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Regulation of shared electric kick scooters in urban areas: Key drivers from expert stakeholders

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ABSTRACT

Shared electric kick scooters (SEKS) have become widespread in many cities worldwide with great expectations from both users and municipalities. Most cities have not yet passed specific legislation to regulate this new phenomenon, thereby increasing uncertainties across different players such as users, operators, etc. This research provides guidelines for regulating SEKS in urban areas for their successful implementation, taking advantage of a collaborative approach with expert stakeholders that look at the regulation problem from different perspectives. The study focuses on the case of Spain where SEKS have been booming over the last few years. The methodology applied follows a three-step process consisting of the identification of crucial issues and key expert stakeholders, a general survey to them, and a final focus group intended to reach consensus. The paper provides regulatory recommendations in four main areas: market access, technical requirements, traffic and safety, and supervision. It finds large agreement on key aspects such as promoting a homogeneous regulation across the municipalities within the same metropolitan area; establishing fixed bases for parking in the city centre while allowing free floating in low density areas located in the outskirts; and promoting an integration with the public transportation system.

1. Introduction

Recent technological advances bring new opportunities that may have a significantly impact on urban mobility with important implications for the environment. This is the case of app-based electric kick scooter sharing services that enable citizens to gain short-term access to vehicles designed to be ridden generally in an upright position, with a handlebar, deck, and wheels propelled by an electric motor (Shaheen and Cohen, 2019). Shared Electric Kick Scooters (SEKS), which might help reducing traffic externalities, have become widespread in many cities worldwide, generating great interest for both users and municipalities. Dias et al. (2021) provide an overview of the world's SEKS market (operators), being the United States (U.S.) and Europe the areas where companies are mostly operating. The number of SEKS systems has increased since first appearing in the U.S. in 2017, with 248 systems spread across 110 cities by August 2021 (U.S. Department of Transportation, 2022). In Europe, SEKS are available in almost 100 cities. Paris and Berlin appear to be the hub of e-scooter sharing, followed by Madrid and Stockholm (Mobility Mobility Foresights, 2022).

The implementation of these shared services has prompted the study of their impacts by the scientific community. Recent research works address topics related to the impacts of SEKS use on pedestrian safety (Che et al., 2020; Ma et al., 2021), urban planning (Gössling, 2020), mobility demand (Kostrzewska and Macikowski, 2017; Lee et al., 2021), and environmental impacts (Hollingsworth et al., 2019; Severengiz et al., 2020; Wang et al., 2021). However, the regulation of SEKS is an issue that is currently gaining relevance as most authorities have not passed yet specific legislation flexible enough to frame this new rapid phenomenon.

This study advances on the abovementioned issues by providing guidelines for regulating SEKS in urban areas for their successful implementation, taking advantage of the points of view of key expert stakeholders with different perspectives and interests. This research contributes to the existing literature in the following areas: (i) the methodology implemented; (ii) the regulatory aspects studied; and (iii) the policy recommendations provided. The study follows a three-phase

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methodology based on: (i) identification of key regulatory issues and key expert stakeholders with different perspectives; (ii) a general survey, and (iii) a focus group session with expert stakeholders to clarify doubts about the results of the survey and reach consensus. Specifically, the present study addresses the following research questions not studied in detail in previous research works: Which regulatory aspects should cities adopt to provide the most suitable SEKS systems? Is there a common consensus among expert stakeholders in the key drivers for regulating SEKS? If not, which are the reasons for conflict? The paper provides regulatory recommendations in four main areas: market access, technical requirements, traffic and safety, and supervision. The results contribute to the current literature with new findings regarding regulation along with policy recommendations for urban decision-makers.

The article is organized as follows. Section 2 provides a literature review of SEKS regulation. Section 3 describes the SEKS services in Spanish cities. Section 4 includes a detailed description of the three-phase methodology used in the study. Section 5 shows the discussion of the main results from the survey and the focus group. Finally, Section 6 provides policy recommendations and concluding remarks, indicating their limitations and further directions of research in this field.

2. Background

Enacting a good regulation for SEKS is very important as it will benefit all stakeholders (users, operators, local governments, planners, policymakers, etc.). Nowadays, the lack of regulation has kept some cities from allowing the use of e-scooters (Gössling, 2020). Depending on the specific regulatory provision, the norm can be passed at either the country or the city level. Country-level regulations usually deal with standard requirements of the vehicles and traffic rules, whereas city-level regulations focus on other aspects such as parking use, information, and economic regulation of the operators (access to the market, fares, etc.). In the case of Spain, key regulations such as the minimum age for scooter use, maximum speed, helmet requirements, or sidewalk use-fall under national jurisdiction. FERSI (2020) describes the different regulation approaches of SEKS in 18 European countries. They found that many countries are struggling with the legal status of this new transport means and are still working on more targeted legislation.

Since the appearance of the first electric fleet of shared kick scooters on the streets of Santa Monica, California in September 2017, some studies have focused on providing analysis and guidelines for the regulation of SEKS systems. NACTO (National Association of City Transportation Officials) in the U.S. was one of the first organisation to provide them —see (NACTO, 2018) and the updated version in 2019 (NACTO, 2019). It produced recommendations for micromobility regulation and management (focusing on electric kick scooters) based upon North American cities' wide variety of experiences. The guidelines concluded that there are three main regulatory areas where all cities should be aligned: (1) oversight and authority (general provisions, operations oversight, public communication), (2) data standards (provision and access, quality and accuracy, and privacy), and (3) small vehicle standards for the shared-use context. In contrast, they suggested that other areas should remain at the local level, such as parking, community engagement, and equity programs (NACTO 2018, 2019).

Following NACTO guidelines, other recommendations appeared (Mason, 2019; Wood and Bradley Shima Hamidi, 2019; Riggs et al., 2021) based on American cities' experiences or interviews. Mason (2019) identified five best practice areas to provide recommendations for SEKS regulation: (1) enforcement (parking, service areas and maintenance/safety of scooters), (2) fees and funding (annual permitting fee, annual per vehicle fee, and daily fee applied either per vehicle or per trip taken), (3) fleet caps and size (fixed cap, dynamic cap, no cap), (4) data sharing and reporting (information relating to trip duration and route, fleet availability data, etc.), and (5) community engagement and equity (accessibility —both physical and digital—, discount programs, etc.). Based on a structured interview with municipalities and operators in the United States, Wood et al. (2019) proposed basic tips to incorporate into the regulatory framework for the effective management of SEKS and their correct integration. Particularly, it recommended: (i) carrying out pilot programs to collect data and subsequently set the regulation, (ii) setting flexible rules in order to adapt to new changes (they advised cities working with permit regulation as opposed to contracts or ordinances), (iii) make a plan for data gathering, and (iv) setting safety rules intended to avoiding media criticism. In the same line, Riggs et al. (2021) recommended implementing a pilot program to study policies that best align with their goals and objectives.

Regarding the assessment of different regulation frameworks, most of the studies have been focused on cities in the U.S. (i.e. Anderson-Hall et al., 2019; Gössling, 2020; Janssen et al., 2020), and Europe (i.e. Eurocities 2020; Moran et al., 2020 for Austria; Caresse et al. 2021 for Italy; Baeza Muñoz et al., 2021 for Spain). From the American cities experiences, Anderson-Hall et al. (2019) highlighted that greater coordination across cities and the private and public sectors would help adapt regulatory frameworks towards an orderly integration of SEKS. Janssen et al. (2020) identified 12 key-thread dimensions of e-scooter regulation that can be considered and discussed among stakeholders when designing a regulatory framework for shared scooters: the number of operators, fleet size and limits, expansion and downsizing plans, designated areas of operation, permitting fees, hours of operation, speed limit, performance bond, equity, parking regulations, parking fines and enforcement, and data sharing.

From the European experiences, Eurocities (2020) surveyed twenty European cities to understand their approach, challenges and regulatory gaps. Around 80% reported the following frequent challenges: parking and use of public space, driving on pavements, lack of a legal framework to address challenges, inability to monitor services, insurance, traffic safety or lack of geofencing precision (also referred in Moran et al., 2020). It is worth noticing that the most cited factors for SEKS management's success were stakeholder involvement and regular meetings with operators since a continuous dialogue will allow boosting mutual understanding and solving challenges in cooperation. These results are aligned with other studies. For instance, Gössling (2020) concluded that city planners and policymakers should minimise market access conflicts, public space use, speed, and safety challenges. Baeza-Muñoz et al. (2021) analysed the SEKS regulations in six Spanish cities by using a cluster analysis based on different regulatory factors to look for groups of cities with similar regulations. The results showed that even though groups of cities can be characterised by their regulation, there are many doubts about the best way of regulating this new shared mobility form. More research, including the stakeholder perspective, is needed.

All in all, the above studies on the assessment of different regulatory frameworks and the recommendations for SEKS services in cities lead to key findings. On the one hand, there is a range of different SEKS regulation frameworks across cities that include many aspects potentially subjected to regulation. The aspects outlined above by NACTO (2019), Mason (2019) and Janssen et al. (2020) could be grouped into the following four dimensions for regulatory framework:

i. *Market access, competition and distribution of vehicles in the city.* This dimension includes aspects such as the legal basis to implement the services, the fleet cap and size, the number of operators, fees, the area of operation or geofence or equity.
ii. *Technical and operational characteristics.* This dimension includes vehicle standards such as weight, maximum speed, braking systems, brake light and visibility, etc.
iii. *Parking, traffic, and road safety.* This dimension includes a variety of aspects such as parking regulation, required safety elements, circulation permissions, etc.
iv. *Supervision of the service.* This dimension includes aspects such as service monitoring via data sharing (fleet availability data location, trips routes, etc.)

On the other hand, the coordination and understanding between public authorities, private operators and policymakers will help adapt regulatory frameworks towards the best practice integration of SEKS options in cities. Therefore, there is the need to analyse the previous key aspects from the point of view of key players. This research conducts a first insight on the consensus among expert stakeholders on crucial regulatory aspects for SEKS systems in cities. The analysis will be based on a general survey and a focus group session. The results contribute to obtain new findings to the unexplored literature and propose policy recommendations for urban decision-makers.

3. Regulation of shared electric kick scooters in Spain

The implementation of SEKS in Spain is heterogeneous, as it depends on the mobility policy of each municipality. From 2017 to 2019, some Spanish cities started adopting different regulation approaches for SEKS as the state-level regulation only dealt with certain safety and vehicle characteristics. The "bbuho" company was the first initiative to offer SEKS in Spain (ReasonWhy, 2018). It was launched in Valencia in 2018, planning to expand its services to Madrid and Barcelona (the country's main cities). Currently, 9 companies provide SEKS services in 10 Spanish cities (see Fig. 1). This Section shows some of the most significant regulation divergences across the biggest cities of Spain where these services are operating (for more details about that, see Baeza-Muñoz et al., 2021).

