

**分析美团外卖在深圳的派单系统和
激励机制：提升外卖骑手社会福利**

Analyzing the dispatch system and
incentive mechanism of Meituan in
Shenzhen: to enhance the overall
social welfare of takeaway delivery
people

摘 要

随着外卖行业的快速发展，配送平台的规模不断扩大，如何在优化派单算法的同时保障骑手的工作条件已成为一大挑战。本研究聚焦于美团的派单系统、“最后一公里”配送问题及激励机制，探讨其对深圳外卖骑手的影响。我们假设，配送路线的低效优化和不完善的激励机制导致骑手工作量增加、工作满意度降低。研究期间，我们采用混合研究方法（包括定量和定性分析），通过问卷调查、访谈和文献分析，探讨算法控制、骑手自主权与薪酬体系之间的关系。研究结果表明，尽管算法优化提高了配送效率，但也对骑手施加了严格控制，增加了工作压力，降低了灵活性。然而，反对观点认为，一些骑手认可平台工作的灵活性和收入潜力。本研究的局限性包括地理范围的限制和外部政策因素的影响。本研究强调，有必要优化算法和激励机制，以在提升配送效率的同时保障骑手的福祉。

关键词：外卖骑手的社会福祉；美团；最后一公里挑战；派单系统；激励机制

Abstract

As the food delivery industry grows and delivery platforms expand, optimizing dispatch algorithms while ensuring fair working conditions for riders has become a critical challenge. This research examines Meituan's dispatch system, focusing on "last mile" inefficiencies and incentive mechanisms, to uncover their impact on delivery riders in Shenzhen. We hypothesize that inefficient routing and inadequate financial incentives contribute to increased workloads and job dissatisfaction among riders. Through a mixed-methods approach, incorporating both quantitative and qualitative research methods, we analyze survey data and literature to assess the relationship between algorithmic control, rider autonomy, and compensation structures. Our findings indicate that although algorithmic optimization enhances efficiency, it also imposes rigid control over riders, increasing stress and limiting their flexibility. However, some riders appreciate the flexibility and earning potential offered by platform-based work. Limitations of this study include geographic constraints and external regulations. Overall, this study underscores the need for balanced algorithmic improvements and refined incentive structures to promote both efficiency and rider well-being.

Keywords: Social Wellbeing of Delivery Riders; Meituan; Last-Mile Challenges; Dispatch System; Incentive Structure

1. Introduction

Every minute, approximately 56,000 online food orders are delivered in China, signifying a massive demand for food delivery services. According to a survey (Yu and Sakurai, 2020), over 30 percent of consumers order food delivery five to ten times weekly. This widespread adoption is facilitated by the convenience of smartphone apps that allow users, from students to corporate employees, to have meals delivered directly to their doorsteps. These services rely on complex algorithms to allocate orders, optimize delivery routes, and predict arrival times. However, significant challenges persist, particularly within the “last mile” of delivery.

Our research examines the inefficiencies in Meituan's path dispatch system, one of China's largest food delivery platforms. Delivery riders frequently face difficulties in locating precise destinations and are often hindered by community managers. Additionally, Meituan's incentive mechanisms are insufficient, with limited benefits and inconsistent performance-based rewards negatively impacting riders' satisfaction. Our mixed-method data analysis reveals that these limitations, combined with overtime work, contribute to a stressful working environment. Our research addresses two key questions: How do “last mile” issues contribute to high workloads and exhausting conditions for Shenzhen's delivery riders? How can changes to the reward system ensure fair compensation and motivate efficient delivery times?

Through surveys and interviews with both customers and Meituan riders, we conclude that the “last mile” and incentive mechanisms not only affect delivery efficiency but also undermine the workforce's well-being. Our goal is to promote a

fairer and more sustainable ecosystem that benefits both workers and the broader delivery industry.

