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Integration of Autonomous Delivery Systems in Event Catering*

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Abstract

The global catering industry, particularly the event sector, requires innovative logistics solutions to optimize last-mile delivery processes, ensure timeliness, and maintain high product quality. The high frequency of catering service use by consumers signals an urgent need for efficient and modern forms of delivery, which is the main focus of this study. Although digital ordering platforms and so-called “crowdserving” have already revolutionized the market, there is a lack of detailed analysis on the integration of fully autonomous delivery systems in event catering, especially in the context of consumer perceptions, concerns, and thorough economic analysis. This paper fills that gap. The study is based on a case study analysis of the implementation of an autonomous catering delivery system in a selected catering establishment, supplemented by a literature review. The methodology included a survey of 40 students at the Rzeszów University of Technology to determine their experiences with catering and attitudes toward ASD, as well as a cost analysis and risk assessment. The results indicate the significant potential of ASD in optimizing logistics, increasing the number of deliveries, and reducing operating costs by up to 60% in the long term. Consumers perceive ASD as useful, appreciating its reliability, but express concerns about technical safety, transported meals, interaction with the environment, and the impact on the labor market. Moderate social acceptance highlights the need to address these challenges for successful implementation.

Keywords: last-mile logistics, autonomous delivery systems, event catering, delivery robots

Introduction

The global catering industry is a dynamic and fundamental sector of the hospitality economy, providing food services for a wide range of events, from corporate meetings to private celebrations. Valued at billions of dollars annually, the sector is constantly striving to innovate and optimise its operations to meet evolving customer demands and market challenges (Tien et al. 2021). A critical aspect of catering services, especially for events, is the efficient and timely delivery of food, often referred to as 'last-mile logistics'. This phase of the supply chain is often plagued by inefficiencies, including traffic congestion, high operating costs, and the need for precise planning to ensure food quality and customer satisfaction.

In response to these challenges, technological advances have accelerated the development and implementation of autonomous delivery systems across various sectors, including food services. Applications such as HelloFresh, GrubHub, DoorDash, and Uber Eats have already revolutionised consumer engagement by offering convenient, intuitive ordering and delivery methods (Burrell et al. 2023; Sykimte 2023). These innovations point to a significant paradigm shift in how food is transported and delivered, promising increased efficiency, reduced operating costs, and potentially improved customer experiences (Rodgers 2006, Sykimte 2023).

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Despite the growing popularity of digital ordering and delivery platforms, the integration of fully autonomous systems such as delivery robots and drones in the specialised context of event catering remains a nascent but rapidly developing field. Research into the practical implementation, operational feasibility and customer perception of these advanced systems is crucial to understanding their potential to transform the event catering landscape.

This article aims to explore the multifaceted integration of autonomous delivery systems into event catering services. A case study describes in detail a project to implement an autonomous catering delivery system in a catering facility. This empirical basis is complemented by a comprehensive literature review that aims to contextualise the findings, identify broader trends, and highlight the challenges and opportunities associated with this technological frontier.

Literature Review

The catering industry, a key component of the broader hospitality sector, is characterised by diversity and complexity, serving various segments ranging from large public events to intimate private celebrations (Tien et al. 2021). The main objective in managing these events is to ensure high customer satisfaction while minimising operational inefficiencies such as food waste (Tien et al. 2021). Customer satisfaction in catering is deeply dependent on several key factors. Research consistently highlights the paramount importance of food quality, including taste and ingredients, as well as the professionalism and responsiveness of service staff (Doppler et al. 2020, Hariharan et al.2024). A memorable, holistic dining experience is created not only by the culinary offerings, but also by the quality of service during pre-event and event planning, the aesthetic presentation of the food, and the overall consistency between the event design, atmosphere, and culinary theme (Doppler et al. 2020).