In January 2021, a state-level regulation came into force, including the electric scooter in the group of personal mobility vehicles. This regulation addresses issues related to technical and operational characteristics of the vehicles, and traffic rules. Such a regulation imposed maximum speed of 25 km/h, forbade e-scooters to circulate on the sidewalk or pedestrian areas, and required them to have no saddle.

Concerning *market access, competition, and distribution of vehicles in the city*, companies can roll out SEKS in public streets by applying for a permit from the municipality or through a concession or franchise awarded in a tender promoted by the municipality to limit the number of operators in the city. Madrid city council, for instance, opted to provide licences to all operators meeting certain technical requirements. However, some companies stopped operating because of the low profitability obtained given the fierce competition. In contrast, Seville and Zaragoza city councils opted to open a tender procedure with the aim of restricting the number of operators for a period of time in each municipality to no more than two companies. Barcelona and Valencia do not allow SEKS services to roll out on their streets, so operators must use private places to park. These cities consider the service a private business that is only subjected to the general circulation rules for the use of e-scooters. Regarding the distribution of SEKS in the city, both Madrid and Zaragoza have set rates on the number of scooters for hire available in each district. Seville is the only city requiring that SEKS are evenly distributed throughout the city. In terms of operational conditions, both Seville and Zaragoza set restrictions on vehicle recharging and require the entire active fleet to be used during daylight hours. In addition, operators are required to have third-party liability insurance in all cities.

Regarding *parking, traffic, and safety*, Madrid allows free-floating in all the city, while Malaga and Seville allow vehicles to park only in fixed bases. Zaragoza has opted for a mixed system, prohibiting free-floating in the city's central areas with little space and a dense network of public parking bases. As it was already mentioned, Barcelona and Valencia do not allow any rental companies to park in the public domain. Hence, companies use private areas (garages, hotels, etc.) to provide services. About the areas where the SEKS are allowed to drive, sidewalks are prohibited in all cities. Some cities, such as Malaga, require the use of cycle lanes if they are available. As for the road, some cities, such as Madrid, allow electric scooters on multi-lane streets, but only if at least one of the lanes are limited to 30 km/h. However, Seville and Zaragoza only allow driving on single-lane streets limited to 30 km/h.

The *supervision of the service* is not common in the regulations. In order to ensure that kick scooter users comply with the regulations, some municipalities, such as Seville and Zaragoza, require the operators to implement remote control systems to disable the vehicle when entering zones where the vehicle is not authorised, or users exceed speed limits, or park in non-permitted areas. Sharing the vehicles' location with the municipality is mandatory in cities such as Madrid, Seville, and Zaragoza.

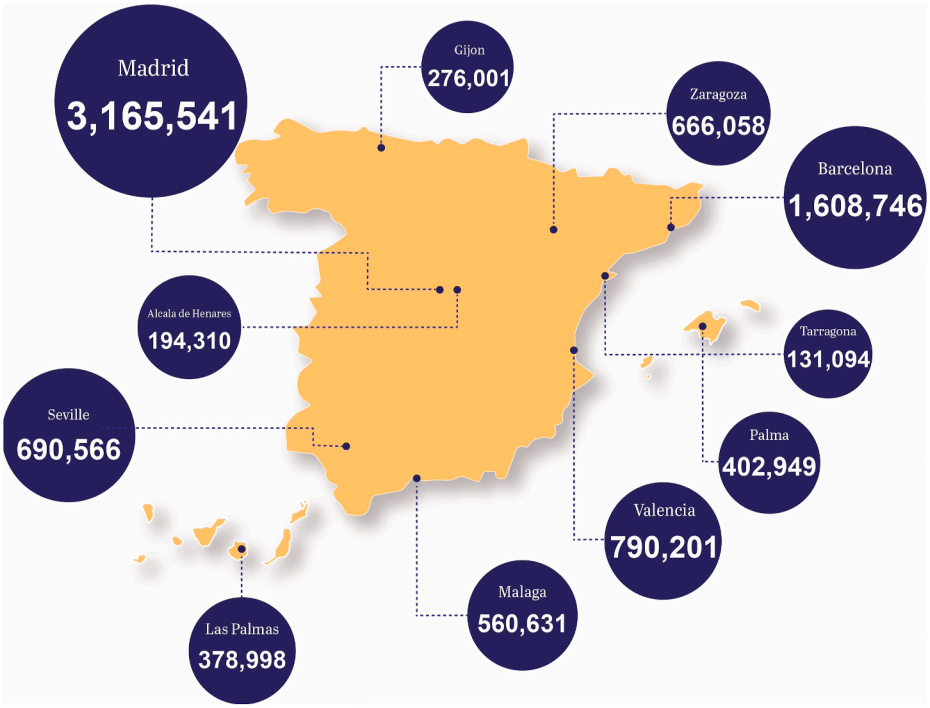

Fig. 1. Cities with SEKS in operation and their population (March 2022).

As can be observed, there is a wide variety of regulatory requirements for SEKS services across the main cities of Spain. Some cities, such as Valencia and Barcelona, decided to leave these services within the private domain by not allowing them to park in public places. These municipalities do not impose any kind of regulation rather than the one applicable to a private vehicle with the same characteristics. Other cities, such as Zaragoza and Seville, decided to constrain the number of operators and subject them to strict regulation. Finally, Madrid decided to regulate the system by requiring a licence to the operators with a lot of freedom for the companies to enter and leave the market.

Given the significant regulation differences across cities and the experience after some years, this paper aims to provide some policy recommendations about the regulatory requirements for implementing SEKS based on a dialogue with expert stakeholders.

4. Methodology

The methodology of this research seeks to identify which specific regulatory issues impacting SEKS are agreed or disagreed among key knowledgeable stakeholders with the aim of identifying potential conflict areas and the reason behind them. The evaluation aligns with the increasing body of work aimed at improving the regulatory framework for the effective management of SEKS and their correct integration (see Section 2). The methodology is displayed on a three-phase framework (see Fig. 2) and is based on a general survey and a focus group session, followed by an overview of data analysis. Phase I of the methodology is common to previous studies (Mason, 2019 or Wood and Bradley Shima Hamidi, 2019). The main novelty of our methodology is that after the expert stakeholder survey, an analysis was carried out to find out whether their answers on the regulatory aspects have consensus or not (see Section 4.2). Those points with no consensus were brought about a focus group to find out the reasons and look for common ground (see Section 4.3).

4.1. Phase I

Phase I aims to identify the key regulatory aspects for successfully implementing SEKS and characterise the stakeholders that have the knowledge to provide their opinion about that subject. Two steps will be developed to achieve that objective (identification of regulatory dimensions and key expert stakeholders):

Identification of regulatory dimensions. According to the analysis conducted in Section 2 (Background) and Section 3 (Regulation of SEKS in Spain), we were able to identify four regulatory dimensions:

(i) Market access, competition, and distribution of vehicles in the city;
(ii) Technical and operational characteristics;
(iii) Parking, traffic, and road safety; and
(iv) Supervision of the service.

Identification of key expert stakeholders with solid knowledge of the SEKS market. According to the literature and the analysis of the regulation experience in Spain, we have identified three main groups, namely:

(i) *Public authorities* that have the goal of outlining and implementing most of the regulations. They are usually in charge of organising and coordinating various modes of transportation across cities (Wright, 2015). Related to SEKS services, they authorise and control the service and enforce legislation. According to O'Neill (1990), public authorities are interested in the potential economic and social benefits, and they recognise the need for planning, regulation, and harmonisation. For this paper, most public authorities consulted were municipalities, but we also incorporated other executive agencies, government departments, etc.
(ii) *SEKS companies* whose role is to run the business and ensure that the vehicles are operational (recharging and maintenance). Additionally, they provide a mobile application that shows all trip attributes (availability, coverage, fare, payment, etc.) helping customers to choose the use of the service (Button et al., 2020). Companies are very much aware and affected by this regulation since it is crucial for their business.
(iii) *Researchers and consultants* that have worked on the topic. They include universities, researchers, or transport consultants. Their role is to develop innovative solutions to face the challenges of new mobility modes and support the city planning process. Furthermore, as Lindholm (2013) mentioned, they oversee the transferability and transfer of knowledge.

It is worth noting that we did not include users of the service since they are not supposed to have criteria in many regulatory aspects, such as the need to limit the competition in the city.

In December 2020, the general survey was sent to 92 expert stakeholders being answered by 62 of them, where 40.3% were public authorities, 53.2% were researchers and consultants, and 6.5% were SEKS companies. At this point, it is necessary to mention that the SEKS market is Spain is made up of just 9 companies. Related to experience in the field of mobility, on average, respondents had 18 years, 13 years, and 5 years of experience for public authorities, researchers, and consultants, and shared kick e-scooter companies, respectively. SEKS service is relatively new; for this reason, public authorities, researchers, and consultants had on average 2 years of experience, while companies had 3 years of experience.

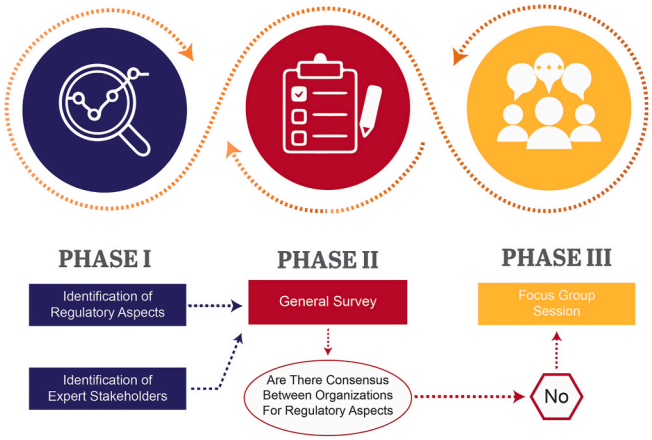

Fig. 2. Methodological scheme.

4.2. Phase II

Phase II aims to know the stakeholders' opinions about the different regulatory dimensions identified in the previous steps. To that end, a survey was conducted. The survey aims to determine what the different stakeholders think about the key regulatory aspects. Most of the questions are multiple-choice with a single response, and other questions allow the respondent to select more than one option.

The survey was developed in three sections that are summarised below:

(i) *Section 1. Respondent profile:* respondents indicate what type of organisation she/he belongs to. Furthermore, the respondent reveals how many years of experience she/he has worked in mobility and SEKS services.
(ii) *Section 2. General opinions:* respondents revealed how identified they are with different factors related to the right implementation

of SEKS in urban areas. Moreover, they were asked to identify the three most important regulatory issues for them among a wide list of possibilities.

(iii) *Section 3. Regulatory dimensions:* respondents select the option(s) that are considered the best among a set of alternatives related to the four regulatory dimensions.

