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Article

Lorry Park Selection Criteria and Drivers' Preferences: A Study from the UK

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Abstract: Increasing urbanization and economic activities has intensified the need for logistical processes in cities. This leads to higher levels of urban freight transport, which is associated with negative social and environmental impacts. Advances in urban logistics can help to alleviate these problems; the recent literature suggests that the creation of appropriate lorry park facilities can represent one of the possible solutions to the social and environmental issues connected to freight transport in urban areas. However, in order to be effective, such facilities need to be properly designed; studies which identify critical success factors for lorry park operations are currently lacking. As such, the purpose of this research is to identify the main criteria which lorry drivers consider when selecting a lorry park facility. In order to achieve these aims, a questionnaire survey was designed; responses from 99 lorry drivers operating in the United Kingdom were collected. Through descriptive statistics, followed by the usage of a conjoint analysis, the main results show that attributes related to food, price, and security are the most important to lorry drivers and are likely to determine the success of such initiatives. These results can provide information to policy and decision-makers related to the design of lorry park facilities in order to achieve the desired results in urban areas.

Keywords: urban freight transport; lorry parking; sustainable urban logistics; urban logistics planning

1. Introduction

Around 55% of the world's population lives in urban areas and it is estimated that this figure will reach 68% by 2050 [1]. In particular, it is estimated that the level of urbanization in Europe will increase to 82% by the year 2050 [1]. As a consequence, urban freight transport figures are also increasing. Only in the United Kingdom, 1.89 billion tons of goods were transported by heavy goods vehicles (HGVs) in 2016, with a 15% increase over 2015 [2]. In addition, the annual moving distance of trucks is also increasing gradually in proportion to the increased cargo volume. Similar figures can also be observed for rest of the European countries. In terms of ton-kilometers (tkm), European road freight transport increased by 4.5% from 2016 to 2017. In 2017, the European road freight transport was the highest recorded over the last 5 years; it increased by 11.8% from 2013 to 2017 [3].

According to [4], increasing urbanization and subsequent economic concentration will promote supply chain activity in cities, as urban freight transport is a necessary factor in fostering urban economic systems, being an important facilitator of economic growth [5]. Increasing freight transport in urban areas is however associated with certain problems, which can be classified into social, economic, and environmental issues [4,6–12]. Social problems include road congestion, noise pollution, and safety. Among economic problems are cost and economic losses because of delivery delays. Environmental issues include air pollution and energy consumption. It is estimated that urban freight represents

10 to 15% of vehicle equivalent miles travelled on city road networks, and is responsible for 25% of the urban transport-related CO_2 emissions and 30 to 50% of other transport-related pollutants, such as particulate matters (PM) and nitrogen oxide (NOx) [13]. This variety of problems highlights the tension between the increasing need for urban freight transport and sustainability.

Nevertheless, with good planning and governance, the increasing concentration of people in urban settlements can facilitate economic growth and social development, while also offering opportunities to mitigate the adverse impacts of consumption and production patterns on the environment. In this regard, advances in urban logistics operations and improved local authority planning, especially in the field of the urban freight transport, can alleviate the associated negative environmental and economic impacts occurring in cities. In this sense, several measures including access and time restrictions, low-emission zones, provision of urban consolidation centers, and the introduction of new vehicle technology have been adopted to improve the efficiency of freight operations, including the provision of appropriate parking arrangements for freight vehicles [14].

Summarizing, there exists certain problems associated with urban freight transport and, given their level of importance, a set of potential solutions should be implemented in order to realize sustainable urban freight transport. These potential solutions should be based on policy development from national and local governments, technological innovation, and development of logistical solutions, in which we could place the provision of lorry parks [15,16]. According to [17], parking policies and transport infrastructure supply are considered the most powerful means that urban planners and policymakers can use in order to manage and shape travel demands and traffic congestion in urban centers, and the problems associated with them. Also, according to [14], lorry parks can be cited as potential solutions in order to realize sustainable urban freight transport and to solve some of the problems mentioned above. In the same vein, delivery bay availability for loading and unloading operations is critical to reduce times and costs of logistics operations, as well as for improving city sustainability and livability [18]. These authors point out that defining the appropriate number of delivery bays, together with their location, is one of the main tasks in addressing traffic problems in cities and, subsequently, the problems associated with them. Also, the management of parking lots in the urban area is a long-term issue when on- and off-street, or even illegal, parking has not been monitored efficiently. Moreover, increasing private vehicles generate corresponding travels and parking spaces, hence parking lots need an appropriate distribution in the urban area [19]. Because of all the above, it could be posted that defining appropriate and attractive parking spaces is a solution and is critical for improving city sustainability.

A lorry park is defined by [20] as "a broad term covering all parking areas deemed to be on-site from a local council car park which allows overnight lorry parking to a secure independent facility."

It could be assumed that when lorry parks are available and are attractive to drivers, they are less willing to park their lorries inappropriately inside urban areas, and therefore, social and environmental unintended consequences associated with freight transport in urban areas can be minimized. Lorry park customers are drivers, and knowing what is attractive to them is critical to implement a lorry park facility in which they want to park their lorries. The more attractive a lorry park is, the less lorries will be parked inappropriately in urban areas. In this sense, studies that allow to discover how lorry parks may motivate lorry drivers to use lorry park facilities are needed. In other words, it is necessary to find out how to better market lorry parks to lorry drivers.

In this context, the purpose of this paper is to identify the preferences of heavy good vehicles (HGVs) drivers when selecting truck stops and explore the factors for sustainable operation of lorry parks. This purpose is expressed through the following research questions:

RQ1: Why do drivers park trucks at unauthorized parking spaces instead of lorry parks?

RQ2: Which characteristics of lorry parks are the most attractive to drivers when selecting where to park their vehicles?

With the aim of addressing these questions, the paper provides a market survey of professional users of lorry parks with the objective of finding out how to better market lorry parks to lorry drivers.

A study has been carried out over a sample of lorry drivers operating in the UK. As such, this work might be of interest to the logistics service providers industry as well as to stakeholders interested in developing and running lorry parks. The results and the consequent conclusions may serve as guide for making decisions related to the proper designing of sustainable lorry park facilities as a solution to sustainability issues associated with urban freight transport.