The event planning industry, in which catering plays a central role, recognises that increasing customer satisfaction is essential to overall performance (Shi 2020). Factors influencing this satisfaction include the physical environment, service climate, employee characteristics and attitudes, and even the role of social media. The professionalism of suppliers, including catering companies, is a determinant of an event's success (Shi 2020). The quality of service in traditional catering companies goes beyond simply providing tasty food; it includes creating memorable experiences from the initial enquiry to after-sales activities, directly influencing customer perception, word-of-mouth recommendations and repeat business (Hariharan et al.2024).

Last-mile logistics represents the final and often most challenging segment of the supply chain, focusing on the direct delivery of products to the end consume (Seghezzi et al. 2020). In the context of food service and catering, LML is particularly complex due to stringent requirements for speed, efficiency, and product quality maintenance (e.g., food temperature and freshness) (Yıldız et al. 2019). The rapid growth of the e-commerce sector and changing consumer habits have intensified the demand for fast, efficient and flexible delivery solutions. LML is critical to customer satisfaction and cost efficiency in online commerce, and poor logistics performance can undermine business success (Seghezzi et al. 2020). Key challenges in LML include the dispersed distribution of small collection points, growing demand for faster deliveries, and new time constraints (García-Retuerta 2023).

Digital innovations have significantly changed food delivery. Online food ordering systems, facilitated by mobile applications and websites, have revolutionised the dining experience by offering convenience and efficiency (Burrell et al. 2023, Sykimte 2023). These platforms have enabled companies to reach customers directly and streamline operations, leading to growing demand for such digital solutions (Sykimte 2023). The emergence of "crowdserving," a model that utilises individuals with available transportation for delivery tasks, has also contributed to increasing the pool of available couriers and providing additional sources of income. However, these evolving models also present operational challenges, including managing flexible delivery fleets and ensuring service quality (Yıldız et al. 2019).

Autonomous delivery systems represent a significant technological innovation that aims to address many of the inherent challenges in last-mile logistics. These systems, which include autonomous vehicles and robots, are designed to operate without direct human intervention, offering potential benefits such as reduced costs, minimised delivery errors, shorter delivery times and lower energy consumption (Schnieder 2022).

The use of autonomous delivery systems is gaining popularity in various urban environments. Examples include UPS testing home deliveries by drone, JD.com deploying autonomous vehicles for urban deliveries, and various start-ups developing unmanned delivery robots capable of navigating urban areas (Yu 2020). Small autonomous ground vehicles are particularly favoured for urban distribution due to their potential to reduce local emissions and their suitability for short-distance deliveries on campuses and in residential areas (Genua Cerviño 2024, Yu 2020). These robots can operate around the clock, effectively alleviating labour shortages and providing greater predictability for urban deliveries. The development of robust planning and perception systems is critical for the effective operation of these autonomous food delivery vehicles (Piñero Estrada et al. 2023).

The successful integration of autonomous delivery systems in catering depends not only on technological capabilities, but also to a large extent on customer perception and acceptance (Said et al. 2023). Research indicates that customer behaviour and attitudes towards new technologies, such as autonomous vehicles, are crucial. In particular, the study aimed to determine customer behaviour in the context of catering services and their attitudes towards autonomous vehicles, as well as to identify key concerns regarding autonomous delivery systems. Initial results from a survey of university students revealed a high frequency of catering service use, suggesting a market open to innovative solutions, including autonomous delivery. However, concerns such as delivery time and cost remain important factors influencing customer choices between in-person collection and delivery services. Understanding and addressing these concerns, including potential psychological barriers and social integration issues, is critical to the widespread adoption of ADS (Montero-Vega et al. 2025).

Beyond efficiency and customer satisfaction, the catering industry is increasingly analysing its environmental and social footprint. Growing global concerns about sustainability and ethical practices are profoundly affecting food supply chains and catering operations (Krishnan et al. 2019, Kumar 2024). Sustainable catering includes strategies such as reducing meat consumption, sourcing ingredients from local food systems, respecting seasonality, and implementing zero-waste approaches to food preparation (Lamy et al. 2022).