Appendix A includes a detailed description of the survey.

With the aim to know whether experts agree or not with a certain issue, a *consensus criterion* was defined based on a disparity index for discrete variables. This index was suggested by Basulto Santos et al. (2012) for categorical variables that compare individuals' responses and observe whether they are similar or not. The index is calculated as shown in Equation (1).

$$D_i = 1 - \sum_{i=1}^{k} \left(\frac{n_i}{n}\right)^2 \quad i = 1, 2, 3, \ldots, k \tag{1}$$

Where n is the number of respondents, n_i is the number of times when i discrete attribute was selected. This index includes the effect of a category having more or fewer options and how dispersed the responses are among that number of options. The disparity index ranges from 0 to 1. The maximum disparity index depends on the number of available options for each question/variable (2 categories - $D_{max} = 0.50$, 3 categories - $D_{max} = 0.67$, 4 categories - $D_{max} = 0.80$ and 5 categories - $D_{max} = 0.83$). The higher the disparity index, the greater the difference of opinion among stakeholders. Moreover, since the representation per stakeholder group is not balanced in the survey, a weighting process was carried out to give equal importance to each type of stakeholder (public authorities, SEKS companies and researchers/consultants). To that end, surveys were randomly repeated for each stakeholder until each group had an equal number of surveys.

4.3. Phase III

The last phase includes a focus group session with the aim of identifying the reasons why there is no consensus among organisations for some of the regulatory issues addressed. The focus group was operationalised through a session where organisations met face-to-face in March 2021. The session had 12 out of 62 participants of the survey who had explicitly indicated to be willing to be contacted for the focus group. Moreover, these 12 participants were 5 from public authorities, 4 from researchers and consultants, and 3 from SEKS companies. Seven questions were previously defined for the workshop regarding topics for which consensus was not reached in the survey. Due to the COVID-19 pandemic, the session was held online using Microsoft Teams. The focus group was divided into two sections. In the first one, the main results of the survey were presented to the participants, and in the second one, the dialogue was open. To help the dialogue flow, seven questions were previously defined regarding regulatory aspects they disagreed with. Participants answered each question (multiple choice or open answer), and according to the live results, the moderator initiated a dialogue. Once everyone voted, the results were displayed, and the participants discussed the subject matter. In order to have continuous interaction with the participants, the Slido (2021) platform was used as an easy-to-use Q&A and polling platform. It bridges the gap between speakers and their audiences, allowing people to get the most out of meetings and events.

5. Results

This section summarises the key findings of the analysis. Firstly, we show the main results from Phase II, the survey. After that, we show the results from Phase III, the focus group session.

5.1. Survey results

5.1.1. General opinions about SEKS

Firstly, stakeholders were asked how much they got identified with some ideas about the correct implementation of SEKS services in the city. That was measured through a 5-points Likert scale (1- Very little identified, 2- Poorly identified, 3- Somewhat identified, 4- Fairly identified and 5- totally identified). Fig. 3 shows the median value of identification for each organisation and idea. As it is expected, SEKS companies are the stakeholders most favourable to the system. They believe that the implementation of the service will happen with very positive consequences. Researchers and consultants are not as optimistic as SEKS companies. For their successful implementation they stress the need to integrate SEKS services with other modes of transport. Public authorities are sceptical about road safety. Ultimately, all of them though that SEKS services have the potential to be a relevant mode of transport in urban areas. However, for this to happen, it is necessary to solve a set of concerns.

Secondly, stakeholders were also asked to point out the most important regulatory issues to rightly implement SEKS services among the ones displayed in Table 1. That table shows the percentage among the members of each group that selected each regulatory issue.

Public authorities have a fairly even distribution of opinions across the regulatory aspects addressed to them. However, more than 50% of them highlight the need to regulate the types of roads where SEKS are allowed to be ridden. Also, 40% of public authorities point out the need to regulate space allowed for parking and establish a homogeneous regulation across municipalities within the same metropolitan area. Reasonably, public authorities are concerned about implementing the proper means for controlling and supervising the service to penalise inappropriate practices.

Researchers and consultants are mainly concerned about regulating the types of roads where shared scooters are allowed to be ridden and the space allowed for parking. Interestingly, unlike public authorities, regulating the supervision and control of the service is not among the greatest concerns of this group of experts. Neither is it defining technical characteristics of scooters, likely because they are already set by State regulation. This is in line with the recent review published by Boglietti et al. (2021), where these topics were not addressed because they fall under state-level regulation outside the authority of city councils.

The most significant regulatory issues for SEKS companies are the space allowed for parking and the number of companies operating the service in the city (free access or limitation of operators). Remarkably, establishing measures to guarantee road safety (protective elements, vests, etc.) and supervision of the service were ignored by them.

Overall, these general opinions give us a first insight into the main concerns of stakeholders on different regulatory aspects. Though they do not have identical opinions, they agree on points such as the need to regulate the space allowed for parking or the need for a homogeneous regulation across municipalities in the same metropolitan area.

5.1.2. Regulatory dimensions

Expert stakeholders were asked about various aspects related to each of the four regulatory dimensions. The complete set of questions is shown in Appendix A. The following paragraphs summarize the main results.

(i) Market access, competition, and distribution of vehicles in the city

As discussed above, all parties are concerned about access to the market. Overall, according to Fig. 4, a large majority of experts stakeholders from public authorities and SEKS companies believe that market access should be conducted through a concession/franchising approach with the aim of restricting the number of operators in the city for a period. This is also supported by consultants and researchers, although

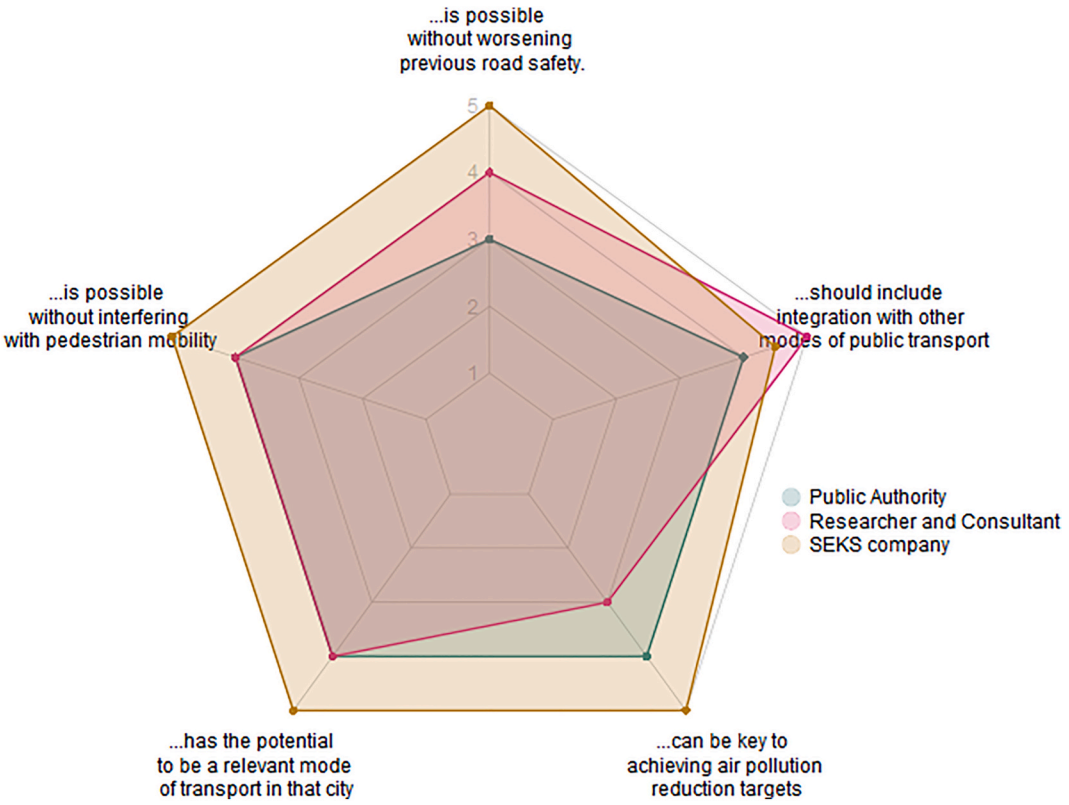

Fig. 3. Likert scale median value of identification for each organisation and idea: *An adequate implementation of a shared scooter service in the city ….*

Table 1
Opinion share of main regulatory aspects to implementing SEKS.

Regulatory Aspects	%		
	Public Authorities N = 25	Researchers and Consultants N = 33	SEKS companies N = 4
Regulate space allowed for parking	40.0	54.5	75.0
Regulate the number of companies operating the service in a city (free access or limitation of operators)	36.0	27.3	75.0
Regulate the type of roads where SEKS are allowed to be ridden	56.0	66.7	25.0
Regulate supervision of the service (parking, routes, etc.)	52.0	21.2	25.0
Regulate the number of SEKS allowed in each zone of the city	16.0	18.5	50.0
Integrate the service with public transport	36.0	48.5	50.0
Establish a homogeneous regulation across municipalities in the same metropolitan area.	40.0	27.3	50.0
Reinforce measures to guarantee road safety (protective elements, vests, etc.)	36.0	45.5	0.0
Define technical characteristics of scooters (wheels, brakes, battery, etc.)	16.0	12.1	25.0

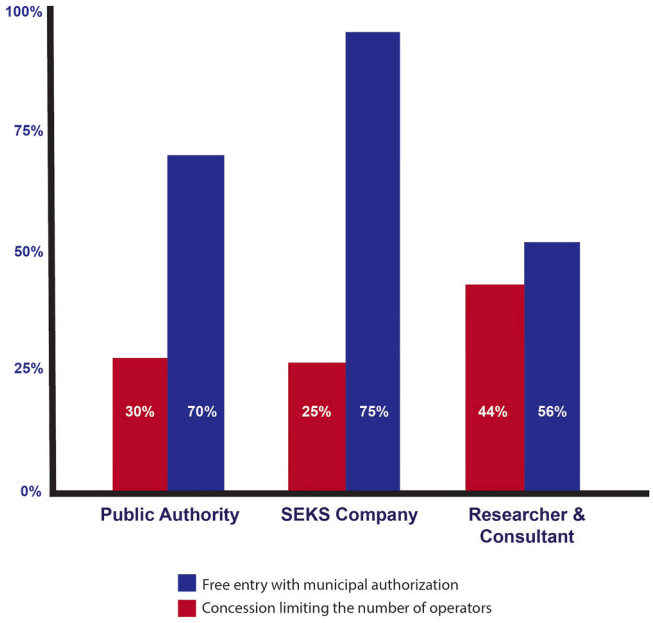

Fig. 4. General survey results: Market access.

almost half of them believe that market access also may be achieved through a municipal authorisation provided to any company complying with a set of technical standards to operate in the city.