The paper is divided into five sections: (i) introduction, (ii) material and methods, in which the background and the methodology are developed; (iii) results; (iv) discussion; and (v) conclusions.

2. Materials and Methods

2.1. Background

In order to describe the most relevant research on this topic, this section has been divided into three parts. The first one is aimed at describing the main problems associated with urban freight transport. The second one is focused on general issues in lorry parking, such as parking availability, supply and demand balance, and security concerns. The last one is focused on lorry park selection criteria.

2.1.1. Socio-Environmental Problems Associated with Urban Freight Transport

As mentioned in the introduction, increasing freight transport activities in urban areas are associated with certain problems. The impacts caused by urban freight transport are divided into environmental impacts and socioeconomic impacts by [9]. Authors note that environmental impacts include air and noise pollution, while socio-economic ones include traffic congestion, accidents, and land use. Table 1 shows the detailed classification developed by [9].

Table 1. The negative impacts from the freight transport.

Emissions		Water Pollution	Noise Pollution	Congestion	Accidents	Land Use
Air Pollution (Local & Regional)	**Greenhouse Gases (Global)**					
SOx NOx CO VOC Other gases	CO_2-eq (CH_4, N_2O, O_3, CFC, Other gases)	Organic-Petroleum hydrocarbons; Inorganic-Heavy metals from motor vehicles; Microscopic-Cargo -Shipwrecks	0–60 dBA (Quiet/comfortable); 61–85 dBA (Moderate); 86–110 dBA (Very loud); 110+ dBA (Uncomfortable/ dangerous)	Wasting time; Delays; Wasted fuel; Health risk; Wear and tear on vehicles; Inaccurate traveling times	Cost of emergency services; Delay of traffic	Destruction of habitats' Visual intrusion on the landscape; Disruptive effect

Source: [9].

In the same vein, the impacts of urban freight transport and logistics on the overall traffic are amply acknowledged, and the negative impact on traffic performance caused by delivery vehicles has been extensively documented. If parking areas dedicated to delivery activities are not the right size, missing or unavailable, illegal parking, on-street parking, or double loading/unloading malpractices reduce road capacity, hence slowing down traffic flow, and increase interferences with other road users with subsequent risk of accidents [18]. Similarly, commercial vehicle traffic in inner city areas is a matter of concern for city authorities given that it contributes significantly to the traffic congestion, pollutant emissions, as well as to road safety [21]. In some areas, illegal parking is highly used in freight operations and that local authorities often face a dilemma on how to allocate public space among loading/unloading activities, traffic, parking, public transport, and so on [22]. Also, in the context of an urban area that has a parking supply deficit, delivery vehicles tend to park in active traffic lanes (double parking), compromising road capacity, safety and freight carriers cost/service levels and sometimes, vehicles also park on sidewalks, interfering with pedestrian traffic [17]. Beyond the above-mentioned socio-environmental problems associated with urban freight transport, if we put

the focus on inappropriate lorry parking, a number of negative consequences could be identified, such as the interferences in the traffic of the cities, the acoustic pollution, and the air pollution caused by the lorries in the urban areas or the damages in the pavement, among other aspects.

As mentioned in the introduction, solutions should be implemented in order to realize sustainable urban freight transport. The literature proposes parking policies and transport infrastructure supply as key measures to manage travel demand and to improve city sustainability and livability [14,17–19]. In this sense, studies that allow to discover how to motivate lorry drivers to use lorry park facilities are needed.

2.1.2. General Literature on Lorry Parking

As defined in the introduction, a lorry park is "a broad term covering all parking areas deemed to be on-site from a local council car park which allows overnight lorry parking to a secure independent facility" [20]. Lorry parks could be analyzed through the different points of view of involved stakeholders, such as the ones of transport operators, shippers (cargo owners), parking operators, insurers, or customers (lorry drivers). This paper is focused on this last group, lorry drivers, considered as the customers of this kind of facility. Transport companies and trading organizations are concerned about the lack of parking and loading (unloading) spaces [15]. Increased truck traffic because of increased cargo volumes and changes in transportation methods such as just-in-time (JIT) delivery have led to an increase in truck parking demand [23]. Also, complex factors such as increased traffic of commercial trucks, transportation schedules, and regulation of driving time result in the demand for lorry parking spaces [24]. These authors also explain that accidents caused by driver fatigue and undesignated parking may occur when there is not enough parking for commercial trucks. According to [25], the demand for freight transport in urban areas is increasing because of population density caused by urbanization, however, infrastructures for freight transport are limited, resulting in frequent small-scale transport and additional negative impacts.

Although urban freight terminals (i.e., parking, loading and unloading facilities) are efficient alternatives, they are not receiving much attention because of high investment and operating costs. Therefore, the development of lorry parking spaces through public investment results in the enhancement of the logistics service and the quality of transportation [26]. In other words, as it is noted by [27], lorry parks in appropriate locations reduce inefficient trucking, help drivers' well-being, and enable efficient transportation to their final destinations, also reducing unintended social consequences of inappropriate parking.

In addition, the European regulation (EC) No. 561/2006 states that the minimum rest time for large trucks' drivers is 9 to 11 h per day, and drivers must rest for at least 45 min after 4 h and 30 min of driving [28]. This highlights the need for appropriate and secure lorry parking spaces.

Despite the positive impact of using new digital systems on trucks' parking during the last few years, in Germany, the number of trucks on the annual road in 2017 reached 3 million units, having trouble parking in unspecified spaces, as noted by [29]. The survey made by [30] also found that 40 percent of trucks in the United Kingdom were parked in non-designated places at night, and the assigned parking space was 20 percent below the demand of trucks. Additionally, their survey found that more than a thousand cargo-related crimes occurred in the United Kingdom in 2017. Around 72 percent of these crimes occurred outside of the designated parking space, and crimes in lorry parks accounted for 2 percent of all crimes. According to [31], cargo thefts in the EU alone result in direct losses estimated to exceed €8.2 billion per year, with most thefts taking place when trucks are parked. In addition, human trafficking is also a serious concern which needs to be considered when lorry parks are analyzed.