Key aspects of sustainable catering practices include implementing waste reduction plans, using recyclable and compostable materials, minimising single-use plastics, and supporting local farmers and producers through 'Km 0' meals (Brescia-Zapata 2023). The pursuit of sustainability requires food companies to integrate these practices to improve overall efficiency while meeting environmental and ethical requirements (Minardi et al. 2021). This includes mitigating environmental impacts through energy-efficient cooking methods and effective waste management (Li 2024). Public catering, in particular, offers significant leverage to promote sustainable nutrition through changes in kitchen practices and food offerings (Speck 2022). Ethical considerations include animal welfare, food waste, and the role of technology in promoting responsible eating habits. The challenge is to find a balance between traditional culinary customs and contemporary sustainability imperatives (Kumar, 2024).

Methodology

The study analysed a case study of the implementation of an autonomous catering delivery system in a selected catering establishment, supplemented by a review of the scientific literature. The methodology used in the case study included a research approach based on a survey conducted among students of the Rzeszów University of Technology to examine their experiences with catering services and attitudes towards autonomous delivery systems.

The key elements of the case study methodology included:

- Survey: The survey questionnaire was designed to collect data on the frequency of catering service use, delivery preferences (personal collection vs. remote delivery), and perceptions and concerns about autonomous delivery robots. The survey was conducted on a group of 40 students.
- Cost analysis: The costs of the current delivery system at a selected catering establishment were calculated and compared with two models for implementing autonomous delivery systems, allowing for an assessment of potential savings and efficiency gains.
- Risk assessment: The project included an analysis of the risks associated with the introduction of autonomous delivery systems, including technological, legal and social aspects.
- Solution selection: Based on market analysis and available technologies, a specific autonomous solution (from Delivery Couple) was selected for potential implementation, assessing its financial model and origin.

Results

The results provide insight into the potential for implementing autonomous delivery systems in the catering industry, as well as into the perception of this technology by potential users.

A survey conducted on a group of 40 students at the Rzeszów University of Technology showed that a significant proportion of respondents regularly use catering services. A high percentage of people were found to use catering services at least once a month, which indicates the high dynamics of this market and its potential for innovative solutions. Such a high frequency of use of catering services indicates a demand for effective and modern forms of delivery.

Preferences regarding the method of ordering takeaway meals, depending on the distance from the restaurant, were also examined. In addition, among the group of 32 respondents who ordered both remotely and in person, the reasons for choosing these behaviours were identified. This data is key to understanding what factors influence consumer decisions and how autonomous delivery systems can influence these preferences.

The survey results were used to assess customers' attitudes towards autonomous vehicles and to identify the biggest concerns about autonomous delivery systems. Autonomous delivery robots were seen as a useful solution, especially in terms of increased reliability and predictability of deliveries compared to traditional methods, as robots are not susceptible to human factors. It was also found that autonomous delivery robots could benefit the elderly and disabled.

Despite the potential benefits, key concerns were also identified among respondents, with 19 out of 40 respondents indicating their concerns, the most important of which were:

- The possibility of serious robot malfunctions (e.g. fire, battery explosion) -- indicated by 42.1% of respondents.
- The safety of the meal being transported -- indicated by 36.8% of respondents.
- The safety of people and animals in the vicinity of the robot -- indicated by 31.6% of respondents.
- The possibility of the robot getting lost on the delivery route -- indicated by 31.6% of respondents.
- Reduced capacity of pedestrian and bicycle routes in the event of a large accumulation of robots in one place -- indicated by 31.6% of respondents.
- Reduction in the number of jobs in the catering delivery market -- indicated by 21.1% of respondents.
- Difficult access for the robot to the customer's place of residence -- indicated by 15.8% of respondents.

The assessment of public acceptance showed that only 19 out of 40 respondents reported concerns, suggesting a moderate level of acceptance but also a need to address the identified risks.

The financial analysis carried out as part of the project included a calculation of the costs of the current delivery system and a comparison with two models for implementing autonomous delivery systems. The study showed that the interaction of the systems (traditional and autonomous) could bring minimal financial savings, but at the same time increase the number of deliveries made, which translates into an increase in the turnover of the catering establishment.