Regarding the number of operators, Fig. 5 shows the expert stakeholders' view on the right number of operators depending on the size of the city. In the case of large-sized cities (such as Madrid or Barcelona), SEKS companies think that 2 or 3 operators is fine. However, most public authorities, researchers and consultants consider that a larger number of

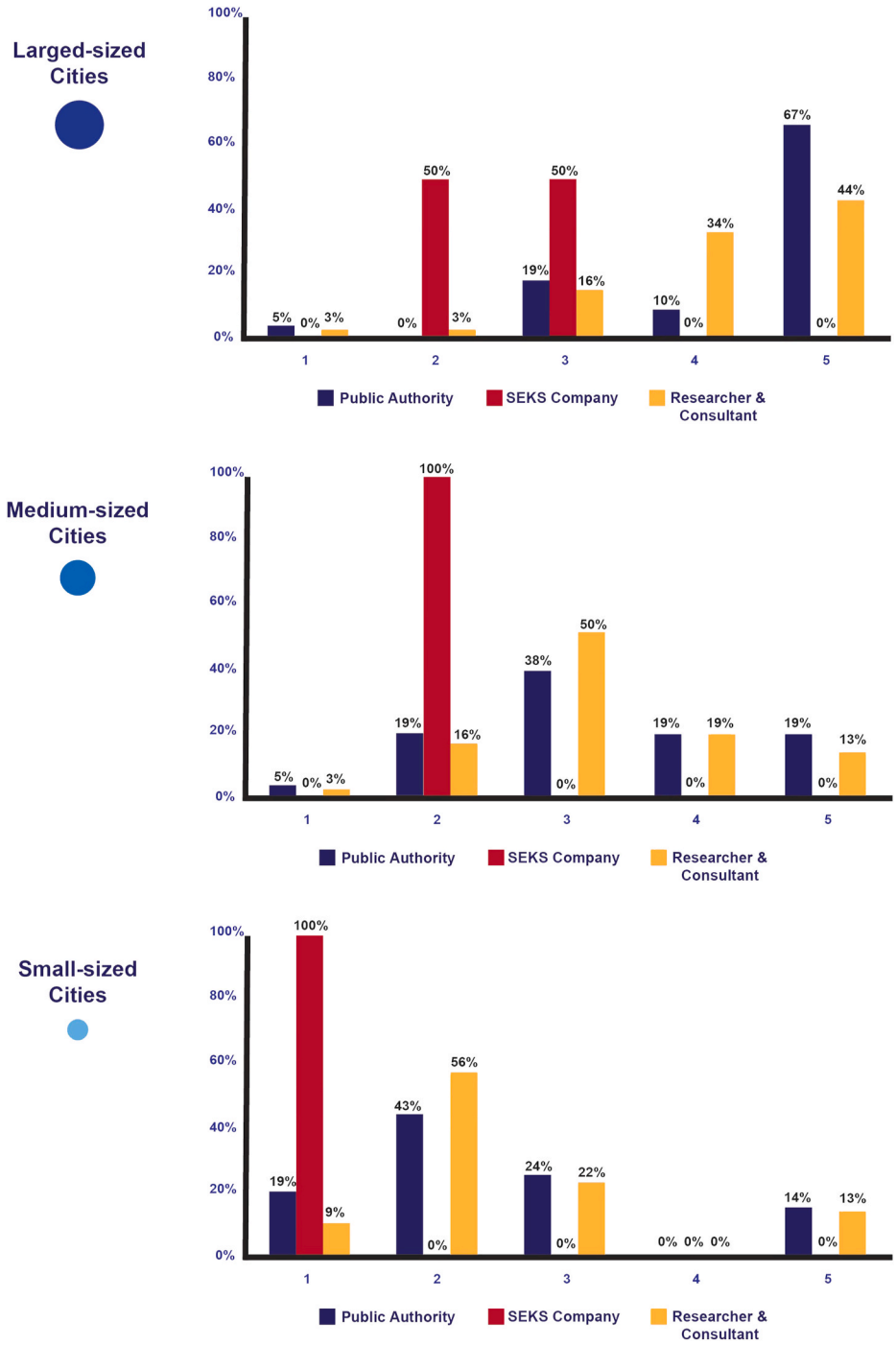

Fig. 5. General survey results: Recommended number of operators in the city depending on the size of the city.

operators, around 4 or 5, is more appropriate. In the case of medium size cities (such as Valencia, Seville or Zaragoza) and small ones (such as Alicante, Granada or A Coruña), SEKS companies agree to allow between 1 and 2 operators. However, there is not a clear agreement in the number of operators for the rest of stakeholders. The respondents were also asked about the possibility of a having a municipal firm supplying the SEKS service, with 62.9% of respondents considering it inappropriate.

On the other hand, the number of shared scooters and the distribution are essential issues in this regulatory dimension. With respect to limiting the number of scooters in the city, large differences were found in the responses across groups. According to Fig. 6, SEKS companies totally agree to have full freedom to place the scooters wherever they want, with no limitations in number. In contrast, public authorities, researchers and consultants are in favour of limiting the number of scooters either per neighbourhood or based on demand. However, they all consider that operators should ensure that the SEKS service is accessible to all citizens, regardless of where they live.

(ii) Technical and operational characteristics

This part of the questionnaire focuses on how the service should be operated (combined with public transport or not, integrating all the SEKS services within a single app, etc.) and what should be the technical characteristics to run the service (such as weight, maximum speed, braking systems, brake light and visibility, etc.).

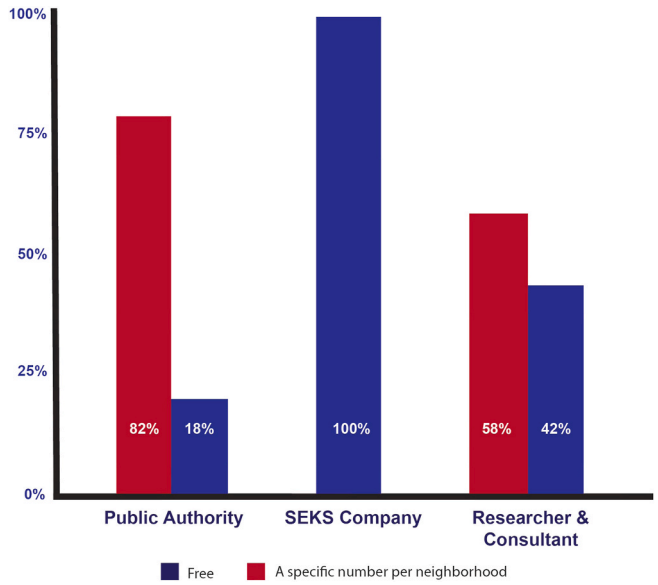

Fig. 6. General survey results: Distribution of SEKS across neighbourhoods.

A crucial aspect that concerns the regulation is the fare and the physical integration with public transport services, where a large share of respondents, 88% of them, consider it appropriate (see Fig. 7). However, at the time of defining how to integrate SEKS with public transport, there are multiple views among stakeholders. For example, many public authorities consider it appropriate to subsidise SEKS trips as long as they are used as a mode to connect to public transport stations. Fig. 8 shows how most expert stakeholders consider appropriate integrating all operators within the same mobile app though half of the SEKS companies are opposed to that integration. Most respondents are favourable to promote integration withing a single app as long as the privacy of the information of each operator is ensured. In the case of public authorities, there is no consensus on how SEKS services should be integrated.

Finally, defining the maximum speed limit depending on the characteristics of the road is highly relevant for regulation purposes. In the case roads are shared with other vehicles, the survey shows that, for 50.0% of respondents, it should be 25 km/h; for 24.2% of the respondents, it should be more than 25 km/h; and for 25.8% of the respondents, it should be less than 25 km/h. By contrast, in the case of segregated bike lines, most of the respondents (69.3%) consider that the maximum speed should be 25 km/h.

(iii) Parking, traffic, and road safety

SEKS parking is one of the most relevant topics to ensure a successful regulation. Fig. 9a depicts each stakeholder's perspective related to the most suitable type of SEKS parking in the city. Most public authorities consider that only fixed bases should be allowed whereas the rest of stakeholders are more favourable to using a mixed system (fixed bases in crowded areas and free-floating in the other areas). In the case of fixed bases, the survey asked the respondents whether SEKS should be anchored/unanchored and about the most distances between bases. Concerning anchoring, there are differences between groups. While public authorities prefer to have SEKS anchored, SEKS companies prefer to have them unanchored. In the case of researchers and consultants, they tend to prefer anchored, although the answer is not clear (see Fig. 9b). In case the municipality decides to establish fixed bases, respondents were asked about the distance between bases. Answers suggest that a maximum distance of 600 m should separate stations though SEKS companies consider that less than 300 m was the most suitable distance (see Fig. 9c).

Finally, regarding the need that the regulation sets that certain safety elements should be mandatory, 72.6% consider mandatory the bell, 53.2% the daytime running lights, 56.5% the helmet, 43.5% the reflective vest, 43.5% the flashing lights, 27.4% the rear-view mirrors. Finally, only 12.9% of the respondent considered it important to have a driver's licence to use the service.

(iv) Supervision of the service

The supervision of the service can be analysed from a double perspective: (i) the monitoring measures required to the users by the operators, and (ii) the information that SEKS companies should share with municipalities.

Regarding the first perspective, 25.8% of respondents were in favour that operators identify e-scooter parking by requiring a photograph taken by the user. In addition, 87.1% of respondents are in favour that operators apply measures to impede the journey from being completed if the vehicle is not in a permitted parking place. The use of sensors to know if a scooter is lying on the ground was approved by 51.6% of respondents. Finally, using remote control to limit speed according to the zone where the vehicle is circulating and prevent travelling in non-permitted zones is approved by 53.2% and 56.5% of respondents, respectively.

Regarding the information that SEKS companies should share with municipalities, 95.2% of respondents chose the location of vehicles, 37.1% the battery status, 69.3% the availability of the vehicle, 82.3% the characteristics of each trip (time, route, time, etc.), and 74.2% the characteristics of users (use, age, sex, etc.).

5.1.3. *Consensus criteria*

To determine whether there is consensus for every regulatory issue included in the survey, the disparity index was estimated for the whole set of respondents and for each group of experts (public authorities, researchers and consultants, and SEKS companies) in an independent way. Appendix B shows disparities indexes for all regulation aspects included in the survey. The higher the disparity index (in dark colours) and the closer to the maximum disparity achievable given the number of options (in the final column), the greater the difference of opinion between respondents. Conversely, the lowest the disparity index (in light colours) and the closer to zero, the greater the consensus. The regulatory aspects with the lowest consensus are safety, supervision of the service, homogenisation of the regulation in cities, integration with public transport, and parking regulation of such services. These findings will help us determine the criteria to discuss in the focus group conducted in Phase 3 and are key to providing comprehensive guidelines for regulating SEKS services.