2. Literature Review

2.1 Academic Definition

2.1.1 Definition for food delivery industry

Meemken et al. (2022) define food delivery as a courier service in which restaurants, stores, or independent companies transport food to customers. In 2023, online catering sales in China increased by 29.1% year on year, with its share of total catering service consumption reaching 22.2%, according to data from the Commerce Industry (Xinhua Net). The growth of food delivery in China extends beyond satisfying consumer appetites, significantly impacting various economic sectors. Valued at approximately 1.2 trillion yuan, the market surpasses the total GDP of Kuwait in 2023, affecting e-commerce giants, restaurant owners, and gig workers who navigate traffic to ensure timely deliveries.

Food delivery has evolved into an ecosystem encompassing restaurants, packaging companies, raw material suppliers, third-party operators, shared transportation, and more (Digital Development Report of Chinese Catering Industry, 2023). This booming industry has not only created millions of jobs but also contributed to a more flexible employment system.

The items delivered typically include meals, medicines, and groceries, packaged in boxes or plastic bags. In densely populated urban areas, electric bike riders in bright

yellow or blue uniforms have become the backbone of China's new urban life and the world's largest online food delivery market.

2.1.2 Definition for Meituan platform

Liang et al. (2024) define Meituan as a pioneer in China's on-demand food delivery service. Founded in 2010 by Wang Xing, Meituan went public on the Hong Kong Stock Exchange on September 20, 2018. The platform allows customers to place orders online for fast food delivery and can handle more than 60 million orders per day through its minute-based delivery network, employing over 5 million active couriers.

The delivery service has expanded both the time and location for food consumption. Meituan reported in 2021 that over 80 percent of small catering businesses experienced increased incomes after adopting online delivery services (Xinhua 2025). This highlights the significant economic impact of Meituan's platform on small businesses.

2.1.3 Definition for dedicated and crowdsourced riders

There are two types of delivery riders are discussed: dedicated and crowdsourced (Hu, 2023). Dedicated delivery riders are employed by takeaway platforms that outsource delivery services in specific areas through cooperation, agency, or contracting agreements with other companies. In contrast, crowdsourced delivery riders independently register through the platform's app and use their free time to accept delivery orders.

The benefits of being a dedicated rider include stable income, while crowdsourced riders enjoy the flexibility of setting their schedules. However, dedicated riders face limitations in work hours, and crowdsourced riders may lack stable income. This distinction highlights the trade-offs between income stability and work flexibility in the delivery industry.

2.2 Supportive literature for our research hypothesis

2.2.1 Optimization of Delivery Systems

Wang (2020) examines the practical applications of optimizing Meituan's dispatch system and highlights Meituan's restrictive delivery range strategy, which allows riders familiar with specific areas to perform tasks more efficiently. Insights into merchant and order aggregation, as well as the deviation between order and merchant centers of gravity, help address the "last mile" delivery challenge.

In response, Zhang et al. (2021) explore a data-driven optimization approach to enhance last-mile delivery performance. Their research combines machine learning with capacitated vehicle routing optimization to address delivery time uncertainties. This approach critiques traditional predict-then-optimize paradigms and introduces a framework based on decision error, providing a more accurate and adaptable solution to delivery challenges.

2.2.2 Emotional Labor and Worker Well-being

Hao (2020) focuses on the emotional labor involved in China's takeaway delivery industry. The research emphasizes the need for organizational and social adjustments

to improve delivery workers' well-being and job performance under high emotional stress. Similarly, Xiang and Wu (2021) investigate the working conditions of food delivery staff in China's gig economy. Their research reveals high work intensity, safety risks, and insufficient compensation.

2.2.3 Current Industry Challenges

In mainland China, approximately 84 million delivery personnel navigate urban streets to meet customer demands (Huld, 2023). Despite the growing workforce, delivery efficiency often comes at the expense of riders' physical and mental health and underscores the challenging conditions and high workloads (Zhang, 2019). Current delivery systems enforce compulsory working times without designated resting periods, leaving workers financially vulnerable during low demand. Additionally, underdeveloped routing algorithms for the "last mile" force riders into unsafe or inefficient decisions.