The previous lines lead us to conclude that the supply of lorry parks satisfies the top priority parking spaces. However, most of the previous studies have focused on comparing the demand of existing parking spaces with the demand of lorry parking lots and then calculating the optimum

supply amount or finding the optimal place to supply new lorry parks. Therefore, studies to identify successful factors for sustainable lorry parks are currently lacking and need to be studied further.

In the last few years, the important role of freight lorry parking facilities as a way to reduce troubles and impact of logistical activities in densely populated urban areas has been translating into the existence of studies addressing the related decision-making and management issues. For example, a comparison of parking practices and problems experienced by freight-vehicle drivers in Gothenburg and Delhi was presented by [14]. The study considers parking practices of freight lorry drivers and their opinions about parking availability, using a comparative descriptive method and data from official documents and surveys. The study concludes that freight parking problems are strictly related to local factors; therefore, it is mandatory to consider each case separately. Moreover, authors highlight that solutions to freight lorry parking problems cannot be based on car parking models as driver behaviors introduce different issues. In the same vein, a large and complex survey in order to define a method for analyzing how to improve security inside freight lorry parking areas was conducted by [32]. To this end, authors evaluated the need for parking slots for freight vehicles by comparing current parking slots provision with future demand calculated using the model developed by [23]; such model was calibrated on the characteristics of the area under investigation. Security being among the many issues stressed in the survey, the paper evaluated different policy options in relation to EU standards and associated financial costs. Based on the analysis of the drivers' willingness to pay for a high level of security with the financial costs to achieve it, the authors conclude that such high security parking areas are unlikely to generate any profit. A more complex approach for understanding how urban areas would respond to a new parking policy was proposed by [33]. For this purpose, authors developed a freight transport traffic simulation model. Then, they applied this simulation to model a small study area with two simple policy scenarios. In order to measure the differences between such scenarios, different elements such as time to find parking and walking distance to the final destination were calculated. The results of this study provide a fairly accurate description of the consequences of different policy scenarios; however, given that this kind of approach apparently requires a deep understanding of local freight vehicle flows, it would be hard to apply over a large area.

2.1.3. Lorry Parking Users' Preferences and Level of Importance That They Attach to Their Main Characteristics

A survey of drivers' parking preferences was conducted by [23] though analyzing 14 evaluation criteria (restrooms, location near highway, shower facility, lighting, public phones, restaurant, fuel sales, security presence, repair facilities, prepaid fuel cards, vending machines, entertainment facilities, travel information, internet connection). More than 400 drivers participated in the survey. As a result, they concluded that restaurant, fuel sale, restrooms, shower facilities, location near highway, phones, security, and lighting were evaluated as important factors for using lorry parks and factors such as entertainment facilities, internet connection, and travel information are relatively less important.

Also, survey related to the preferences of drivers for selecting lorry parks was conducted by [34]. They asked drivers three priorities of selection criteria for three different locations: public rest areas, truck stops, and on/off ramps. Their report resulted that the top priority for choosing truck stops is restaurants (61%). Shower (50%), telephone use (44%), long-term breaks (36%), toilet (32%), and equipment checks (31%) are also selected as important factors. Separately, safety was rated 18%.

According to the "lorry parking baseline report" conducted by [35] with the UK Department for Transport (DfT), lorry parking should not follow a specific format, but should be structured differently depending on the purpose, amount, and location, with the exception of minimum requirements. Within this study, high quality security, reasonable price, and clean facilities were considered as drivers' requirements for the development of lorry parks. In addition, DfT actually conducted a survey covering the elements for improving lorry parks by dividing respondents into British and Non-British for drivers using Lorry parks. The outcome of the survey is that British people consider prices a key factor in choosing lorry parks, while non-British people deem security as a priority. Apart from this,

in response to the drivers of the expected factors for each type of lorry parks, securing the shower facilities was the top priority at basic and intermediate levels, and security devices were the most important for premium lorry parks.

Meanwhile, the LABEL project [36] classified the type of lorry parks into security and service, and selected them as five criteria. In this document, level 1 refers to the basic level including lighting and elementary security checks. Level 2 adds security fence, CCTV, and security checks. In level 3, only lorry parks users and staff are permitted to enter as well as all crimes are reported. All situations are monitored by professional staff in level 4. Lastly, all vehicles and drivers are verified in level 5.

The document also classified lorry parks based on the service level offered (Table 2). Level 1 provides the most basic services such as toilets and trash cans. Level 2 includes washing facilities and level 3 is the addition of a shop and a fuel station. Level 4 contains a snack bar and entertainment facilities. Level 5 is the highest level of services such as restaurants and truck washing facilities with all facilities included in level 4.

Table 2. Service level of lorry parks.

Service Level	Description
1	Basic necessities: Toilets, water taps, waste bins/walking and driving across the area should be safe
2	Washing facilities and a more convenient lay-out of the parking area: level 1 + washing facilities
3	Personal hygiene and shop/fuel station: level 2 + showers, a shop and a fuel station
4	Full service for driver and vehicle: level 3 + a snack bar, laundry, spare parts shop, and leisure facilities
5	The high end of comfort levels: level 4 + a restaurant, truck wash, electricity, and snow/ice removal equipment

Source: [32].

The above studies are considered to be useful in selecting elements for sustainable lorry parks management. However, these studies are based on a descriptive analysis of the responses provided by lorry drivers to direct questions about the importance they attach to different criteria. Besides that, these studies have been in existence for more than a decade since its implementation and, as mentioned in the introduction, the current situation has changed deeply in the last few years. Having been identified the creation of lorry parks as a potential solution for some of the problems caused by urban freight transport, it arises a need for studies aimed at identifying successful selection criteria for sustainable lorry parks. Therefore, new studies are necessary to analyze at a deeper level the tendency of the preferences of the lorry drivers for motivating them to park their trucks in lorry parks.