Regarding *market access, competition, and distribution of vehicles in the city*, respondents disagreed on questions 6 to 12 of the general survey (see Appendix B). There was unanimous disagreement with respect to establishing a maximum limit in the number of vehicles (See question 6). Regarding the respondents' opinion about the need for a municipal company to provide the service, it is worth mentioning the high disparity among public authorities (See question 9). Another important aspect with no consensus is the best way for companies to access the market (see question 8). Finally, the optimal number of SEKS companies among different cities and the distribution of scooters throughout the city have high disparity indexes (see questions 7, 10, 11, 12), though SEKS companies largely agree on how vehicles should be distributed across the city and the most suitable number of operators in large-, medium- and small-sized cities.

Within the *technical and operational characteristics* dimension, there is a large consensus among stakeholders (low disparity index values) when it comes to the homogenisation of certain regulatory aspects (see question 15 in Appendix B traffic rules, parking and road safety) within the same metropolitan areas. Nevertheless, in the case of the maximum speed, there is no clear pattern to come up with a single value. On the

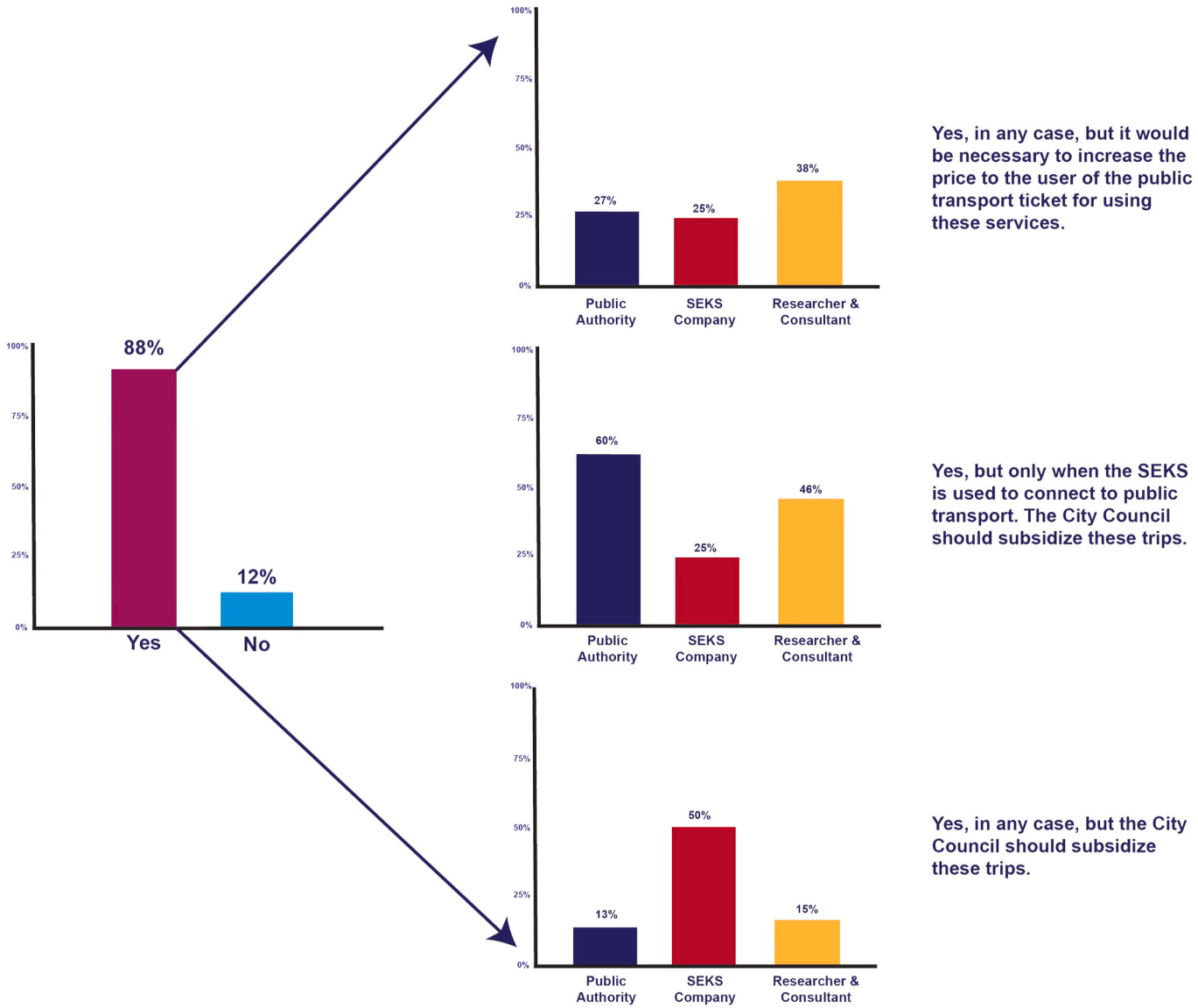

Fig. 7. General survey results: integration with public transport.

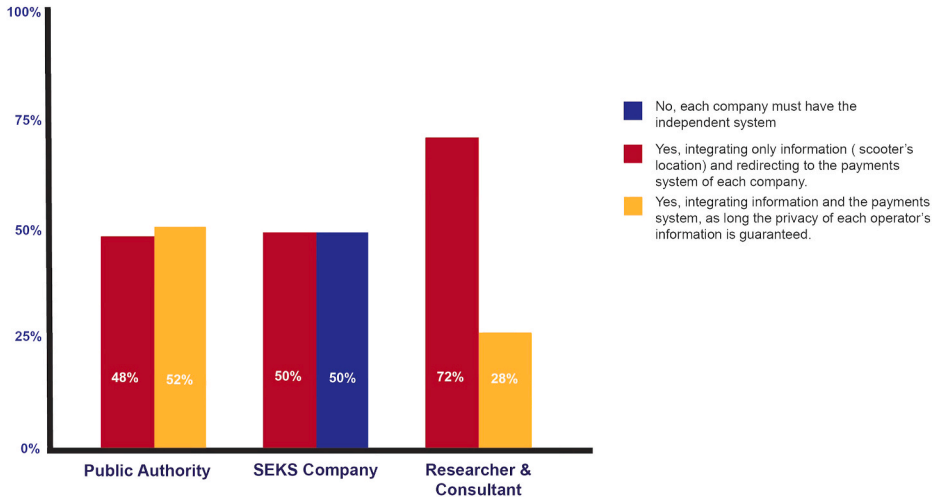

Fig. 8. General survey results: Integration of all operators in the same mobile app.

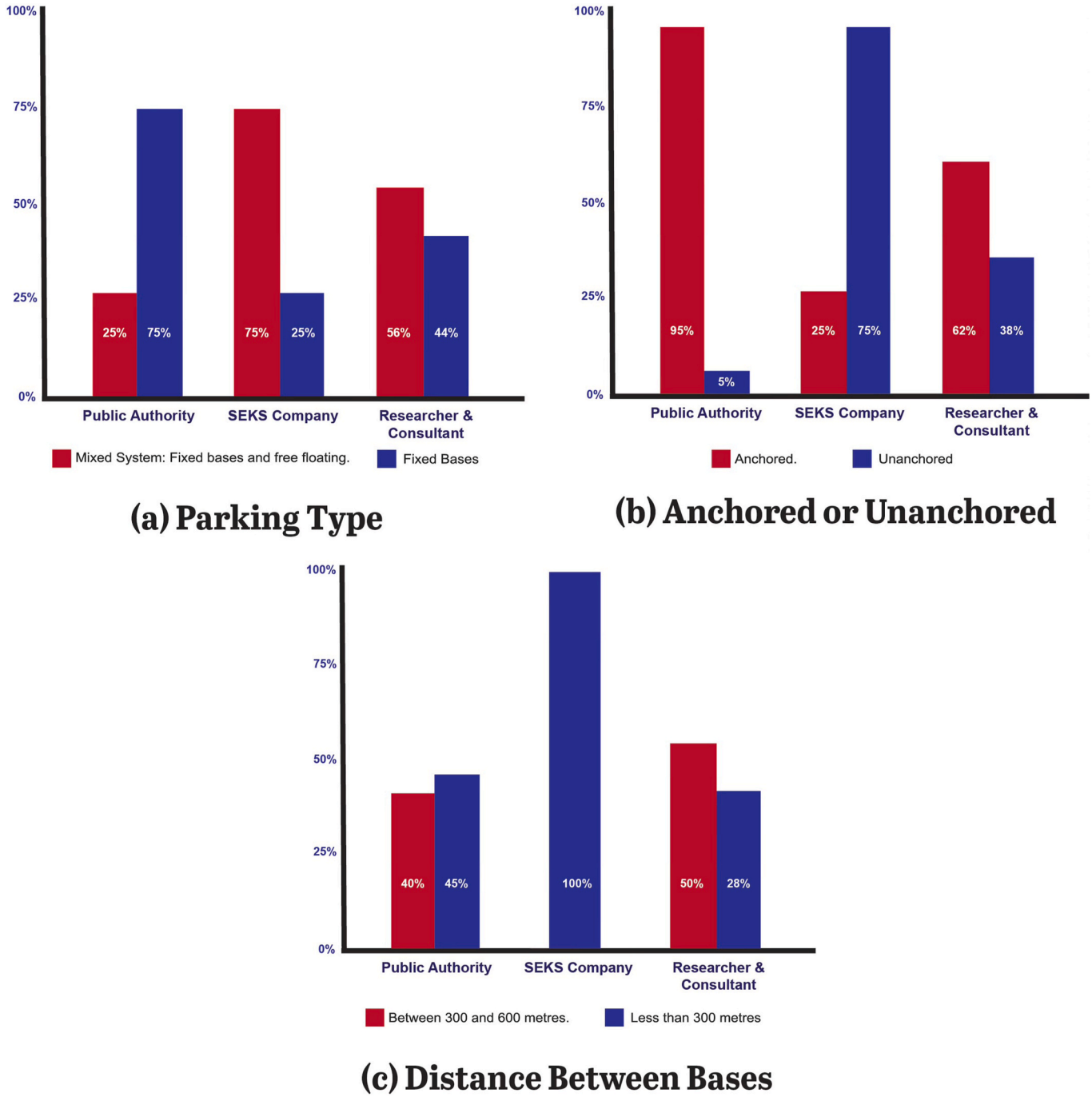

Fig. 9. General survey results: SEKS parking characteristics.

other hand, stakeholders strongly disagree, both among themselves and among groups, regarding the integration and coordination of the access to the market (concession, authorisation, etc.). Additionally, although stakeholders agree on integrating SEKS services with public transport (see Fig. 7), they have great disparity on how to do the integration, for instance using transport tickets is not considered appropriate for most stakeholders (see question 14 in Appendix B).

