorted by staff according to dormitory zones, and then transported by in-campus couriers to pick-up points near dormitory buildings. Currently, the university sets up 9 take-out pick-up points and 3 sets of intelligent take-out lockers covering all its 22 dormitory buildings. Nevertheless, campus access rules differ across platforms: Taobao Flash Shopping orders can be delivered to shelves near dormitory buildings; Meituan take-out meals can only be placed on the ground adjacent to pick-up points; meals from other platforms cannot enter dormitory zones and have to be stored in lockers at the main gate.

Evaluation results show that coverage capacity (3.61 points) performs well thanks to reasonable layout of pick-up points and convenient walking access for students. Cost-benefit stands at medium level with a score of 3.08. Capacity boundary and resilience (2.73 points) are the most prominent shortcoming, mainly manifested as heavy pressure for sorting

staff and delivery workers during dining rush hours. Delivery efficiency (2.98 points) and service quality (2.95 points) also require improvement. Long delivery time in peak hours constitutes the main drawback for delivery efficiency. For service quality, inconsistent user experience arises from simultaneous operation of multiple take-out platforms. Overall, although the campus take-out delivery system possesses sound fundamental conditions, considerable improvement space exists in peak-hour manpower guarantee, coordination of multi-platform regulations and optimization of student pick-up experience.

5. Promotion Strategies for University Campus Take-out Delivery Efficiency

Based on diagnosis results, while maintaining existing advantages in coverage and cost-benefit, this paper puts forward optimization countermeasures targeting weak links such as peak-hour manpower guarantee and pick-up-experience improvement from four dimensions: flexible capacity allocation, process optimization and information

empowerment, pick-up-experience upgrading, and construction of continuous improvement closed-loop.

5.1. Coordinate Resource Supply to Strengthen Service Resilience

Aimed at the weakness of capacity boundary and resilience, university administrative departments take charge of resource planning and institutional design. A supply pattern combining regular basic resources and peak-hour supplementary resources is adopted to balance service guarantee and labor-cost control.

First, improve processing capacity of sorting links. During lunch peak hours (11:30-13:00) and dinner peak hours (17:30-19:00), logistics departments deploy extra sorters to lift sorting capacity to 1.5-2 times of regular volume. Unified operating procedures are formulated. Color-coded partitions are set by dormitory zones to guide sorters to place meals into transfer boxes by zones, facilitating pick-up for in-campus couriers and reducing sorting errors.

Second, optimize staffing of in-campus couriers. A part-time courier mechanism for peak hours shall be established, under which university students are recruited as part-time couriers to work alongside full-time couriers within divided service zones. Part-time couriers get paid by completed orders, which not only provides work-study opportunities for students but also reinforces peak-hour delivery capacity. Only a small number of full-time staff remain in off-peak periods to avoid personnel idleness and higher per-order delivery costs.

Third, implement unified management for deployment and scheduling of take-out lockers. Logistics or property departments investigate utilization status of each site. Add locker compartments at high-demand locations. Cooperate with take-out platforms to relocate under-utilized lockers to high-demand zones. Activate locker management systems equipped with message push and overtime occupation reminders to enhance compartment turnover and guarantee practical performance of facilities.

5.2. Upgrade Information Tools to Optimize Campus Delivery

To boost delivery efficiency, university departments sort out practical business requirements while take-out platforms provide corresponding technical interfaces for joint renovation. In-campus couriers execute on-site delivery tasks following operational standards. Off-campus couriers are only responsible for delivering meals to campus sorting points without participating in in-campus transshipment.

First, realize information-based upgrading for sorting work. Logistics departments cooperate with take-out platforms to develop functions for order scanning and identification. The system automatically matches orders with dormitory zones and pick-up points to cut time consumed by manual judgment. In-campus couriers can monitor sorting progress via mobile terminals and pick up goods immediately after sorting is finished to plan delivery routes and reduce unnecessary waiting. Meanwhile, the system sends pick-up reminders to students to prevent long-term stacking of meals at pick-up points.

Second, implement zonal delivery operations. Divide service zones according to dormitory distribution and define working scopes for couriers. In-campus couriers complete deliveries only within assigned zones and avoid cross-zone travelling to lower efficiency loss caused by detours.