This study responds to this need. On the one hand, it aims at updating the conclusions of previous studies trough a descriptive analysis of the importance that current lorry drivers attach to different lorry park's selection criteria. And, on the other hand, the study aims at identifying the preference structure of lorry drivers so as to determine which criteria they consider in choosing truck stops. This analysis will allow us to discover what level of relative importance they attach to these characteristics and which level of the attributes analyzed provides a greater utility for them in their preference structure.

2.2. Research Questions and Objectives

As it was mentioned in the introduction, two research questions were stablished:

RQ1: Why do drivers park trucks at unauthorized parking spaces instead of lorry parks?

RQ2: Which characteristics of lorry parks are the most attractive to drivers when selecting where to park their vehicles?

With the aim of getting a response to these research questions, the main objective of this research is to identify the preferences of heavy good vehicles (HGVs) drivers when selecting truck stops and explore the factors for sustainable operation of lorry parks.

This main objective is divided into two specific objectives:

(O1) To analyze the preference structure of HGVs drivers so as to determine which criteria they consider in choosing truck stops. This analysis will allow us to discover what level of relative importance they attach to these characteristics and which level of the attributes analyzed provides a greater utility for them in their preference structure.

(O2) Via a descriptive analysis of the responses to a number of direct questions, it is intended to identify the HGVs drivers' evaluation of and willingness to pay for a set of existing services from lorry parks.

Prior results of the studies conducted by [23,34] will serve as comparative framework to discuss our own results. Those studies indicated that restaurant and safety are the factors that drivers consider importantly. These two studies also explained that the public phone in lorry parks are considered as an important factor, adding that entertainment facilities are considered less important. Meanwhile, according to the report written by [34], the cheap price and high-quality security of lorry parks are considered the most significant factors for drivers to select lorry parks. However, the results of the [36] LABEL project do not mention the existence of public phones unlike previous studies. This could be due to the increase in the use of mobile phones during the years after the previous studies. Another distinctive feature is that a shared room with beds for the driver's rest is not mentioned in most studies.

2.3. Methodology

2.3.1. Structure and Design of the Questionnaire

The questionnaire has its basis on a series of previous studies aimed at analyzing the needs of the lorry drivers when deciding to stop in lorry park facilities and rest areas [23,34,35]. An adaptation was made in line with the goals of our research.

The final questionnaire is divided into three fundamental parts. The first one contains questions aimed at learning about professional aspects and main characteristics of lorry drivers operating in the United Kingdom.

A second part of the questionnaire is intended to analyze the lorry driver's valuations of certain services associated with lorry parks. Specifically, in terms of the importance that lorry drivers attach to these services when selecting where to park their lorries to have a rest. This section is divided, in turn, into two parts. The first one uses a compositional method to analyze driver evaluations. That is, it tries to obtain the driver's evaluation of the attributes through direct questions. The second part of this section uses the statistical technique of conjoint analysis (decompositional method) to know the preference structure of lorry drivers with respect to a series of pre-selected attributes.

A third part of the questionnaire contains a final question regarding the respondents' willingness to pay for certain services such as unlimited Internet Wi-Fi, waste and recycling facilities, lorry washing facilities, entertainment facilities or room with beds, among others.

In compositional methods such as that of our explorative-descriptive part of the questionnaire, direct questions are put in order to evaluate each attribute's relevance. Conjoint analysis, however, uses a decomposition method to determine the customers' preference structure. In particular, it comprises a set of market research techniques that together measure the value that the market places on each feature of the product and predicts the value of any combination of features. In essence, it is all about features and trade-offs. The researcher simulates a real market by presenting the consumer with a set of different lorry parks to evaluate. By analyzing the preferences that they express, one can evaluate the importance they attach to the different attributes of those lorry parks, and the utilities they give to the various levels of each attribute. For this reason, the technique is particularly well-suited to our

objectives. This technique was first used in the field of marketing in the mid-1970s [37]. Since then, it has been extensively applied to different fields [38].

Among the stages carried out for the design of the conjoint analysis is to decide the attributes and levels to use in the study. To do this, in first place, an analysis of the competition through a literature review was made, in which the basic and differentiating services offered by a set of lorry parks located in different areas of the United Kingdom were defined (see Tables 3 and 4). Second, and in a complementary way, interviews were carried out with industry professionals, which gave us some insights about the characteristics of the sector and helped us to validate the questionnaire. Finally, a group or marketing scholars reviewed the questionnaire to guarantee the content validity.

Table 3. Lorry park rating basis.

Rating	Facilities	Description
1	Toilets	Basic rest area offering truck drivers a place to park and access to toilets.
2	Toilets and Cafe	Basic/medium rest area offering truck drivers a place to park and access basic amenities (toilet and cafe)
3	Toilets, Shower, and Cafe	Medium level facility that offers truck drivers a place to park with shower facilities as well as toilets and a cafe
4	Toilets, Lighting, Shower, café, and Security Fence	Medium/High level facility that offers a degree of secure and safe truck parking while also offering a decent level of facilities for truck drivers.
5	Toilets, Lighting Shower, Cafe, Security Fence Accommodation, and CCTV	High end truck parking facility offering truck drivers a place to park securely and safely while also enjoying extensive facilities.

Source: [26].

Table 4. Number of lorry parks and their ratings in each region.

Region	Number of Lorry Parks Ranked at Each Level					Average Price (£)
	1	2	3	4	5	-
East Midlands	4 (9%)	14 (30%)	22 (48%)	5 (11%)	1 (2%)	£13.2
East of England	2 (7%)	7 (23%)	10 (33%)	8 (27%)	3 (10%)	£18.7
London	1 (25%)	0 (0%)	3 (75%)	0 (0%)	0 (0%)	£21.7
North East	1 (6%)	3 (19%)	10 (63%)	2 (13%)	0 (0%)	£13.5
North West	2 (5%)	4 (11%)	18 (49%)	8 (22%)	5 (14%)	£18.0
South East	4 (8%)	16 (31%)	27 (52%)	3 (6%)	2 (4%)	£18.6
South West	3 (8%)	6 (16%)	18 (49%)	9 (24%)	1 (3%)	£15.5
West Midlands	3 (8%)	6 (16%)	18 (47%)	8 (21%)	3 (8%)	£16.3
Yorkshire and Humber	2 (6%)	2 (6%)	24 (73%)	4 (12%)	1 (3%)	£17.2
England	22 (8%)	58 (20%)	150 (51%)	47 (16%)	16 (5%)	£16.6

Source: [26].