In the model assuming a complete takeover of the delivery market by autonomous delivery robots, savings of around 60% are expected compared to the traditional system. However, it should be noted that this model is currently difficult to implement due to insufficient technological development.

The main anticipated benefits of implementing an autonomous delivery system include:

- Optimisation of logistics processes, allowing for more efficient operations.
- Increased predictability and repeatability of deliveries, as robots travelling on cycle paths and footpaths are not susceptible to traffic disruptions.
- Minimisation of the impact of staff turnover, reducing problems associated with driver unavailability and training costs.
- Promotional potential for the premises.
- The possibility of waiving the delivery fee charged to the customer, which will increase the attractiveness of the offer.

As part of the work, an assessment of the risks associated with the introduction of autonomous delivery systems was carried out. Attention was drawn to the risk associated with potential changes in legal regulations that could prevent the use of Delivery Couple's solution in its current state of technological advancement. The risk of lack of public acceptance was also highlighted, although the survey helped to determine attitudes towards autonomous solutions and identify concerns.

Based on a review of the literature and a comparison of solutions available on the market, Delivery Couple's solution was selected. Key aspects influencing this choice were the favourable financial model and the origin of the solution. The project involved the implementation of this solution in a selected catering establishment.

Discussion

The results of the case study analysis, combined with the literature review, shed light on the complexity and potential of integrating autonomous delivery systems into the event catering sector. The case study provides unique data on consumer perceptions of this technology and economic analysis, while the literature review places these findings in a broader academic context. The high frequency of catering service use by respondents confirms

the dynamic nature of the market and indicates a demand for innovative logistics solutions. Autonomous delivery systems have the potential to significantly optimise last-mile logistics processes, which is crucial in event catering, where timing precision and product quality maintenance (e.g., meal temperature) are critical (Seghezzi et al. 2020, Yıldız et al. 2019). The study showed that autonomous delivery systems can increase the number of deliveries made and the turnover of a catering establishment, even if the initial financial savings are minimal. In the long term, when fully implemented, savings can reach around 60% compared to traditional methods.

The concept of "crowdserving" (Yıldız et al. 2019) and digital ordering platforms (Burrell 2023, Sykimte 2023) have already revolutionised food delivery, and autonomous delivery robots are a natural evolution of these trends (García-Haro et al. 2020, Hossain 2023). Their ability to operate around the clock and their independence from human factors such as driver unavailability or staff turnover translates into increased predictability and repeatability of deliveries, which is invaluable in managing large events (Tien et al. 2021).

An analysis of consumer perceptions of autonomous delivery robots reveals a dual perspective. On the one hand, respondents appreciate their usefulness and potential benefits, especially in terms of reliability and the ability to support the elderly and disabled. On the other hand, there are a number of significant concerns that need to be addressed. The most significant of these relate to technical safety (robot malfunctions, fires, battery explosions), the safety of transported meals, and the safety of people and animals in the robot's environment... These concerns are consistent with broader findings in the literature on the acceptance of new technologies, where safety, reliability and ethical issues are key (Kumar 2024). Concerns about robots getting lost, reduced traffic flow and job losses in the delivery industry are also important social aspects that must be taken into account in the development and implementation of autonomous delivery systems (Ivanov et al. 2022). The partial concerns expressed by less than half of the respondents suggest that, although there is initial acceptance, education and transparency regarding the safety and functioning of these systems will be crucial for their mass adoption (Montero-Vega et al. 2025, Said et al. 2023).

The implementation of autonomous delivery systems also presents regulatory challenges. As indicated in the case study, potential changes in legislation may affect the usability of existing solutions. This is particularly relevant given the rapid development of technology and the often slower process of legal adaptation (Basu et al. 2024, Kovacic et al. 2023, Nweje et al. 2025).