In the *parking, traffic, and road safety dimension*, most topics with little consensus are related to safety elements (question 18). It is worth noting that SEKS companies have similar views on those aspects, while other stakeholders disagree (high disparity index). Requiring helmets, driver's licence, turning signals, and rear-view mirrors are the main elements of discord among stakeholders. On the contrary, stakeholders agree on requiring a drivers' licence for using SEKS. Issues such as parking rules, the minimum age, or extended cycling infrastructure for SEKS generate diverse opinions among experts. There is little agreement on whether vehicles should be parked on a fixed base or under free-floating conditions and whether e-scooters should follow the same regulation as bicycles. Finally, expert stakeholders agree that SEKS should not be ridden on multi-lane roads, but they do not find consensus on whether they should be ridden on a wide sidewalk with low pedestrian traffic or bus lanes. All these issues are discussed in the focus group in Phase 3.

Knowing whether a scooter is lying on the ground and using the remote control to limit speeds are the main issues with little consensus within the *supervision of the service* dimension. Both issues have a high disparity index for researchers, consultants and public authorities but a low disparity index for SEKS companies. By contrast, there is consensus on the information that operators should provide to the city council,

such as the location of scooters, route of the trip, users characteristics, etc. However, it should be highlighted that SEKS companies do not agree on what data they should be obliged to provide, showing a great disparity in trip routing or state of the scooters.

5.2. Focus group analysis and discussion

An online focus group session with 12 participants was also held in March 2021 to explore deeper opinions and attitudes towards regulatory aspects with little consensus. These participants were selected among survey respondents who had explicitly indicated to be willing to participate. A reduced group of participants help to have a fluent interaction. Seven questions were previously defined for the workshop regarding a selection of important topics for which consensus was not reached in the survey. On the basis of the responses to those questions, the moderator opened a dialogue for discussion. Below, we present the results of each question and the main comments of the dialogue.

Question 1. "*In which streets should kick scooters be allowed to drive?*". The answers and the percentage of participants who selected them are: "*Only one-lane streets limited to* 30 km/h" (11%), "*Streets with one or more lanes if all lanes are limited to* 30 km/h" (22%), "*Single or multi-lane streets, driving in the right lane limited to* 30 km/h*, without allowing left turns*" (0%) and "*Streets with one or more lanes, driving in the right lane limited to* 30 km/h*, allowing to join the rest of the lanes for turning left*" (67%).

Currently, the maximum speed permitted in the road is the main attribute to allow kick scooters drive in most cities. Some participants agreed that it is necessary to restrict kick scooters to drive in 30 km/h streets. However, most participants were in favour that kick scooters may be allowed to use streets with one or more lanes, as long as the right lane is limited to 30 km/h, but e-scooters should be allowed to join lanes with higher maximum speed limits with the sole purpose of turning left.

During the discussion, attendants highlighted some pros and cons of allowing kick scooters to drive in streets with a maximum speed higher than 30 km/h. The main conclusions were that some exceptions to the limitation to use 30 Km/h lanes should be made to improve the accessibility of kick scooters. In addition, the regulation should grant SEKS to have technical characteristics suitable enough to drive in good safety conditions. Some of the main ideas discussed were:

> "We need to reach an equilibrium between different factors at the time of setting the circulation restriction for SEKS. It is necessary to focus on the condition of the road surface of the street along with speed. If the pavement condition is adequate, we should facilitate the use of the SEKS. That way, we will avoid users to get off the kick scooter" *Public Authority 2*

> "Users request to circulate safely and that no islands are generated in the city. We have to try to make it possible for the kick scooter to move around the city." *SEKS Company 1*

Question 2. "*How do you think the parking of SEKS should be arranged?*". The answers and the percentage of participants who selected them are: "*Using only fixed bases, anchored*" (30%), "*Using fixed bases, without anchoring*" (0%), "*Using a mixed system: free-floating in low-density areas and fixed bases in dense areas, anchored*" (40%), "*Using a mixed system: free-floating in low-density areas and fixed base in dense areas, without anchoring*" (30%) and "*Free-floating* " (0%).

Parking is a critical regulation topic for SEKS services. In most cities, SEKS can park free-floating or in some specific places designed for them to park. This question tried to identify the best parking strategy for SEKS. It is noticeable that all the respondents agreed on using fixed bases to park, while 70% of them pointed out that free-floating should be implemented in low-density areas. Regarding the characteristics of the bases, most of the attendants were in favour of anchoring the scooters, the same results as in the general survey (see Fig. 9b). Interestingly, the only free-floating option was not selected by any participant.

One idea that the participants repeatedly mentioned is that fixed bases help to reduce vandalism towards SEKS. The decision of whether anchoring or not the SEKS brought with it different points of view. Anchoring the scooters ensures the operator and the public authority that the scooter will be in the right place. However, inexperienced users may be delayed in the anchoring process. Some of the main ideas that appeared in the discussion were:

> "Kick scooters showed up sharply in our society. As operators, we would like the parking to be as easy as possible. However, we understand that this desire was not possible until people were educated in this new mobility forms. Technologies were allowing the companies a more precise tracking of the scooters. Because of that, we support having mostly fixed bases" *SEKS Company 2*

> "Fixed bases with anchoring help prevent vandalism and avoid sidewalks full of scooters. We should not blame the users for vandalism, but we live in a society that needs to be adapted to the deployment of the SEKS in the city. Also, investment in fixed bases is not expensive." *Public Authority 1*

> "Anchorages are not helpful for users because system failures make them waste time. Moreover, vandalism is going down over the years, being now almost zero" *SEKS Company 1*

> "I propose the option of using fixed bases without anchoring in densified areas and anchoring it in low-density areas." *Public Authority 3*

Question 3. "*How do you think the SEKS service should be provided?*". The answers and the percentage of participants who selected them are: "*By restricting the number of operators through concession/franchise and integrating all of them in the same application*" (50%), "*By restricting the number of operators through a concession without forcing them to integrate into a single application*" (50%), "*Using authorisations with no limit on the number of operators, and limiting the total number of scooters allowed per operator*" (0%) and "*Using authorisations with no limit of operators and without limiting the total number of scooters allowed per operator*" (0%).

Restricting the access to the market versus liberalising the service is one of the critical factors that should be defined in the regulation. It is worth noting that participants had a broad consensus to limit the number of operators for a period of time through a concession/franchise awarded in a competitive tender. There was a greater debate regarding the need to integrate all the operators in a single app. For public authorities, researchers, and consultants that is theoretically acceptable, but for the SEKS companies, it generates doubts about the interaction of the company with the client. Some of the main ideas discussed in the debate were:

> "Integrating all services in an application is something we have to reach, but now, it is not possible, and we need to study it more" *SEKS Company 2*

> "The fewer the number of operators in a city, the easier it is to integrate all of them within a single app." *Research and consultant 2*

> "The number of companies depends on the size and characteristics of the city. Allowing any company to enter the market will hinder the quality of service. The number of kick scooters should be limited, but with flexibility depending on demand." *SEKS Company 1*

> "Integrating operators within a single app will be interesting, but this integration is not possible yet." *Public Authority 4*

> "For the sake of improving the mobility service, limiting competition through a concession is a much better option. The contractual term of a concession grants the user that the service will be provided correctly. It is important to define the area where the concessionaires will operate to avoid overlaps and competition between them" *Public Authority 3*

Question 4. "*Do you believe that the operator should be required to*

provide service in all neighbourhoods of the city?". The answers and the percentage of participants who selected them are: "*Yes, in any case*" (11%), "*Yes, except in neighbourhoods with excessive vandalism and/or very low demand*" (22%), "*Yes, but subsidising (or incentivising) neighbourhoods with excessive vandalism and/or very low demand*" (67%) and "*No, operators should have full freedom to operate wherever they want to do it*" (0%).

The area coverage of mobility services is a topic that directly affects organisations and consumers. Areas of low demand or high vandalism are not attractive for private operators since they are not profitable for them. This question tries to identify how feasible it is to provide the service in all city neighbourhoods. The conclusion is that, while public authorities should ensure that the service is provided in most city neighbourhoods, they should subsidise private companies for operating in low demand and/or high vandalism areas. Some of the main ideas discussed are:

"We think that the more, the better. We are having good results in neighbourhoods that a priori did not appear interesting. But it is necessary to roll out the system little by little so that we do not go bankrupt. At this point, we are not making money. Our improvement plans are designed with a long-term perspective." *SEKS Company 1*

"If the electric kick scooters want to be part of the mobility system of a city, they should have complete coverage in the city. Vandalism is a problem that has been huge until now, but with control and support from the community, we have been able to solve it." *Public Authority 3*

"Could locking the scooter help decrease vandalism in the city? It can help with harmless vandalism, but for professional vandalism, a lock is not enough" *Public Authority 1 and SEKS Company 1*

"It is essential that the kick scooters components are not usable by other scooters. The less compatible the parts of the vehicle are with private vehicles, the less the black market." *SEKS Company 2*

Question 5. "*Do you consider it convenient to implement measures to integrate the shared scooter service with public transport?*". The answers and the percentage of participants who selected them are: "*Yes, totally, without public subsidy*" (33%), "*Yes, totally, with a public subsidy for the deficit generated by the integration*" (33%), "*Yes, partially, only trips that complement the public transportation network, with public subsidies for the deficit generated by the integration*" (33%) and "*No, since most shared scooter trips compete with public transport instead of complementing it*" (0%).

Public transport is one of the most sustainable modes of transport available in urban areas. However, it has the disadvantage that it cannot provide door-to-door services. This question tried to understand the potential advantages of integrating (through a common fare and physical infrastructure) public transport with SEKS services. The answers showed a consensus on the benefits of integration, but not so much on how to make it possible. There seems to be an agreement on the need for subsidies to compensate for the revenue shortfall of operators caused by fare integration. Some participants in the workshop mentioned that integration and its subsequent subsidies, should only be possible for combined trips with the public transportation system. Some experts pointed out the need to develop infrastructure for the integration prior to promoting fare integration.

Some key ideas that came up in the workshop were:

"If we want to promote scooters for last-mile trips, offering an affordable price is key. Currently, most users cannot afford paying for public transport and then another fee to use the scooter." *SEKS Company 2*

"Currently, it is not clear how people will combine this service with public transport. Moreover, it is still too early to calibrate a transport model to estimate demand with the aim of measuring the impact that integration may have on the revenue for public transport authorities and operators. It seems reasonable to wait until having more information about this service". *Research and consultant 2*

"The integration is necessary, but it should start with the infrastructure, leaving the fare to a second stage." *Public Authority 1*

"For years, we have been trying to integrate public transport with bicycles, but it takes time to do it. "*Public Authority 3*

Question 6. "*Do you think it is necessary to require the use of protective helmets to ride kick scooters on the road?*". The answers and the percentage of participants who selected them are: "*Yes, the electric scooter is particularly unstable and unsafe. In addition, there are solutions such as equipping the scooter with a luggage rack*" (22%), "*Only if the electric scooter is allowed on multi-lane roads*" (0%) and "*No, as the speed limit set at* 25 km/h *greatly reduces the risk*" (78%).