2.3 Counterargument

Optimizing food delivery platform algorithms enhances operational efficiency but poses challenges to riders' autonomy and working conditions. As Lee (2021) argues such automated systems impose constraints that decrease job satisfaction. These systems contribute to higher stress levels and diminished job satisfaction. Besides, the rigid control reduces their ability to navigate unexpected challenges, such as traffic congestion or adverse weather conditions, further impacting their sense of agency and well-being (China Labor Security News, 2024).

Robotic delivery systems have been proposed as a solution to mitigate some of these challenges, but they introduce other problems. Yu and Puchinger (2024) discuss how robots, while capable of addressing inefficiencies in the “last mile” of delivery, threaten to displace human labor entirely. This raises critical ethical questions about the economic and social consequences of replacing riders with autonomous technologies.

Zhang (2022) focuses on Meituan’s current incentive system and supports it for many delivery riders are satisfied with their working conditions, highlighting the flexibility and earning potential of platform-based employment.

These findings reveal the trade-offs of algorithmic and robotic innovations in food delivery. While optimization boosts efficiency, it can restrict rider autonomy and increase stress. Robotic delivery may address last-mile issues but raises labor concerns. To ensure sustainability, platforms must refine dispatch systems, enhance incentives, and align technology with rider well-being.

3. Research Methods

3.1 Quantitative Research Method

Quantitative data refers to data expressible by numbers and thus used to quantify characteristics objectively, given that it allows for a high level of precision (Verhoef and Casebeer, 1997). In this research, we collected quantitative data through the means of surveys, which gather numerical data from predefined groups of respondents through structured questions to statistically identify specific patterns (Timonera 2024). Aiming to determine the factors of difficulties concerning delivery personnel’s status quo, we

conducted two surveys, one directed towards students and their experiences with deliveries from their own point of view, another towards delivery persons themselves - their backgrounds, the treatments they receive, and the issues they face, and both of these have achieved a remarkable database, with 285 valid data for the former, and 429 for the latter - validation based on the IP locations and the time it took the respondents to finish - further proof of its authenticity.

3.2 Qualitative Research Method

Qualitative analysis is a research method primarily focused on understanding and interpreting non-numerical data, such as interviews and observations. Therefore, the telephone interviews employed in this research emphasize the depth of research by exploring complex social phenomena or actions while also being cost-effective, speedy, and capable of screening candidates.

The research aims to gain an in-depth understanding of the delivery personnel's unique experiences and perceptions related to Meituan's dispatch system and incentive mechanisms. Through these interviews, systemic drawbacks or areas for improvement can be identified.

3.3 Mixed-Research Method

Mixed-research methods, integrating quantitative and qualitative approaches, enable researchers to leverage the strengths of both paradigms for a nuanced understanding of complex issues (Hassan, 2024). Neither approach alone suffices for

addressing factors like routing and reward systems, which impact delivery personnel. Only through this combined method, with qualitative elaboration on quantitative data, can well-rounded conclusions be generated.

4. Research Analysis

4.1 Rider Interview

We interviewed six Meituan riders, all aged between 20 and 30. Among them, four were crowdsourcing riders who completed 30 to 40 orders daily, earning a monthly salary of approximately 7,000 to 8,000 yuan. The remaining two were special delivery riders, completing 70 to 80 orders daily, with a monthly salary exceeding 10,000 yuan. However, Shenzhen's average monthly wage for employees in non-private urban units in 2023 was 14,321 yuan, significantly exceeding the monthly salary of Meituan delivery workers (Shenzhen Statistics Bureau, 2023). Regarding work experience, five riders have been in the industry for about a year, while one has been working for approximately seven years. In terms of education, five riders are junior college graduates, and one holds a bachelor's degree. Their delivery areas include the commercial and residential regions of Longgang, Longhua, Luohu, and Bao'an Districts.