Third, pilot the appointment-based pick-up mode. Take-out platforms develop relevant functions enabling students to select preferred pick-up time windows to mitigate pressure brought by order surges within short time. Universities carry out internal publicity and guidance. In-campus couriers conduct deliveries in batches according to pre-ordered requests.

5.3. Unify Delivery Specifications to Improve Pick-up Experience

For service-quality improvement, administrative departments formulate regulations and renovate hardware facilities. Take-out platforms shall comply with campus access rules. Sorters and in-campus couriers standardize meal placement on-site.

First, university logistics departments negotiate unified campus-access delivery specifications with major take-out platforms. Constraints are imposed on campus-access delivery requirements, and the workflow of "centralized sorting-zonal distribution-delivery at pick-up points" shall be enforced to eliminate chaotic coexistence of shelf placement, ground stacking and locker storage. Meanwhile, both sides negotiate cost-sharing mechanisms for facility maintenance and manpower investment.

Second, carry out standardized hardware renovation for pick-up points. Logistics departments install unified partition signs and implement color-coding for take-out shelves corresponding to dormitory zones. Operational requirements specify that sorters and couriers shall place meals with pick-up codes facing the same direction. Most pick-up shelves have already been fitted with rain shelters. Subsequent work focuses on sign maintenance and supervision of on-site compliance with meal-placement rules.

5.4. Establish Evaluation Mechanism to Monitor Delivery Efficiency

Integrate the above-mentioned evaluation indicator system into daily logistics administration. Organize regular assessment of delivery efficiency. Students participate mainly as questionnaire respondents rather than administrators responsible for rectification. Logistics staff identify priority improvement targets according to score variations, implement corrective measures, and verify improvement effects through subsequent rounds of assessment. Thus a cyclic mechanism of "evaluation-diagnosis-optimization-re-evaluation" is formed. Instead of one-off rectification measures, this reusable management tool helps logistics departments continuously track changes in delivery efficiency and flexibly adjust optimization countermeasures.

6. Conclusion

The difficulty of university campus take-out delivery governance does not lie in simple adjustment of individual links, but in maintaining reasonable levels of coverage, efficiency, service quality, cost-benefit and system resilience under scenarios of concentrated order surges, multi-platform co-operation and closed-campus space environment. This research proves that assessments merely focusing on student satisfaction or delivery routes cannot reflect real-world performance of delivery systems. Incorporating capacity boundary and resilience into evaluation frameworks helps identify bottlenecks of peak-hour carrying capacity and terminal conflicts caused by inconsistent platform regulations.

Taking a university in Chengdu as an empirical case, the evaluation verifies the practical applicability of this indicator system. Most universities possess solid hardware coverage foundations, yet peak-hour manpower guarantee and pick-up experience are generally insufficient. Inconsistent rules among multiple platforms further increase difficulties of terminal delivery. It indicates that campus take-out governance cannot rely merely on adding pick-up facilities. More importance should be attached to peak-hour manpower scheduling, coordination with platforms and standardization of pick-up workflows. Countermeasures proposed from flexible capacity allocation, information-driven process optimization, pick-up-experience improvement and cyclic monitoring mechanism provide practical references for improving campus take-out delivery efficiency in universities.

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References

- [1] Teng, M., & Wang, C. (2024). Research on evaluation and promotion of campus take-out service quality in universities based on AHP and fuzzy comprehensive evaluation. *Journal of Wuhan Textile University*.
- [2] Yuan, W., & Cui, B. (2024). Research on customer satisfaction evaluation indicator system of take-out delivery services. *Logistics Technology*, 43(2), 74–81.
- [3] Fan, L., & Lü, P. (2021). Campus take-out delivery route planning based on improved genetic algorithm. *Logistics Sci-Tech*, 44(1), 14–19.
- [4] Cai, T., Hong, J., & Zhou, Y. (2026). Research on delivery route optimization of university campus take-out based on hub-and-spoke network model. *China Logistics & Purchasing*, (2), 35–36.
- [5] Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1988). SERVQUAL: A multiple-item scale for measuring consumer perceptions of service quality. *Journal of Retailing*, 64(1), 12–40.
- [6] Mentzer, J. T., Flint, D. J., & Hult, G. T. M. (2001). Logistics service quality as a segment-customized process. *Journal of Marketing*, 65(4), 82–104.