Furthermore, in the context of sustainability and ethics in catering, the integration of autonomous delivery systems must be considered holistically (Krishnan et al. 2019, Kumar 2024). Although autonomous delivery systems can contribute to reducing emissions in urban Logistics (Schnieder et al. 2022, Yu et al. 2020) and reduce food waste through delivery optimisation (Tien et al. 2021) the carbon footprint of robot production and disposal, as well as their impact on local urban ecosystems, must also be taken into account (Alverhed et al. 2024). Integrating autonomous delivery systems with broader sustainable catering practices, such as sourcing local ingredients and minimising waste (Brescia-Zapata 2023, Lamy et al. 2022) can increase their positive impact.

The choice of Delivery Couple's solution based on its favourable financial model and origin is understandable from a business perspective, but in a broader academic discussion, it would also be worth examining how this particular solution addresses identified consumer concerns and sustainability challenges.

In summary, autonomous delivery systems offer significant operational and economic benefits for event catering. However, their successful implementation requires not only further technological development, but also proactive management of consumer concerns, regulatory adaptation and integration with broader sustainability goals.

Conclusions

The integration of autonomous delivery systems in the event catering sector is a promising path for innovation, operational efficiency and sustainability. The case study, based on a project to implement an autonomous catering delivery system in a selected catering establishment, combined with a review of the literature, provided a comprehensive picture of the potential, challenges and prospects of this technology.

The main conclusions from the analysis are as follows:

- Market potential and logistics optimisation: The catering services market is highly dynamic and in need of innovative solutions, especially in the area of last-mile logistics. Autonomous delivery systems have the ability to significantly improve delivery processes, increasing their predictability, repeatability and reliability, which is crucial for maintaining the quality of catering services. In the long term, they can generate significant financial savings for catering businesses, exceeding 60% compared to traditional delivery methods.

- Public acceptance and key concerns: Consumer opinion surveys indicate moderate but growing acceptance of autonomous delivery systems (Montero-Vega et al. 2025), particularly due to their potential usefulness and support for the elderly and disabled. Nevertheless, for full implementation, it is necessary to address significant concerns regarding the technical safety of robots (breakdowns, battery fires), the safety of delivered meals, interactions with humans and animals, as well as issues related to the capacity of urban transport routes and potential job losses.

- Regulatory and environmental challenges: Technological development often outpaces the adaptation of legal frameworks, creating regulatory risks for the implementation of autonomous delivery systems. This is particularly relevant given the rapid development of technology and the often slower process of legal adaptation (Kovacic et al. 2023, Nweje et al. 2025). Furthermore, although autonomous delivery systems can contribute to reducing emissions in urban logistics (Schnieder et al. 2022, Yu et al. 2020) and reducing food waste through delivery optimisation (Tien 2021), their overall impact on sustainability requires further assessment, including aspects of the life cycle of robots and their integration with broader green practices in catering, such as waste minimisation and local food sourcing.

- Recommendations for further research and practice:

- Further field testing and piloting: Extensive testing of autonomous delivery systems in real-world event catering conditions is necessary to verify their effectiveness, reliability, and safety in diverse urban and rural environments.

- Safety-oriented technology development: Manufacturers of autonomous delivery systems should prioritise the further development of safety systems to effectively minimise the risk of breakdowns and collisions, as well as to build public trust (Esmaili et al. 2025).

- Consumer education and public dialogue: Educational campaigns should be conducted to inform the public about the benefits and functioning of autonomous delivery systems, while openly addressing public concerns, including those related to ethics and the impact on employment (Pani et al. 2020, Pettigrew et al. 2024).

- Cooperation with regulators: It is important to actively engage in dialogue with regulatory authorities to develop an appropriate and flexible legal framework that will enable the safe and effective implementation of autonomous delivery systems (Kovacic et al. 2023).

- Integration with sustainable practices: Future implementation projects should holistically integrate autonomous delivery systems with broader sustainability strategies in catering, maximising environmental benefits and minimising negative impacts (Alverhed 2024).

- In summary, autonomous delivery systems have the potential to fundamentally transform event catering, offering not only increased efficiency and cost reduction, but also new opportunities to create value for the customer. However, the key to success will be a responsible approach that takes into account both technological and social and environmental aspects.

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