It is time to get virtual: limitations of shared e-scooter mobility points, case study in Cracow (Poland)

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ABSTRACT Underpinned by the shift towards implementing solutions supporting sustainable mobility, shared e-scooter services are evergreen in many urban areas worldwide. However, their growing use leads to new challenges connected with their operation in the urban space. This article showcases instruments called mobility points, designated to define, and improve parking practices of shared e-scooters. To evaluate the potential of mobility points fieldwork was conducted into the vectorization of shared e-scooters' operational zones and mobility points in Cracow. The study proves that the mobility points' visual and technical organization is adequate and thought-out in ways based on functions of the areas they are placed in. However, due to insufficient cooperation between the private and public sectors that would ensure the mobility points are virtually implemented into the service operation, the mobility points' potential to solve parking issues is low. This calls into question their role in the sustainable mobility agenda.

KEY WORDS mobility points – shared e-scooters – shared mobility – public space – safety – Cracow

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1. Introduction

As the quality of life in cities is greatly influenced by transport, city planning authorities are confronted with many transport-related challenges (Bannister, Hickman 2013, Bossetti et al. 2014) and it is no surprise that the concept of sustainable development has penetrated urban and transport planning across urbanities over the past years (Hickman, Banister 2014; Boussauw, Vanoutrive 2017). Unfortunately, there is an existing gap between what is understood as sustainable mobility by the scholars and transport or city planning authorities (Kębłowski, Bassens 2018, Brůhová Foltýnová et al. 2020). There is also evidence that the term 'sustainable mobility' is being used as an attractive label, used mainly as a marketing strategy aiming to distinguish one urban area from another without effectively solving the transport and mobility issues (Boussauw, Vanoutrive 2017; Reigner, Brenac 2019; Carr, Hesse 2020) which invites the transport and urban geography research to explore the tensions between new form of mobilities and creation of urban space (Jonas 2015, Ryghaug et al. 2020). This study follows the above-mentioned academic debate over the sustainable mobility policy actions by examining the concrete managerial practice of Cracow's city planning authorities regarding the use of an e-scooter sharing system as an instrument to support sustainable mobility.

Underpinned by the expansion of sharing economy and fast technological development allowing to keep track of the vehicle's movement and the user's payment, the popularity of e-scooter sharing schemes is on the rise (Schellong, Sadek, Barrack 2019; Clewlow 2019; Morean, Laa, Emberger 2020). For the transport planners, it offers a solution to mitigate the negative externalities of transport and improve the transport options in a given urban system (Holden et al. 2020, Hosseinzade et al. 2020), while for the users, e-scooters[1] represent an attractive mode of private transportation suitable for the"last-mile" or a quick, comfortable and flexible alternative to the bike or public transport (Smith, Schwieterman 2018).

However, the rising popularity of shared e-scooters creates a new conflict over the use of public space and comes along with new challenges the public authorities and users must face (Anderson-Hall et al. 2019). Gauquelin, Schlebusch and Faure (2020) with Riggs and Kawashima (2020) demonstrate that the shift to define clear managerial practices for the operators of e-scooter sharing services is currently undergoing throughout Europe, but the portfolio of new issues varies greatly. For illustration, the challenges are connected not only with urgent problems, such as safety on the roads and streets (Allem, Majmundar 2019; Choron, Sakran 2019; Trivedi et al. 2019; Todd et al. 2019; Namiri et al. 2020; Yang et al. 2020;

[1] The term of e-scooters and shared e-scooters are in this article used as synonyms and they both refer to e-scooters sharing systems.

Toofany et al., 2021), but also with more system-wide problematics. For example, how to manage the e-scooter sharing systems or how to integrate them into the current transport network (Oeschger, Caroll, Caulfield 2020) and urban land nexus, which are described later. Different issues represent the rationalisation of supply chains, so it would meet growing environmental demands (Bolt 2020, de Bortoli 2021). Recent reports also point out to a significant gender gap in the use of shared e-scooters (Krizek, McGuckin 2019; Howe 2020) underpinned by different mobility strategies of females and males, the way e-scooters are designated, or cultural factors. In addition, a different category is represented by the issue of fleet optimisation, like re-distribution of the e-scooters and their re-charging, which, in fact, increases the footprint of those green vehicles (Chen et al. 2018, de Bortoli 2021).