During the interviews, four riders expressed dissatisfaction and distress with the navigation and "last mile" issues associated with Meituan. They reported that the navigation system suffers from inaccurate destination positioning and unreasonable delivery route planning. The navigation plans only the main roads and fails to consider auxiliary and smaller roads that could reduce delivery time. Regarding the "last mile"

problem, all riders indicated they often encounter obstacles in the final delivery section, mainly due to community restrictions that prevent deliverymen and their electric vehicles from entering. When this occurs, deliverymen must complete the delivery on foot, typically covering 500 to 600 meters. More distant residences require over ten minutes of walking, primarily because deliverymen are unfamiliar with the community's internal routes. These issues significantly impact deliverymen's work efficiency.

Besides, all riders stated that Meituan's support for them is inadequate. This lack of support is evident in several areas:

- 1) Meituan consistently lowers the commission per order for riders;
- 2) It does not provide five insurances and a housing fund for crowdsourced riders, nor accident insurance for any rider;
- 3) fines for overtime and complaints are increasing;
- 4) Meituan offers few reward mechanisms, limited to holiday and bad weather subsidies and bonuses for the best riders of the month.

Regarding Meituan's recently proposed policy (announced on December 30, concerning the "anti-fatigue" mechanism, where riders receive reminders after working more than eight hours and are forced offline after 12 hours, and the plan to cancel overtime deductions by the end of 2025), half of the riders expressed optimism, while the others were skeptical. The skepticism is mainly due to the high time cost of implementing this policy, raising doubts about its realization by the end of 2025. Our

research aims to address the "last mile" problem and the social care issues faced by riders.

4.2 Questionnaires Data Analysis

The validity of our questionnaire data is ensured through several rigorous methods. First, data cleansing is employed to remove responses with IP locations outside Shenzhen and those completed too quickly to be accurate. This step is crucial as it enhances the reliability of the dataset by ensuring that only relevant and thoughtfully completed responses are analyzed. According to data quality theories, such as those proposed by Wang and Strong (1996), accuracy and relevance are fundamental dimensions of data quality.

After cleaning the data, we started to analyze the 429 valid questionnaires collected, bar and pie charts are used to present data intuitively, ensuring clarity. These visual tools are chosen because they simplify complex data sets, making it easier to identify trends and patterns at a glance. Bar charts are particularly effective for comparing quantities across different categories, while pie charts are useful for showing proportions within a whole. Tufte's theory of data visualization emphasizes the importance of clarity, precision, and efficiency in graphical representations, which are achieved through these charts (Tufte, 2001).

Third, cross-examination combines multiple aspects to thoroughly examine the fundamental issues. This method involves comparing and contrasting different data points or variables to uncover deeper insights and validate findings. Cross-examination

is rooted in triangulation theory, which suggests that using multiple methods or data sources can enhance the credibility and validity of research findings (Denzin, 1978). The data collection process took approximately one month, allowing sufficient time to ensure data accuracy and comprehensiveness. This duration reflects a balance between timely data collection and the need for thoroughness, aligning with best practices in survey research methodology.

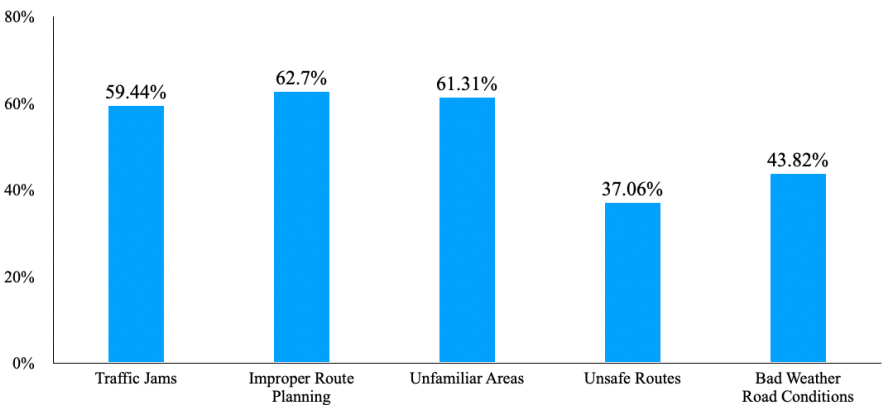


Figure 1 Difficulties during delivery (route)