Based on the information obtained through these methods, the conjoint analysis study to be introduced in the final questionnaire was designed. The full-profile method was used, in which the respondent is presented with a single set of stimuli to evaluate. Each stimulus consisted of information about all five of the attributes included in the study. The number of stimuli used in the full-profile method depends on the number of attributes and their levels. There were 48 possible stimuli, but it was carried out an orthogonal design to reduce the combinations to a subset of just 10 (Table 5) because of the fact that such an overload of information would have adversely affected the quality of the responses. The reduction was done in such a way that all the attributes and their corresponding levels were presented with equal unbiased intensity. The attributes and levels introduced are the following:

1. Price: which may be 16 £, 20 £, or 24 £.
2. Meal: one meal may be included in the price or not.
3. Beds: a shared room with beds may be included in the price or not.
4. Level of security: the park may have a high level of security (including a big fence, CCTV, security personnel and an insurance in case of vandalism) or just a standard level of security (including a big fence and CCTV).
5. Entertainment facilities: the park may have TV rooms (including DVD, pay TV, and sport events) included in the price or not.

Table 5. Stimuli presented to respondents.

Lorry Park	Price	Meal	Bedrooms	Security	Entertainment
Lorry park 1	£24	No meal included in the price	Shared room with beds	High level	No entertainment facilities
Lorry park 2	£16	No meal included in the price	No room with beds	Standard level	No entertainment facilities
Lorry park 3	£20	No meal included in the price	Shared room with beds	Standard level	Entertainment facilities
Lorry park 4	£20	One meal included in the price	No room with beds	High level	No entertainment facilities
Lorry park 5	£24	One meal included in the price	No room with beds	Standard level	Entertainment facilities
Lorry park 6	£16	One meal included in the price	Shared room with beds	Standard level	No entertainment facilities
Lorry park 7	£16	One meal included in the price	Shared room with beds	High level	Entertainment facilities
Lorry park 8	£16	No meal included in the price	No room with beds	High level	Entertainment facilities
Lorry park 9	£16	One meal included in the price	No room with beds	High level	Entertainment facilities
Lorry park 10	£20	No meal included in the price	Shared room with beds	High level	Entertainment facilities
Notes: The result of the orthogonal design was carried out by SPSS 25.0					

Source: the authors.

2.3.2. Sampling

The population of this study is composed by lorry drivers using lorry parks in the United Kingdom. According to [39], the number of lorry drivers in the United Kingdom in 2017 is more than 300,000. In addition to the British, lorry drivers in other European countries also use truck stops in the United Kingdom during transport. Therefore, data collection for all objects is impossible in terms of time, cost, and access.

For these reasons, this study selected to disseminate the questionnaire through the social networking site, Facebook. The reason for selecting Facebook was based on different reasons. In first place, as Table 5 shows, Facebook is the most popular site in the world in January 2019 [40]. Second, posting a link to a web-based questionnaire on social media as one of the delivery methods of questionnaire [41]. Dissemination through Facebook has the advantage of not having to incur costs and saving time.

A group named LDUK-Lorry Drivers UK was selected as the target population among the United Kingdom lorry drivers' communities operated on Facebook. This group had 13,153 members at the

time of data collection and is made up of people who are operating HGVs in the United Kingdom and are therefore suitable as participants in this study.

While sampling has the advantages of saving time and money, improving the accuracy of the results, and being able to apply it to the study of various purposes, disadvantages include the possibility of error and bias of the samples [41].

The sampling method for large-scale is suitable for probability (representative) sampling [41,42]. In specific, this study applied the random sampling method among the probability methods. Random sampling is referred by [36] as a representative method of probability sampling, and, as explained by [38], random sampling could eliminate possible bias in sample selection.

According to [38], most researchers use a 95% confidence level to calculate the sample size. Therefore, the sample size was calculated using a confidence level of 95% and applying 10 confidence interval. As a result, the responses of more than 95 participants were derived as the required sample size.

3. Results

3.1. Survey Results

The survey sent through Facebook received 99 responses. The study´s data sheet can be consulted in Table 6. The confidence interval of 99 respondents for 13,000 plus population at the 95% confidence level is 9.81 (t-value). Participants' anonymity was ensured in all processes of the survey. All respondents participated in the survey after being aware of the purpose of the survey and ethical issues in advance. Moreover, no personal information from the participants was included because it was not necessary for the study. As mentioned above, the purpose of the study is to identify the preferences of HGVs drivers for lorry parks services and analyze factors for sustainable operations of lorry parks.

Table 6. The study's data sheet.

Universe: Lorry Drivers Using Lorry Parks in the United Kingdom
Sample size: 99
95% confidence level
Sampling: Non-probabilistic. Questionnaire disseminated through Facebook
Type of survey: Personal, self-administered, fulfilled on-line
Fieldwork: August 2018

Source: the authors.

3.1.1. Sample Description

The majority (86%) of the participants are big-sized truck drivers. Nonetheless, this study included data for medium-sized truck drivers and small-sized truck drivers since they are also customers using lorry parks. As for ownership of the truck, 97% of the participants are driving a truck owned by a company or a third party. Additionally, in the type of transport contract, 92% of participants are employed by a company or an agency, and self-employed is only 8%. These data indicate that most drivers are transporting under company control.

Nearly half (48%) of the participants answered that there is no policy related to parking. This result shows that it might be difficult for the company to raise a problem even if the drivers park their trucks in an undesignated place. With regard to parking of participants' vehicles, 54% of the participants responded that they planned in advance, and 12% of participants usually parked unplanned. Responses to participants' preferred parking places are 50% for lorry parks and public rest areas, 22% for unauthorized space parking, and 28% for convenient parking areas (see Figure 1). These results are in line with the background of this study and support the necessity of utilizing lorry parks.