The research problem of this paper is the presence of e-scooter sharing services in public spaces and their impact on urban space. As it has been said, recent years have been characterised by the rapid development of shared mobility services and their growing popularity. However, while they may be a desirable way to expand transport offerings, new challenges arise at the same time. Among these challenges is the organisation of parking practises to maintain order and safety in public spaces. This study explores the potential of the so-called "mobility points", also referred to as "mobility hubs", "mobility spots" or "parking bays", which emerged as a reaction to growing problems with e-scooters' parking practices (James et al. 2019) by mitigation of e-scooters littering the public space. This is a particular task for the geography of transport and mobility as it brings more clarity into the question how a sustainable transport and mobility system should be design, what is the role of public authorities in shaping such a system and how it meets the day-to-day mobility needs (Ryghaug et al. 2020).

Ravazzoli and Torricelli (2017) cogitated on how can public space affect the sustainable traits of urban mobility, and also how can urban mobility contribute to the social qualities of public space. These two spheres of urban reality should indeed be studied together because they are closely intertwined in everyday life. However, the authors of this paper propose to reverse this viewpoint and note that urban mobility, if not properly managed, can negatively affect the image of public space. As Mehaffy, Elmlund and Haas (2019) notice, although cities allow us to grow and use their resources, at the same time they can "bring us into conflict with others – conflicts over adjacencies, over noises and smells, over competition for space in crowded places and other disruptions" (Mehhaffy, Elmlund, Haas, p. 81). As this is undoubtedly true for the question of how shared mobility services affect our public spaces, the authors want to draw the attention to one such challenge.

The main inspiration for the authors was the prevalent sight of either abandoned or incorrectly parked vehicles in the streets of Cracow, Poland. However, the authors realised that the problem lies elsewhere, namely mobility points in the

Cracow centre, which are not explicitly outlined and do not distinguish themselves from the surrounding landscape. The regular pedestrian often cannot even tell if the pile he walks by is a designated spot or someone decided to leave his scooter there and other users followed due to a lack of sufficient information. For the authors, this is another act in the broad debate on the relationship between the public and the private urban spaces, which can be discussed in many contexts, often not being related to each other due to different definitions of "private" in respective studies (e.g. Kohn 2004; Nèmeth, Schmidt 2011). In the case this paper is presenting the problem lies not so much in the "privatisation" of the parcels of the public space in question, but in degrading the quality of use and aesthetics of urban spaces as an undesired result of a private enterprise operating in urban areas. Public spaces in contemporary cities are subject to the "great complexitiy of (...) tensions (...) and the presence of opposing strategies and practises aimed to their organisation and use" (Mela 2014, pp. 5–6). As outlined later in the paper, in Poland sharing services seem to be "taking over" (e.g. Górny 2020).

The main aim of this study is to examine the potential of the mobility points to solve or mitigate problems of incorrectly parked e-scooters in selected Polish settlements where e-scooter sharing systems are in operation. By revealing the problem of abandoned and badly parked vehicles and their impact on the basic qualities of public space, the article draws the attention to yet another dimension of the public-private conflict over public spaces and tries to show what the consequences of the presence of shared mobility services are in the light of the ideal type of public space. The conclusions and recommendations are therefore mainly addressed to decision makers, municipal employees and transport authorities, but they may also interest shared mobility service providers when planning further development. After the Introduction, the Theoretical background describing the conflict between the public space and the operators of e-scooter sharing schemes is provided, followed by the Methodology, Results, Discussion and Conclusion.

2. Mobility points in the context of public space concepts

Over the recent years, shared mobility services have been becoming increasingly popular in cities, mainly changing the landscape of their centres, where today we can see not only pedestrians and cyclists, but also swiftly moving e-scooters (Clewlow 2019). They broaden the catalogue of means of individual transport and the physical accessibility of the city, making travel patterns more flexible, but at the same time tease a whole new branch of challenges. Also, their declared pro-environmental and sustainable nature/image is not absolute and undisputable (Štraub 2020). Others state that cities were almost "conquered" by the shared mobility services, which e-scooters are a part of. "It should be stated that Polish

cities have passively given in to the expansion of commercial moped and e-scooter renting systems, but do not follow the problems that unfold" (Górny 2020, p. 48).