According to Figure 1, 62.7% of the respondents have faced traffic jams leading to order delays, and 61.31% have experienced delays due to unfamiliarity with the delivery area. These findings underscore significant challenges faced by delivery personnel and suggest that strategic planning of delivery routes using predictive analytics might help anticipate and mitigate potential delays. Addressing last-mile issues can collectively contribute to optimizing delivery operations and improving customer satisfaction.

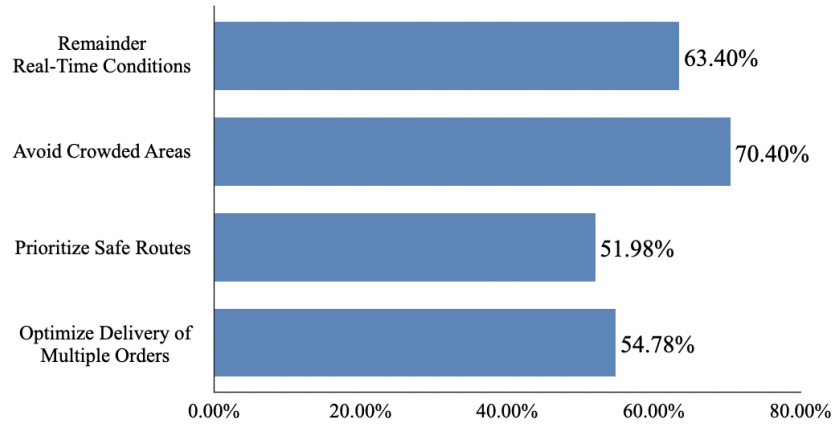


Figure 2 Means to boost efficiency

Figure 2 points out 70.4% of respondents believe that route planning to avoid crowded areas can be beneficial to their efficiency. 54.78% of respondents consider that optimizing the delivery sequence of multiple orders can lift their efficiency. This highlights delivery personnel's demand for a more efficient and secure optimization.

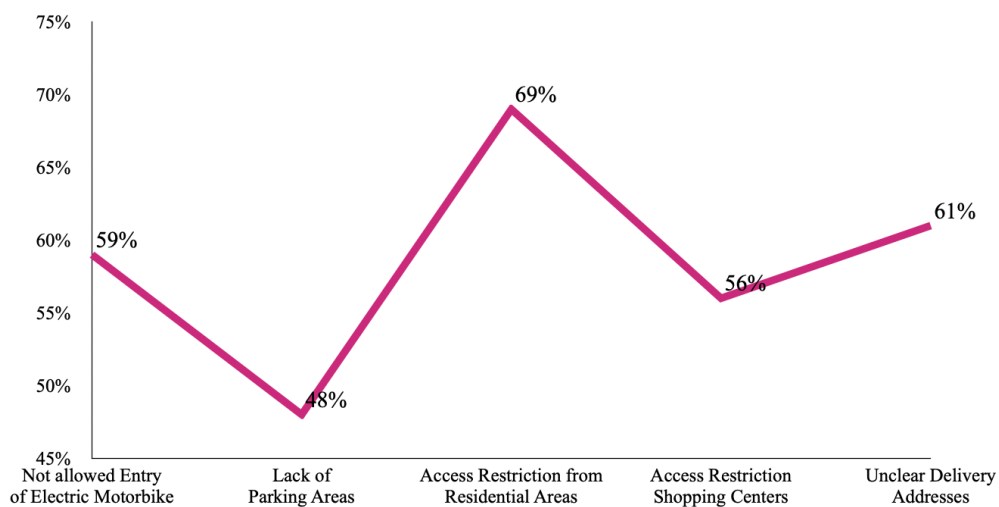


Figure 3 Difficulties during delivery (last-mile)

Figure 3 shows that 61% of respondents have faced unclear delivery addresses. Additionally, 69% of them can't deliver smoothly because of access restrictions from the residential property. These difficulties demonstrate the universality of the last-mile problem and how it bothers delivery personnels to a great extent.