With the upcoming of SEKS in the cities, road safety has been one of the main issues that people are concerned about. This question tries to understand the opinion of expert stakeholders about requiring the helmet to use the kick scooter. The helmet appears to mitigate the impact of accidents, but it is a barrier to the use of SEKS services because it obliges users to bring it with them, or companies to provide it. Some participants claimed there are no data to prove the benefits of the helmet in reducing accidents due to the novelty of the service. Participants agreed that in the case of SEKS, safety depends more on other vehicles than on the measures adopted to protect users. Some of the main ideas discussed were:

"SEKS accidents data do not prove the need of a helmet. However, obliging to use the helmet can discourage its use" *Public Authority 1*

"We always recommend using the helmet, but our company does not agree with obliging to use it". *SEKS Company 2*

"Authorities should make sure that the speed of different vehicles using the same road is as equal as possible." *Public Authority 3*

"Requiring different safety measures for different modes of transport, especially for comparable ones such as bicycles and kick scooters, will end up confusing users." *SEKS Company 2*

Question 7. "*In what aspects do you consider that SEKS should be regulated separately from bicycles?*". Participants were asked to type the key aspects they considered important in answering this question.

Bicycles and e-scooters are considered active modes of transport. The first one has been powered for years, and its use and behaviour are known. The second one can be considered new, so its impact on mobility is still unknown. The goal of this question is to identify similarities and differences between the regulation of both modes. According to the expert stakeholders asked, age is the main aspect that needs to be regulated separately. From the public authorities' point of view, there is no consensus on this (some cities allow it from the age of 14). However, some SEKS companies require 18 as the minimum age because of the contract with the user and the insurance required to provide the service. Parking differences between bikes and kick scooters is also a topic of discussion.

6. Policy recommendations and conclusions

This research study provides guidelines for the successful regulation of SEKS in urban areas, taking advantage of a collaborative approach with expert stakeholders that look at the regulation problem from different perspectives. The methodology applied follows a three-step process consisting of the identification of crucial issues and key expert stakeholders, a general survey to them, and a final focus group intended to reach consensus. The results provide regulatory recommendations in four main areas: market access, technical requirements, traffic and safety, and service supervision. The results of our analysis underline the importance of seeking consensus among stakeholders when designing regulatory frameworks for these sharing services in urban areas, like Laa

and Emberger (2020) in studying the regulation of bike sharing.

The study concludes that stakeholders are interested in a homogeneous regulation of SEKS across different cities within the same metropolitan area, and a coordination of SEKS with the public transportation system, though there is not a clear agreement on how to operationalise it. That regulation should be similar to the one of electric shared bike services, but with some differences in specific points. Below we provide some regulatory recommendations from the study that are worth being considered by public authorities when implementing SEKS services in urban areas.

To ensure a good service to the user, it is advisable to limit the maximum number of operators by means of a concession/franchise awarded in a competitive tender. Concessions however should allow for certain flexibility to adapt to potential service changes that may appear (Wood and Bradley Shima Hamidi, 2019 or Riggs et al., 2021), such as promoting cooperation with the public transport system. The number of operators will depend on the size of the city and the coverage areas. Regarding the distribution of the vehicles over the city, it is recommended that the service be deployed across all the city districts to grant universal accessibility to all citizens. However public authorities should put into effect mechanisms to compensate SEKS operators for deploying vehicles in districts with high vandalism or low demand.

It is recommended that the technical requirements of the vehicles are set by a common state-level regulation. The SEKS service should be as integrated as possible with the transit system of the metropolitan area to promote complementarity. Such an integration service should start with the development of infrastructure to facilitate the physical connection. This type of integration may require subsidies to the operators that have to be carefully studied by planners and operators.

Regarding parking, the results of our study show that a mixed system made up of fixed delimited bases in dense areas of the city and free-floating in low density areas appears to be a good solution similar to the one proposed by Lazarus et al. (2020) for bike sharing. Though generalized free floating in the city is not approved by any stakeholder, free floating is crucial to ensure accessibility in peripheral neighbourhoods of the city (Shaheen and Cohen, 2019). Our findings show that there is a big open debate about the need of anchoring, being SEKS companies less favourable to that option compared to consultants, researchers and public authorities.

Expert stakeholders agree that SEKS should not be ridden on multilane roads with allowed speed higher than 30 km/h. There is a debate focused on whether scooters should be ridden in roads where road safety is ensured, for instance ridding on pavements in good condition to reduce the risk of accidents (Ma et al., 2021). Similarly, there is still a big discussion on other regulatory issues such as whether wearing a helmet should be mandatory, though most of the expert stakeholders in the case of Spain were not favourable to that option.

There is consensus on the information that operators should provide to the city council, such as the location of scooters, route of the trip, users characteristics, etc. Our research recommends that SEKS regulations oblige private operators to provide certain anonymised data to the public authorities for the sake of improving transport planning, doing research and promoting the coordination of SEKS with other transport modes. That will allow public authorities to make up homogeneous datasets to support additional decision making and improve environmental goals (Zakhem and Smith-Colin, 2021). The information provided should ensure the necessary privacy for users and SEKS companies.

The research identifies some limitations worthy to be addressed in future contributions: *i)* apart from expert stakeholders, to consider users' points of view for specific aspects where their opinion may be important; *ii)* to extend this study to other cultures, regions and types of urban areas to capture potential differences beyond the Spanish context; *iii)* to conduct more detailed research to assess the optimal number of operators and vehicles deployed in different types of cities; *iv)* to study in detail the pros and cons of anchoring SEKS; *v)* to determine the influence of certain regulatory aspects (such as speed, wearing of the helmet and type of road) on road safety; *v)* to study the financial consequences for transport authorities of implementing an integrated fare with the public transportation system of the city; and last but not least, *vi)* to study the energy and environmental impacts of such services, especially regarding the capacity of renewable energy resources.

Author statement

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Data availability

Data will be made available on request.

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Appendix A

Table A.1
General Survey

ID	Dimension	Question	Type	Options
Section 1. Respondent profile				
1	–	In which sector are you currently working?	Multiple choice	Public authorities; researchers and consultants, shared kick scooters companies
2		How many years of experience do you have in the field of mobility?	open	–
3			open	–

(*continued on next page*)

Table A.1 (*continued*)

ID	Dimension	Question	Type	Options
		How many years of experience do you have to work on issues related to electric scooters?		
Section 2. General opinions				
4	–	Indicate how you feel identified with the following statements: "A correct implementation of a shared scooter service in the city …	5 points Likert scale	… is possible without worsening road safety … should include integration with other modes of public transport … can be key to achieving air pollution reduction targets … has the potential to be a relevant mode of transport … is possible without interfering with pedestrian mobility
5		Point out the most important regulatory challenges of shared scooters in cities.	Multiple choice – multiple answers	Define roads that allow kick scooter circulation Define space allowed for parking Regulate the number of shared scooters allowed in each zone Regulate the number of companies operating the service (free access or limitation of operators) Integrate with public transport Establish a homogeneous regulation between municipalities in the same metropolitan area. Establish measures to guarantee road safety (protective elements, vests, etc.) Establish supervision of the service in terms of circulation and parking Define technical characteristics of scooters (wheels, brakes, battery, etc.)
Section 3. Regulatory dimensions				
6	Market access, competition and distribution of vehicles in the city	Do you think that the city council should set a maximum limit on the number of shared scooters in the city?	Multiple choice	Yes, depending on how demand evolves at any given time. Yes, by neighbourhood or district. Yes, in the city as a whole. No. Don't know
7		Do you think that municipalities should require operators to distribute vehicles evenly throughout the city?	Multiple choice	No, they should leave the operator free to place the scooters where he/she deems appropriate. Yes, they should ensure that the scooter service is accessible to all citizens, regardless of where they live. Don't know
8		What do you think is the optimal way for shared scooter companies to access the market?	Multiple choice	Concession limiting the number of operators. Free entry with municipal authorisation. Free entry without municipal authorisation. Don't know
9		Do you consider it advisable that a municipal company provide the scooter rental service?	Multiple choice	Yes, but leaving free access to the market to other shared scooter companies. Yes, on an exclusive basis. No. Don't know
10		What do you think is the optimal number of shared scooter companies in a large city (Madrid or Barcelona)?	Multiple choice	1 operator 2 operators 3 operators 4 operators 5 or more operators
11		What do you think is the optimal number of shared scooter companies in a medium-sized city (Valencia, Seville, Zaragoza, or Malaga)?	Multiple choice	1 operator 2 operators 3 operators 4 operators 5 or more operators
12		What do you think is the optimal number of shared scooter companies in a smaller city (Alicante, Granada, La Coruña, etc.)?	Multiple choice	1 operator 2 operators 3 operators 4 operators 5 or more operators
13	Technical and operational characteristics	For better functioning of the scooter service in a city, do you consider integrating the different operators of shared scooters under the same support or application?	Multiple choice	Yes, integrating information and payment system, as long as the privacy of each operator's information is guaranteed. Yes, integrating only information (location of the scooters) and redirecting to the payment system of each company. No, each company must have its independent system.