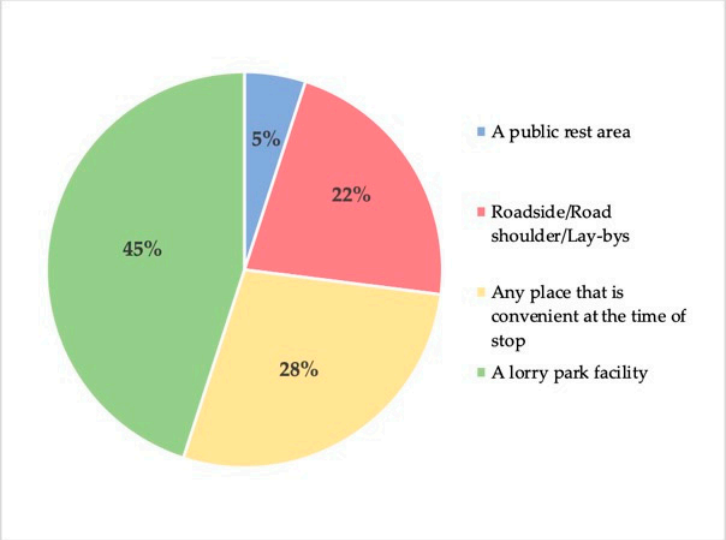

Figure 1. Which place do you prefer the most when you stop to rest?

The question regarding the distance of transport (long-haul or short-haul) was included to analyze the differences in evaluation of lorry parks services between overnight parking drivers and non-overnight parking drivers. 82% of the participants mainly carry long-haul and 18% are short-haul. Based on this data, an analysis of participants' lorry parks evaluation was conducted by dividing into long-haul transport and short-haul transport.

3.1.2. Analysis of Participants' Evaluation of Lorry Parks Services

Reasons for Inappropriate Parking

In the questionnaire, four items concerning the reasons for inappropriate parking (fully-occupied parking spaces, lack of lorry parks, value of lorry parks, high cost) were evaluated by participants, scoring from 1 (totally disagree) to 7 (totally agree). Responses were analyzed separately for the evaluation of long-haul transport drivers and short-haul transport drivers, and analyzed based on the average value for each item. Long-haul transport drivers selected no worth paying for lorry parks (5.02) and the expensive price (5.02) as the most important reasons (Figure 2). The result is consistent with the reason mentioned in an interview with Mr. David Clarkson that drivers tend not to use lorry parks to save money. The evaluation of short-haul transporters also had the highest value of not being worth paying for lorry parks (4.67), but the price index (4.00) was scored the lowest in 4 criteria (Figure 3).

Figure 2. Reasons for inappropriate parking (long-haul drivers).

Figure 3. Reasons for inappropriate parking (short-haul drivers).

Assessment of the Importance of Services Provided by Lorry Parks

In the second section of the questionnaire, participants were asked to directly evaluate the services associated with lorry parks. Thirty-five items were evaluated, and the importance of each item was evaluated from 1 (not at all important) to 7 (extremely important). The importance of each item was analyzed separately for the evaluation of long-haul transport drivers and short-haul transport drivers, and analyzed based on the average value for each item.

The results for this question partially corroborate that price, security, and meal (restaurant/meal included in lorry park price) are the most significant factors for truck drivers to select lorry parks), and also that shared room with beds, public phones have little impact on drivers' choice of lorry parks. Tables 7 and 8 display the importance ranking for services of lorry parks evaluated by long-haul and short-haul transport drivers, respectively.

Table 7. The importance ranking of lorry parks services (long-haul transport drivers).

Services	Score (Average)	Services	Score (Average)
Size of truck space	6.00	One meal included in the price	4.89
Toilets	6.00	Cafeteria	4.86
Number of parking spaces	5.98	Waste and recycling facilities	4.78
Large enough parking spaces	5.94	Fuel sales	4.51
24 h access	5.91	Grocery store	4.35
Showers	5.90	Automatic teller machine	3.73
Safe & clear environment	5.85	Unlimited internet Wi-Fi	3.68
Friendly personnel	5.75	Laundry facilities for drivers	3.56
Proper accessibility	5.74	Vending machines	3.35
CCTV	5.72	Lorry washing facilities	3.32
Security personnel	5.62	TV rooms	2.84
Location close to highway	5.56	Picnic tables	2.69
Located along your transport route	5.56	Lorry repair facilities	2.67
Insurance in case of vandalism	5.52	Rooms with beds	2.62
Timing on your route	5.11	Electric vehicle recharging station	2.59
Restaurant	5.10	Kitchen/kitchenette	2.49
Night lighting	5.04	Public phones	2.33
Loyalty card (e.g., discounts for long-term contract)	4.89		

Source: the authors.

Table 8. The importance ranking of lorry parks services (short-haul transport drivers).

Services	Score (Average)	Services	Score (Average)
Toilets	5.94	Restaurant	4.67
24 h access	5.89	Cafeteria	4.56
Safe & clear environment	5.78	Fuel sales	4.33
Friendly personnel	5.78	Waste and recycling facilities	4.28
CCTV	5.67	Unlimited internet Wi-Fi	4.28
Proper accessibility	5.50	Automatic teller machine	4.22
Showers	5.50	Grocery store	4.00
Large enough parking spaces	5.44	TV rooms	3.67
Size of truck space	5.39	Vending machines	3.56
Insurance in case of vandalism	5.39	Lorry washing facilities	3.39
Number of parking spaces	5.22	Rooms with beds	3.33
Located along your transport route	5.22	Laundry facilities for drivers	3.28
Security personnel	5.17	Picnic tables	3.22
Location close to highway	5.00	Electric vehicle recharging station	3.17
Timing on your route	4.94	Lorry repair facilities	2.89
One meal included in the price	4.94	Kitchen/kitchenette	2.67
Loyalty card (e.g., discounts for long-term contract)	4.89	Public phones	2.56
Night lighting	4.78		

Source: the authors.