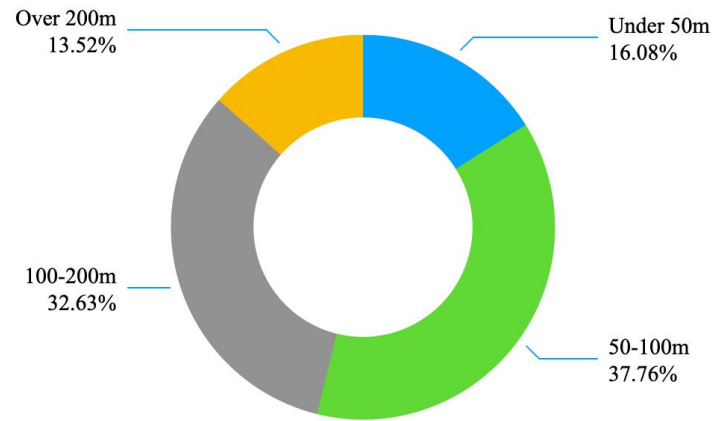


Figure 4 Average walking distance (last-mile)

Figure 4 shows that 37.76% of respondents need to walk 50-100 meters for each order on average, and there are 13.52% of respondents walk over 200 meters for each order. Such results demonstrate the walking distance on average that is related to the last-mile problem, which is commonly 50-500 meters in densely populated cities.

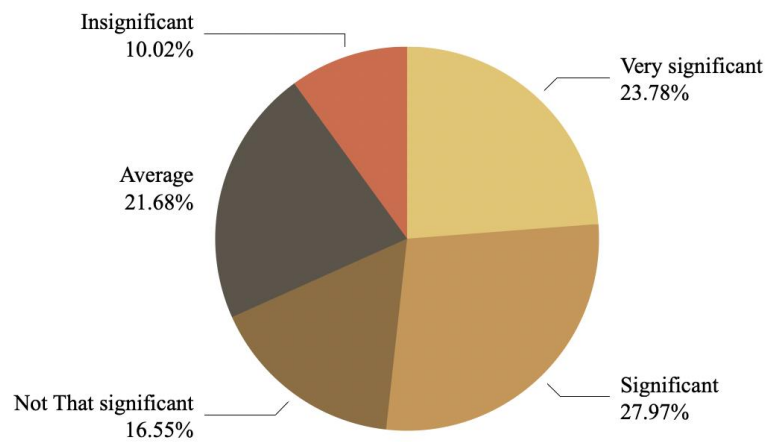


Figure 5 Opinions about route optimization

In figure 5, 23.78% of the respondents claim that route optimization and the improvement on the last mile problem can enhance their working experience very significantly. The pie chart showcases the expectant result that route optimization and improvement on last-mile problem can offer to the delivery workers from their perspectives.

4.3 Optimization Routine Solution Analysis

We use Canva draw this solution picture of the “last-mile” challenge for Meituan platform. By pointing out four aspects solutions, 1). Equipped with intelligent delivery robots; 2). Enhancing the efficiency of Meituan Route planning algorithm, 3). Platforms certify to award riders; 4). Optimizing delivery riders’ equipment, we believe the last miles issues can be solved.