The challenges would be, among others: ensuring the safety of pedestrians (*ibidem*), ensuring the relevant infrastructure and providing good conditions for the co-presence of e-scooter users with other traffic participants. As M. Wójcicka from "The City is Ours" association (Stowarzyszenie Miasto jest Nasze) states, "the sharing business is a classic case of socialisation of costs and privatisation of profits. It creates social problems and generates costs, with the profit remaining private" (Romanowska 2019).

The problem of safety and e-scooter sharing schemes co-existing with other users of the city implies that shared-mobility services can and should be situated in the context of public space. The authors argue that whatever branch of problems regarding the urban fabric is disputed, sooner or later their impact on public space qualities should be taken into consideration. The problem of mobility points and their situation can be seen as one of the factors to bring about the context of management and control issues.

2.1. The public space understanding and context

There are many great definitions and approaches to the term "public space", among them especially relevant being the one developed by Carmona, de Magalhães and Hammond (2008, p. 8) saying that "public space (broadly defined) relates to all those parts of the built and natural environment, public and private, internal and external, urban and rural, where the public has free, although not necessarily unrestricted, access."

As it was noticed, "free" is not the same as unrestricted. This was recognised by Bierwiaczonek and Nawrocki (2012) in their proposition of an "ideal type" of public space, based on a broad literature review. The below table shows an extended version of this "ideal type" completed with additional characteristics and their relevance to the question of e-scooters. The intention is to show a certain semantic context as a basis for further operationalisation (Table 1).

The ability to impose organisation is derived from the notion that public space is always in some way organised and in someone's control (Marody, Giza-Poleszczuk 2004; Ercan 2010). Bierwiaczonek and Nawrocki (2012) also ponder on who controls the space and whether they are public or private actors. In the context of the above-mentioned critique, it can be said that "socialisation of costs and privatisation of profits", as stated by Wójcicka (Romanowska 2019), could be interpreted as a reference to another quality of public space: serving the public interest, being a common good (Bierwiaczonek, Nawrocki 2012; Ercan 2010). All of the above is a consequence of the key quality of public space – accessibility

Table 1 – An ideal type of public space in the context of e-scooter sharing services

An "ideal type" of public space	Proposed reference to e-scooter services
1. Public space as an element of the public sphere – the sphere of discourse (Marody, Giza-Poleszczuk 2004).	1. E-scooters as an element of the new urban mobility discourse and conditions of implementing such a policy.
2. Access (Marody, Giza-Poleszczuk 2004; Kohn 2004; social, physical or symbolic – Carr et. al., 2009 [1992]).	2. E-scooters broaden the access to public spaces in the physical sense, but can affect accessibility for pedestrians.
3. Control – e.g. how public actors and agencies can exercise control over space (Ercan 2010).	3. Whether the city authorities to any extent control the aspect of public space that is bound to the usage of e-scooters introduced by private enterprise.
4. Public interest – public space as a common good (Ercan 2010).	4. In the context of the above-mentioned critical remarks (Romanowska 2019), it is about claiming the public space by a private enterprise that operates in "everyone's land" – which may create problems that impair the qualities of public space that serve "the public", not only e-scooter users.
5. The organisation of space – rules and signs that make it possible to function in the space (Marody, Giza-Poleszczuk 2004; Ercan 2010).	5. Organisation can be referred to the visual characteristics of mobility points and preventing visual pollution.
Additionally: public space functions	
6. In the literature, there is a broad understanding that public space serves specific functions. The functions can be discussed in social and/or utilitarian sense, see: (Wallis 1977, Lofland 2007 [1998], Lynch 1990 [1960]).	6. Shared mobility services could be discussed in terms of situating the mobility points in various areas of the city and identifying the primary function of the area. It can be sought whether there is a functional pattern of choosing where to situate the mobility points.

Source: elaborated by the authors based on Bierwiaczonek, Nawrocki (2012)

(Lynch 1981; Carr et al. 2009 [1992]; Bierwiaczonek, Nawrocki 2012). As Kevin Lynch notes: "Access may be classified according to the features to which access is given and to whom it is afforded." (Lynch 1981, p. 188)

E-scooter sharing schemes broaden the physical accessibility of space but can impair the right to access for pedestrians. As our own research shows, the main problem that the pedestrians have with e-scooters is abandoned vehicles and acting against riding ethics (Gauquelin, Schlebus, Faure 2020; Toofany et al. 2021). As such, it impairs public interest in what the space serves. The context of the Polish law should be considered here, as preserving the safety, public and spatial order is one of the key tasks of the municipality (Kancelaria Sejmu 1998).