Long-haul transport drivers considered sufficient spaces, basic facilities (toilets, shower facilities), security, location of lorry parks, accessibility, and staff friendliness as the most significant factors in the service of lorry parks (Table 7). In contrast, lorry repair facilities (2.67), rooms with beds (2.62), electric vehicle recharging station (2.59), kitchen/kitchenette (2.49), and public phones (2.33) were selected as relatively unimportant factors. Similar to long-haul transport drivers, short-haul drivers also assigned a high degree of importance to basic facilities, accessibility, security, location, and staff friendliness, while those with relatively low importance were similar to long-haul drivers (Table 8). In addition, the scores of the factors related to meal (one meal included in the price, restaurant and cafeteria) were both significantly higher than the average of each case's total score (Long-haul: 4.58/Short-haul: 4.53).

Expectation Price for Extra Services

Section 4 of the questionnaire provides a list of 13 items excluding the basic elements of lorry parks (24 h access, security facilities, toilets, shower facilities, and restaurants) and asked participants to write their expected prices directly. The data from this question is not only valuable to select the expected price when each extra service is introduced, but enables to measure the priority of the extra services.

The data on this question was analyzed based on the total responses without distinction according to the transport distance, since it is the data of expected consumers' expectation price for extra services irrespective of frequency of lorry parks use. Data analysis revealed two interesting facts.

The first is that consumers' expectation prices for lorry washing facilities are the highest of the factors given an average of £8.65 (Table 9). This could have been foreseen because of the current cost of using lorry washing machines, which is between £15 and £20, and because of the information collected in the interviews with the industry professionals.

The second is that prices of services related to meal (one meal included in the price) and security (security personnel, insurance in case of vandalism) are relatively high (from second ranked to fourth ranked) compared to other factors. This result is parallel to the service's importance ranking results.

Table 9. Expectation prices for extra services.

Services	Prices (£)
Lorry washing facilities	8.65
One meal included in the price	6.99
Security personnel	5.08
Insurance in case of vandalism	4.62
Lorry repair facilities	4.56
Unlimited internet Wi-Fi	3.23
Laundry facilities for drivers	2.87
TV rooms including DVD and sports events	2.68
A shared room with beds	2.39
Electric vehicle recharging station	2.13
Kitchen/kitchenette	1.94
Public phones for unlimited national use	1.28
Waste and recycling facilities	1.07

Source: the authors.

3.2. Conjoint Analysis

The scores given by participants to the 10 hypothetic lorry parks (Table 7) were used to estimate the utilities the participants were implicitly assigning to the levels of the attributes considered in the model (Table 10). Conjoint analysis results were obtained through SPSS 25.0, 3 out of 99 responses were excluded from the analysis because they gave the same scores to all conditions. The results demonstrated that, representing the samples as a whole, the preferred lorry parking lot would be a low price including one meal voucher, high level of security, and entertainment facilities but no room with beds. One unique fact was obtained from the analysis results. As for the utility of bedrooms among attributes, no room with beds (0.50) was preferred to shared room with beds (−0.50). This result showed that lorry drivers do not consider bedrooms as the main component of lorry parks.

Table 10. Estimated utility of each level of the attributes.

Attribute	Level	Estimated Utility	Standard Error
Price	£16	−0.56	0.15
	£20	−1.13	0.30
	£24	−1.69	0.45
Meal	One meal included in the price	0.98	0.12
	No meal included in the price	−0.98	0.12
Bedrooms	Shared room with beds	−0.50	0.12
	No room with beds	0.50	0.12
Security	High level (big fence, CCTV, security personnel and insurance in case of vandalism)	0.37	0.12
	Standard level (big fence and CCTV)	−0.37	0.12
Entertainment	Entertainment facilities (TV rooms) included	0.04	0.12
	No entertainment facilities (TV rooms) included	−0.04	0.12
Constant	-	5.35	0.29
Notes: Pearson's R = 0.990, Kendall's tau = 0.909			

Source: the authors.

The validity and reliability of this model were assessed through Pearson's R and Kendall's tau statistics. The closer these two indicators are to 1, the greater the reliability and validity of the analysis because there is a strong correlation between the predicted values in the model and the actual observed values [43]. The Pearson's R and Kendall's tau correlation coefficients for this conjoint analysis are 0.990 and 0.909 respectively. Therefore, this model can be assumed to be representative.

With respect to the relative importance of each attribute in the formation of lorry drivers' preferences (Figure 4), the most important one was meal (one-meal included in the price), with a relative weight 31.13%. Meal was followed by price (22.10%), no rooms with beds (21.53%), level of security (14.66%), and entertainment facilities (10.59%). Hence, these results corroborate that, under equal conditions, meal and price have shown a total of 53.22% significance on the preferences of lorry drivers, which shows that these factors have the greatest impact on driver's selection of lorry parks. Moreover, no rooms with beds is the third highest relative importance among attributes, thus proving that lorry drivers don't want bedrooms. This could be due to the fact that drivers are used to sleeping in their own cabins and they could perceive bedrooms as a useless service that could make the lorry park facility more expensive. The fact that a standard level of security (big fence and CCTV) is guaranteed could have been significant to put that attribute in fourth place in terms of relative importance.

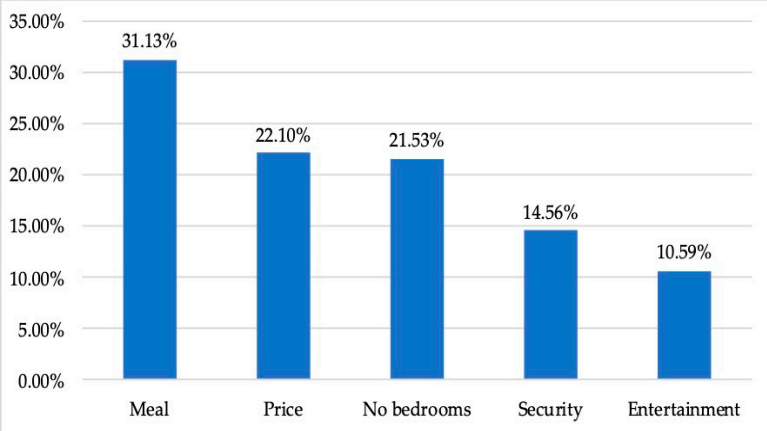

Figure 4. The relative importance of each attribute.