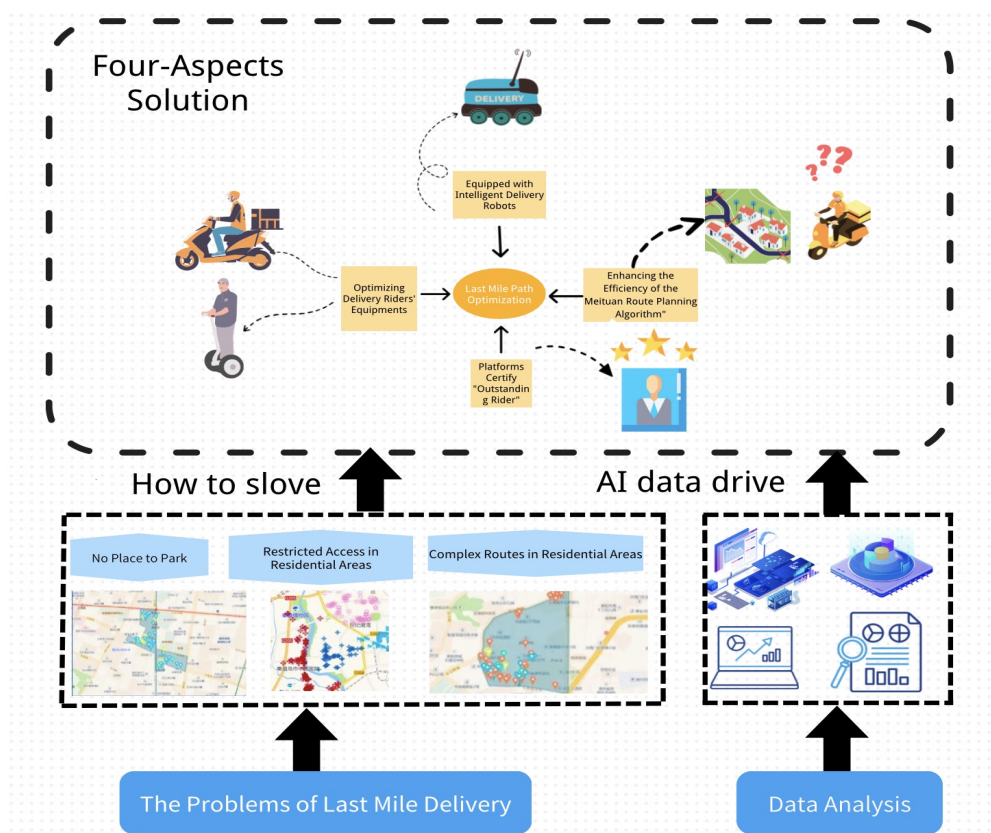


Figure 6. Optimization Routine Solution Analysis

4.4 Cross-Tabulation Analysis

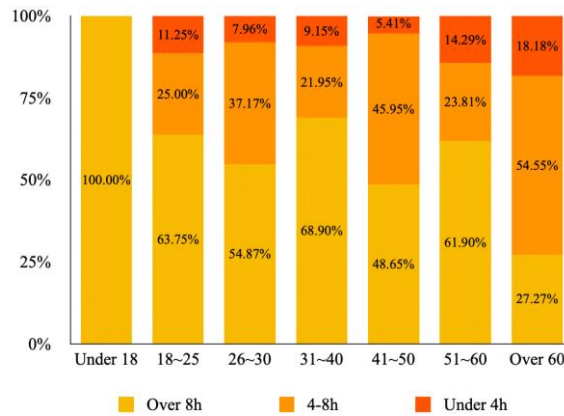


Figure 7 Age Group and Delivery Duration

The data reveals that nearly all riders under 60 years old work over 8 hours daily, emphasizing the physically demanding nature of the job. 3 respondents who answer this questionnaire and are under 18 worked over 8 hours every day. 63.75% of those aged 18–25 work extended shifts, with over half of the riders aged 26–50 also exceeding 8-hour workdays. Even among older riders (51–60), 61.9% still work over 8 hours daily. This trend highlights the heavy workload and long hours required to sustain a stable income in the food delivery industry, reflecting the need for better labor protections and optimized delivery routes to reduce fatigue.