Ultimately, it all comes down to a question of public space management, as it was discussed by Carmona, De Magalhães and Hammond (2008). In their book, the authors proposed four key intertwined processes that comprise the question of management: (1) The regulation of uses and conflicts between them. This recognizes the many functions that public spaces have and anticipates conflicts between some of them. (2) The maintenance routines, understood as actions that serve to

ensure that public spaces remain usable. (3) New investments and resourcing to support the above. (4) Coordination of interventions between the units and agents responsible.

As the paper focuses on mobility points, the authors propose to focus on the visual dimension of public space. Once again, the inspiration here comes from the access characteristic, this time discussed in the visual context (Carr et al. 2009/1992). Although the cited sources point mostly to safety and privacy matters, the hereby article proposes visual access as a component of the broader composition of characteristics for discussing the public space in a visual sense. For better understanding, a selection of concepts and/or definitions that inspired this study are now talked through.

Starting with *legibility***,** which the authors of this paper consider a "buckle-concept" – according to Lynch, is "the ease with which ... pars can be recognised and organised into a coherent pattern..." (Lynch 1990 [1960], pp. 2–3). The author stresses that "legibility is crucial in the city setting" (Lynch, 1990 [1960], p. 3). It is important in the context of mobility points because in order to be used, they should be recognisable. The user should know that what he encounters on his path is a mobility point, even if it does not currently have parked vehicles. If the respective parts and points in the city are visually well-organised, one can talk about a city being legible. According to the presented concepts, the public space legibility would be a general assessment, based on a few characteristics, such as visual access, informational cloak, urban and architectural/aesthetical order and virtual environment.

Visual access (Carr et al. 2009 [1992], pp. 144–146) applied here means that in the public space, the user/resident can identify the mobility point: they are approachable. One can distinguish certain parts or elements of the public space, serving a specific purpose, and thus access or use them.

The term *Informational cloak*, coined by Wallis (1979), refers to the parts of the urban landscape that are temporary in nature. It is not architecture, but rather the informational layer of it, serving a number of purposes, among others, with regulative and ordering functions. The cloak may then inform the user about the purpose of the encountered elements of the urban landscape. It denotes signs and other ways of organising the space in order to point out that what the user sees is a mobility point. As such, it is a function of an organisation of space, only in this case in terms of rules and signs as pointed out in the ideal type (Bierwiaczonek, Nawrocki 2012) by reference to Marody, Giza-Poleszczuk (2004) (Table 1).

Urban and architectural/aesthetical order defined by the compactness of composition, its logic and legibility, and the use of small architecture. It denotes the aesthetical correspondence with the surroundings. It contributes to the general "aesthetical" order, defined by the rich informational layer and symbols, easing orientation and moving efficiently around the area (Szczepański 1991). Like the

safety and public order in the above-mentioned Local Government Act, the quality of spatial order is also reflected in the Polish law, in the context of conditions and requirements (e.g. functional, aesthetical and compositional) to create a harmonious whole (Kancelaria Sejmu 2003). Mobility points can be organised either in the form of horizontal markings or urban furniture. Depending on the surroundings, choosing one or another form of organisation can help in integrating the points with the rest of the cityscape. However, to comprehensively focus on the mobility points, which intend to be a critical element of shared micro-mobility systems, the authors, besides the physical layer of the urban space, turn to the virtual environment.

The *virtual environment*, in this case, the mobile phone application, is fundamental for the operation of shared micro-mobility services. It not only collects and evaluates data on the user behaviour, allows to start and end the rental, but also inform the user about the location of shared vehicles, zones with restricted use (e.g. caped maximum speed limits) but also about where it is possible to end the rental. For the latter, it is essential for this study to also understand whether mobility points are also visible in the virtual environment of the municipality and shared mobility operators, as this environment possesses key information about the terms of use (e.g. Fig. 5).