4. Discussion

Sustainability, as a research topic, is not only focused on environmental issues, such as, sustainable development, ecology, or global warming, but also on the social and economic impacts of human activity, among others, freight transport, as can be seen in previous literature [14,17–19,21]. As it was said previously, there exist certain problems associated with urban freight transport and, given their level of importance, a set of potential solutions should be implemented in order to improve the urban sustainability and livability. Advances in urban logistics can help to alleviate these problems; the recent literature suggests that the creation of appropriate lorry park facilities can represent one of the possible solutions to social and environmental issues connected to freight transport in urban areas. However, in order to be effective, such facilities need to be properly designed. In this context, studies which identify critical success factors for lorry park operations are currently needed.

The present study was designed based on these necessities. The previous studies of [23,34,35] applied the method of deriving the results through the direct evaluation of the factors by participants after presenting the factors in advance. To further this method, this study applied the conjoint analysis model, used in marketing field to compare the importance of customers' preferences [37], to enhance the reliability of responses.

In the literature reviewed, restaurant, basic facilities (i.e., toilets and showers), public phone use, security, location, and prices are considered as the most preferred factors of lorry parks [23,34,35]. As a result of the study, basic facilities, security, location, restaurant recorded high scores in the direct

evaluation of the participants as in the previous studies. In addition, meals and prices ranked first and second in the relative importance analysis of five attributes (price, meal, bedrooms, security, entertainment facilities) through conjoint analysis. In contrast, public phones were chosen as the least important consideration in the evaluation from lorry drivers. The result is contrary to [23,34].

Like reviewed literature, which explains that entertainment facilities are not the preferred factor for drivers, the results of the study show that TV rooms received relatively low scores in the direct evaluation of participants and the lowest relative importance (11.39%) in conjoint analysis.

Two interesting results were found in the study. The first is that the cause of the inappropriate parking is that no worth paying for lorry parks and expensive prices accounted for the largest portion. Second, the insurance in case of vandalism included in the factors showed high importance in actual survey results. This factor scored more than 5 points on a scale of 7, regardless of long-haul transport drivers (5.52) and short-haul drivers (5.39).

Except for the above results, this research investigated the necessity of bedrooms in lorry parks, not addressed in reviewed literature. Conjoint analysis results proved that bedrooms have little impact on lorry parks utilization. As anecdote, an anonymous participant in the survey commented that bedrooms would not be a success factor for lorry parks operations since there is plenty of rest place inside the vehicle.

5. Conclusions

As mentioned above, increasing freight transport activities in urban areas is associated with certain problems, which can be classified into social, economic, and environmental problems. Parking policies and transport infrastructure supply are considered the most powerful means that urban planners and policymakers can use in order to manage and shape the travel demand and traffic congestion in urban centers, and the problems associated with them [17]. In the same vein, studies like [14] state that lorry parks can be cited as potential solutions in order to realize sustainable urban freight transport and to solve some of the problems associated to it. This paper assumes that, when lorry parks are available and are attractive to drivers, they are less willing to park their lorries inappropriately inside the urban areas; as such, the more attractive a lorry park is, the less lorries will be parked inappropriately in urban areas. Therefore, designing proper and attractive lorry park facilities would help to minimize social and environmental unintended consequences associated with freight transport in urban areas.

In this context, knowing what is attractive to drivers is critical in implementing a successful lorry park facility. Based on these assumptions, the primary aim of this research was to explore factors for sustainable lorry parks operations. Differently from previous studies, this study incorporated a conjoint analysis method. The findings in the present research have corroborated that price, security, and meals are the most significant factors for truck drivers to select lorry parks. It has been also shown that bedrooms and public phones have little impact on drivers' choice of lorry parks, formulated from the literature review and interviews with industry professionals.

With respect to the direct evaluation of the participants, items related to security (safe and clean environment, CCTV, security personnel, insurance in case of vandalism, night lighting) and meals (restaurant, cafeteria, one meal included in the price) were scored higher than the overall average score. Moreover, in the expectation price results for extra services, the items related to these two factors (one meal included in the price, security personnel, insurance in case of vandalism) were ranked among the top 13 items (from second to fourth). In conjoint analysis, relative importance was given in the order of meals, prices, and security. Public phones were ranked in the bottom of the direct evaluation of participants, and bedrooms were also located near the bottom. In the survey asking for expectation prices, bedrooms ranked ninth and public phones ranked twelfth among the 13 items. Conjoint analysis also concluded that participants preferred lorry parks with no bedrooms.

Based on the results obtained, the "ideal" lorry park is the one with one meal included in the price, restaurant (including cafe, bar), low price, high level of security, 24 h access, large enough spaces, and accessible location. These conditions can be utilized as indicators that contribute to the operation

of lorry parks from a lorry park manager's perspective since these are generated by the evaluation of customers who actually use lorry parks. Through a literature review, the study confirmed that lorry parks in the United Kingdom currently lack supply to demand. Thus, the data in this study provide a rationale for public authorities to build new lorry parks. In addition, research has provided optimal options for constructing lorry parks based on customer preferences, which will contribute to the construction and operation of sustainable and efficient lorry parks for private companies investing in lorry parks. The provision of attractive lorry park facilities will help to minimize social and environmental unintended consequences associated with freight transport in urban areas.

The study has two limitations to advance further research. The first limitation is the results of this study might not be directly applied to other countries or regions. According to [38], customer behavior may vary depending on the political structure of the region or country and the historical background. This study is based on customer evaluations of the United Kingdom lorry parks. Therefore, this study can provide a methodology for studying customer preferences for the factors of lorry parks in other countries where lorry parks are operated. Furthermore, this shows the possibility of developing the direction of comparative analysis of the difference of the results between countries.

Finally, our paper looks into the driver's perspective regarding lorry parks, but there exist other perspectives on the issue, such as the ones of transport operators, shippers (cargo owners), parking operators, or insurers. In this context, a second suggestion for future research would imply these stakeholders in the study.

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