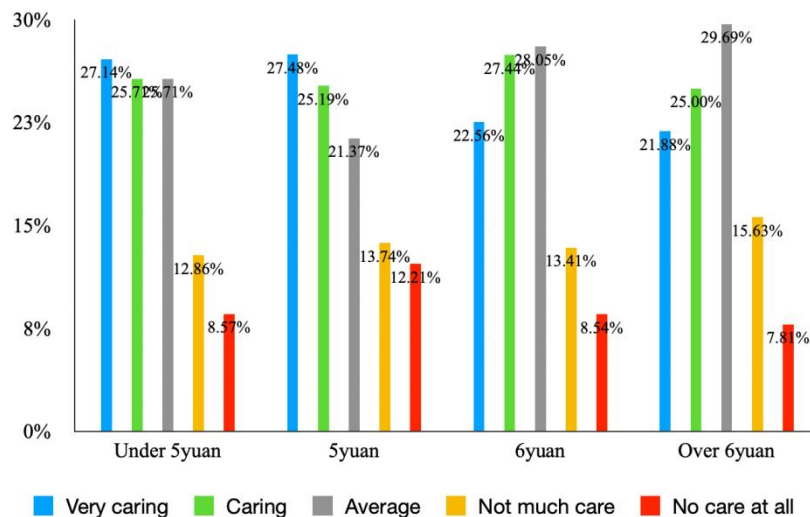


Figure 8 Price Level and Welfare Demand

The earnings per order in figure 8 remain relatively low, leading to dissatisfaction among delivery riders. Riders earning less than 5 yuan per order report a dissatisfaction rate of 21.43%. At 5–6 yuan per order, satisfaction increases slightly, but the overall trend suggests that current payment structures do not fully meet riders' expectations. The results indicate that to improve rider conditions effectively, platforms must focus on optimizing pricing models, enhancing welfare benefits to increase riders' job satisfaction, and ultimately benefiting both workers and the platform.

5. Discussion and Conclusion

This research highlights the significant challenges faced by food delivery workers within Meituan's algorithm-driven ecosystem, emphasizing the tension between technological optimization and workers' well-being. Although Meituan's algorithmic systems enhance delivery efficiency, they impose rigid controls that limit riders' autonomy, contributing to inefficiencies in last-mile delivery and increasing mental stress. Furthermore, inadequate incentive mechanisms, such as low commissions and inconsistent bonuses, exacerbate dissatisfaction and financial insecurity among workers.

In January 2025, Meituan proposed anti-fatigue policies to show the cares of delivery workers, while the issues on “last miles” were still not addressed. This research goes beyond anti-fatigue policies and provides a comprehensive view by capturing both statistical trends and the personal experiences of riders.

The limitation of this research lies in the geographic scope. This research only works in Shenzhen, which restricts the generalizability of findings to other regions in

China. Expanding the research to include a broader range of cities would offer a more representative picture of delivery workers' conditions. Second, the sample size was relatively small, and reliance on delivery station managers for survey distribution may have introduced response bias.

Additionally, our research objectives evolved during the study. Initially focused on optimizing Meituan's dispatch algorithms, we shifted to addressing labor rights upon discovering these concerns were more pressing for riders. This shift highlights the complexities of researching gig economy platforms.

While our mixed-methods approach was a notable strength, integrating data from different methodologies presented challenges, especially when qualitative insights conflicted with quantitative trends. For instance, we interviewed a 28-year-old part-time rider who only accepted 10 orders per day, whereas the questionnaires indicated that nearly 90% of riders worked over four hours and more than 50% worked over eight hours daily. In this context, the study should increase the number of rider interviews and potentially include interviews with Meituan's administration team.

In conclusion, this research underscores the urgent need to balance technological efficiency with equitable labor practices in the food delivery industry. Addressing the limitations discussed, such as expanding the geographic scope and refining data collection methods, will strengthen future research and contribute to meaningful policy recommendations for improving the well-being of delivery workers.

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