3. Methodology

There exists various studies from Cracow which deals with the topic of shared mobility, namely the former bike-sharing system, and transport infrastructure (Nosal 2015; Czech, Turoń, Urbańczyk 2017; Czech, Turoń, Sierpiński 2017; Bryniarska, Wilk 2018; Świgost-Kapocsi 2019; Banet 2021). However, they are focusing rather

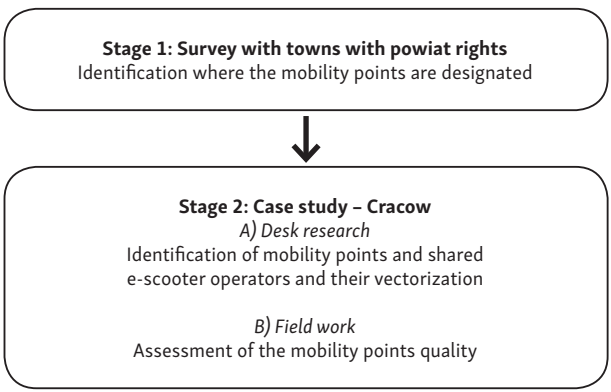

Fig. 1 – Scheme of the research work

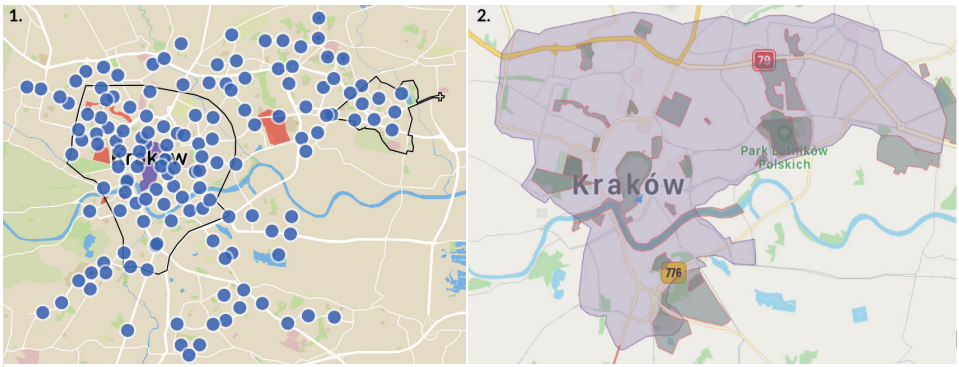

Fig. 2 – Mobility points (1; Public Transport Authority 2021a) and Bird shared e-scooter operational zone (2) before vectorization, Cracow (accessed 5. 5. 2021)

on overall evaluation of the bike-sharing system or user behaviour, it was necessary for this research to develop it's own methodology. The identification of the operational zones of shared e-scooters and mobility points is based on the similar approaches as (Moran, Laa, Emberger 2020; Štraub, Gajda 2020) which is due to data availability more convenient for the purpose of this study then using the approached proposed by Mckenzie (2019) or Younes et al. (2020) based on the application programming interface or Bai and Jiao (2020) who had at their disposal aggregated and anonymised data on e-scooter trip records from city officials. The criteria how to asses the quality of mobility points is described in below in the subsection 3.1.

The study work was divided into two main stages (Fig. 1). In the first stage, electronic questionnaire was distributed to 66 municipalities – towns with powiat rights[2]. Aim of this step was to identify whether in the selected municipalities there are designated mobility points. In the second stage, the town of Cracow was selected for a case study, as it is one of the example that is developing activities to diminish the problem of incorrectly parked e-scooters.

In the Cracow case study, desk research and field work were conducted. The aim of the desk research was to identify all e-scooter sharing services and mobility points that are available in the Cracow and was followed by manual vectorisation. The manual vectorisation of e-scooter sharing services was based on the dataset containing the e-scooter operational zones of all voivodeship capitals in Poland made by Štraub and Gajda (2020). Operational zones from the mentioned dataset were compared with the actual (5. 5. 2021) spatial extent of the geofenced areas

[2] According to Act on County Self-Government (Kancelaria Sejmu 1998), a town with powiat rights is a town with special status in Poland's settlement system. These are presidential cities, either above 100,000 inhabitants and those that were previously seats of voivodes.