(*continued on next page*)

Table A.1 (*continued*)

ID	Dimension	Question	Type	Options
14		It seems reasonable to you that shared scooter services can be used with integrated public transport tickets (transport pass, etc.).	Multiple choice	Yes, in any case, but it would be necessary to increase the price to the user of the public transport ticket for using these services. Yes, but only when the scooter is used to connect to public transport. The City Council should subsidise these trips. Yes, in any case, but the City Council should subsidise the operator for those trips. Not a good option. The scooter should be independent of public transport.
15		In a metropolitan area that includes several municipalities, which of the following regulatory aspects do you consider necessary to homogenise?	Multiple choice – multiple answers	Traffic regulations. Parking rules. Road safety rules (helmet, vest, etc.). Integrate the granting of authorisations in the same competition. It is not necessary to homogenise any regulatory aspect.
16		What do you consider should be the maximum allowed speed of the scooter when riding on the road with other vehicles?	Multiple choice	Less than 25 km/h 25 km/h. Greater than 25 km/h
17		What do you consider should be the maximum speed allowed in a segregated bike lane?	Multiple choice	15 km/h. 20 km/h. 25 km/h. Mayor at 25 km/h. Don't know
18	Parking, traffic and road safety	Indicate the safety conditions that you consider should be mandatory to ride a shared scooter safely.	Multiple choice – multiple answers	Protective helmet. Reflective vest. Turn signals. Rear-view mirrors. Buzzer. Daytime running lights. Driver's license.
19		What is the minimum age for a shared scooter user?	Multiple choice	14 years old or younger. 15 years old 16 years old. 17 years old. 18 years old.
20		In terms of road safety, how do you think electric scooters should be regulated?	Multiple choice	In the same way as the bicycle. With a specific regulation, different from that of the bicycle.
21		On which roads should shared scooters NOT be ridden?	Multiple choice – multiple answers	On a wide sidewalk with low pedestrian traffic. On a bus lane. On multi-lane roads with one lane limited to 30 km/h. On multi-lane roads with maximum speeds above 30 km/h.
22		Do you consider it essential to extend the bike lane infrastructure in cities for the proper functioning of the shared scooter service?	Multiple choice	Yes, in some strategic ways. Yes, throughout the city. No.
23		When scooters ride on the roadway, do you think they should ride in which part of the lane?	Multiple choice	On the right side of the lane. In the centre of the lane. Do not know
24		In terms of traffic, how do you think electric scooters should be regulated?	Multiple choice	The same as the bicycle. The scooter must have its regulation independent of the bicycle.
25		In your opinion, which of the following modes of parking shared scooters is the most suitable for the city?	Multiple choice	Using a mixed system: fixed bases in crowded areas and free parking in the rest of the areas. Only on fixed bases (racks or specific parking areas). Freely on the sidewalk (as long as it allows pedestrians to pass).
26		If allowing free parking in the city, do you think that the accumulation of shared scooters parked in the same place should be limited?	Multiple choice	Yes No. Don't know
27		If the City Council decides to establish fixed bases in the city, how far apart should they be from each other?	Multiple choice	Less than 300 m. Between 300 and 600 m. More than 600 m. Do not know
28		Should the City Council decide to establish fixed bases in the city, what do you think would be the best way to provide them?	Multiple choice – multiple answers	On the sidewalk. On the parking strip. Do not know
29		If fixed bases are available in the city, how do you think shared scooters should be parked?	Multiple choice	Unanchored. Anchored Don't know
30		Should the City Council decide to establish fixed bases in the city, do you think they should incorporate a scooter charging system?	Multiple choice	Yes No. Don't know

(*continued on next page*)

Table A.1 (*continued*)

ID	Dimension	Question	Type	Options
31		In terms of parking, how do you think shared scooters should be regulated?	Multiple choice	In the same way as the shared bicycle. With a specific regulation different from bike sharing.
32	Supervision of the service	Of the following user supervision measures, which ones should the City Council impose on the operators in regulating the service?	Multiple choice – multiple answers	Knowing the parking of scooters using a photograph taken by the user. Prevent completion of the trip if the scooter is not in a permitted parking area. Know if a scooter is lying on the ground (by sensors). Use the remote control to limit speeds according to the zone. Make use of the remote control to prevent travel in non-permitted zones.
33		What information do you think operators should share with the City Council?	Multiple choice – multiple answers	Location of scooters. Battery status. Status of scooters (available/not available). Characteristics of each trip (time, route, time, etc.). Characteristics of users (use, age, sex, etc.).

Appendix B

Table B.1

Disparity indexes for the four dimensions.

ID Question number in the survey Appendix A, (1) all respondents, (2) Researcher and Consultant, (3) Public Authority, (4) Shared electric kick scooter company and (5) Maximum Disparity Index

ID	Question	*(1)*	(2)	(3)	(4)	Max
Market access, competition and distribution of vehicles in the city						
6	Set a maximum limit on the number of shared scooters in the city	***0.75***	0.74	0.76	0.63	0.80
9	A municipal company provide the scooter rental service	***0.59***	0.56	0.65	0.38	0.67
11	Optimal number of shared scooter companies in a medium-sized city (Valencia, Seville …)	***0.73***	0.70	0.74	0.00	0.83
8	Optimal way for shared scooter companies to access the market?	***0.57***	0.63	0.47	0.38	0.67
12	Optimal number of shared scooter companies in a smaller city (Alicante, Granada, La Coruña, etc.)	***0.68***	0.61	0.70	0.00	0.83
10	Optimal number of shared scooter companies in a large city (Madrid or Barcelona)	***0.66***	0.66	0.51	0.50	0.83
7	Municipalities should require operators to distribute vehicles evenly throughout the city	***0.51***	0.49	0.44	0.00	0.67
Technical and operational characteristics						
15	Metropolitan area: regulatory aspects needed to homogenise. **Answer 4.** Integrate the granting of authorisations in the same competition.	***0.48***	0.49	0.44	0.50	0.50
14	SEKS services with integrated public transport tickets (transport pass, etc.).	***0.74***	0.70	0.74	0.63	0.80
16	Maximum allowed speed of the scooter when riding on the road with other vehicles	***0.61***	0.64	0.55	0.38	0.67
13	Integration of different SEKS operators under the same mobile App	***0.52***	0.39	0.54	0.50	0.67
15	Metropolitan area: regulatory aspects needed to homogenise. **Answer 2.** Parking rules	***0.30***	0.36	0.24	0.00	0.50
17	What do you consider should be the maximum speed allowed in a segregated bike lane?	***0.48***	0.51	0.46	0.38	0.80
15	Metropolitan area: regulatory aspects needed to homogenise. **Answer 3.** Road safety rules (helmet, vest, etc.).	***0.22***	0.23	0.24	0.00	0.50
15	Metropolitan area: regulatory aspects needed to homogenise. **Answer 1.** Traffic regulations.	***0.13***	0.12	0.17	0.00	0.50
15	Metropolitan area: regulatory aspects needed to homogenise. **Answer 5.** It is not necessary to homogenise any regulatory aspect.	***0.10***	0.12	0.09	0.00	0.50
Parking, traffic and road safety						
18	Safety conditions mandatory to ride a SEKS safely. **Answer 1.** Protective helmet.	***0.50***	0.50	0.49	0.38	0.50
18	Safety conditions mandatory to ride a SEKS safely. **Answer 6.** Daytime running lights.	***0.50***	0.50	0.47	0.38	0.50
20	In terms of road safety, how do you think electric scooters should be regulated?	***0.50***	0.46	0.47	0.00	0.50
18	Safety conditions mandatory to ride a SEKS safely. **Answer 3.** Turn signals.	***0.49***	0.49	0.50	0.00	0.50
21	Roads SEKS NOT be ridden. **Answer 1.** On a wide sidewalk with low pedestrian traffic.	***0.49***	0.46	0.50	0.50	0.50
24	Traffic regulation for e-scooter	***0.49***	0.50	0.47	0.00	0.50
18	Safety conditions mandatory to ride a SEKS safely. **Answer 2.** Reflective vest.	***0.48***	0.42	0.47	0.00	0.50
31	Parking regulation for e-scooter	***0.47***	0.48	0.47	0.38	0.50
22	Extend the bike lane infrastructure in cities for SEKS services	***0.59***	0.56	0.63	0.50	0.67
19	Minimum age for a SEKS user	***0.72***	0.73	0.65	0.63	0.83
23	Part of the lane that e-scooter ride on the roadway	***0.58***	0.55	0.57	0.50	0.67
29	Way of parking SEKS if fixed bases are available in the city	***0.57***	0.60	0.38	0.38	0.67
30	City Council should incorporate scooter charging systems for fixed bases	***0.57***	0.46	0.63	0.63	0.67
27	Distance between fixed bases	***0.67***	0.66	0.68	0.00	0.80
18	Safety conditions mandatory to ride a SEKS safely. **Answer 4.** Rear-view mirrors.	***0.40***	0.39	0.44	0.00	0.50
18	Safety conditions mandatory to ride a SEKS safely. **Answer 5.** Buzzer.	***0.40***	0.39	0.44	0.00	0.50
21	Roads SEKS NOT be ridden. **Answer 2.** On a bus lane.	***0.40***	0.32	0.47	0.38	0.50
25	Suitable parking modes for SEKS in cities	***0.53***	0.54	0.41	0.38	0.67
26	Limitation of SEKS parked in the same place if allowing free parking in the city	***0.32***	0.29	0.39	0.00	0.50
28	Best way to provide fixed bases in the city if City Council decide to establish them in the city. **Answer 1.** On the sidewalk.	***0.30***	0.36	0.17	0.38	0.50
21	Roads SEKS NOT be ridden. **Answer 4.** On multi-lane roads with maximum speeds >30 km/h.	***0.27***	0.28	0.24	0.38	0.50
28	Best way to provide fixed bases in the city if City Council decide to establish them in the city. **Answer 2.** On the parking strip.	***0.25***	0.32	0.17	0.00	0.50
18	Safety conditions mandatory to ride a SEKS safely. **Answer 7.** Driver's license.	***0.22***	0.23	0.24	0.00	0.50

(*continued on next page*)

Table B.1 (*continued*)

ID	Question	*(1)*	(2)	(3)	(4)	Max
21	Roads SEKS NOT be ridden. **Answer 3.** On multi-lane roads with one lane limited to 30 km/h.	***0.07***	0.12	0.00	0.00	0.50
Supervision of the service						
32	User supervision measures that the City Council could impose on the operators. **Answer 1.** Know if a scooter is lying on the ground (by sensors).	***0.50***	0.49	0.49	0.50	0.50
32	User supervision measures that the City Council could impose on the operators. **Answer 2.** Use the remote control to limit speeds according to the zone.	***0.50***	0.50	0.50	0.00	0.50
32	User supervision measures that the City Council could impose on the operators. **Answer 3.** Make use of the remote control to prevent travel in non-permitted zones.	***0.48***	0.50	0.44	0.00	0.50
33	Information that operators should share with the City Council. **Answer 1.** Battery status.	***0.46***	0.48	0.44	0.38	0.50
33	Information that operators should share with the City Council. **Answer 2.** Status of scooters (available/not available).	***0.41***	0.42	0.36	0.50	0.50
32	User supervision measures that the City Council could impose on the operators. **Answer 4.** Knowing the parking of scooters using a photograph taken by the user.	***0.40***	0.42	0.36	0.38	0.50
33	Information that operators should share with the City Council. **Answer 3.** Characteristics of users (use, age, sex, etc.).	***0.34***	0.28	0.24	0.00	0.50
33	Information that operators should share with the City Council. **Answer 4.** Characteristics of each trip (time, route, time, etc.).	***0.22***	0.12	0.24	0.50	0.50
32	User supervision measures that the City Council could impose on the operators. **Answer 5.** Prevent completion of the trip if the scooter is not in a permitted parking area.	***0.19***	0.23	0.17	0.50	0.50
33	Information that operators should share with the City Council. **Answer 5.** Location of scooters.	***0.07***	0.06	0.09	0.00	0.50

Appendix C. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.tranpol.2023.02.009.

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