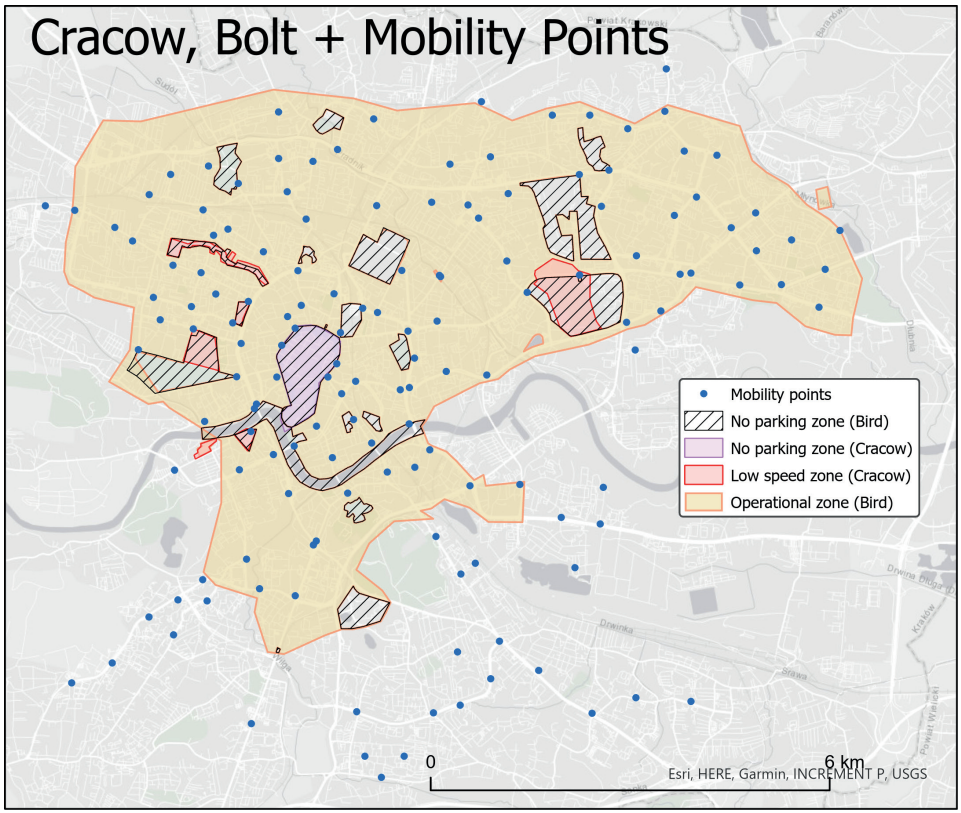

Fig. 3 – Vectorised mobility points and operational zone (Bird), Cracow. Source: authors' own elaboration based on Štraub and Gajda (2020), and Mobility point map of the administration of Public Transport Authority in Cracow (2021a).

from mobile applications and adjusted if necessary not only for the overall operational zones, but also for the specific's zones: no parking zones, special parking zones, low-speed zones and no-go zones (Fig. 2). Afterwards, point-to-point and feature-to-feature vectorisation (lastly actualised 6. 4. 2021) of official mobility points defined by Cracow officials was performed (Figure 2). This resulted in a new and actual dataset containing the various spatial areas used by the operators of e-scooter sharing services and all (n = 146) mobility points in Cracow (Fig. 3).

To asses the quality of the mobility points in Cracow, field work in four urban districts that represents city centre, the inner-city and the suburb (Fig. 4) was conducted. The city centre is for the purpose of this study defined as the Old Town (Stare Miasto), whereas Nowa Huta (Stara Nowa Huta) is considered by the authors as a secondary centre. The inner-city is defined as an urban district called Stare Podgorze, whereas, by suburb, this study understands Ruczaj-Kobierzyn.

In total, there are 26 parking bays in the selected districts that are used for the assessment of mobility points: 5 in the city centre, 8 in the secondary city centre, 5 in the inner city, and 8 in the suburb.

3.1. Assesment criteria

The examination of the mobility points' potential to solve parking problems is based on the assessment criteria grounded in the literature over the public space were developed (Table 2).

The above Table 2 served to discuss the potential of adopted literature to analyse the case of mobility points in Cracow. The "definition" column presents what was understood under the adopted terms, as the original concepts were an inspiration, rather than a direct point of reference. The subject can, therefore, be analysed by

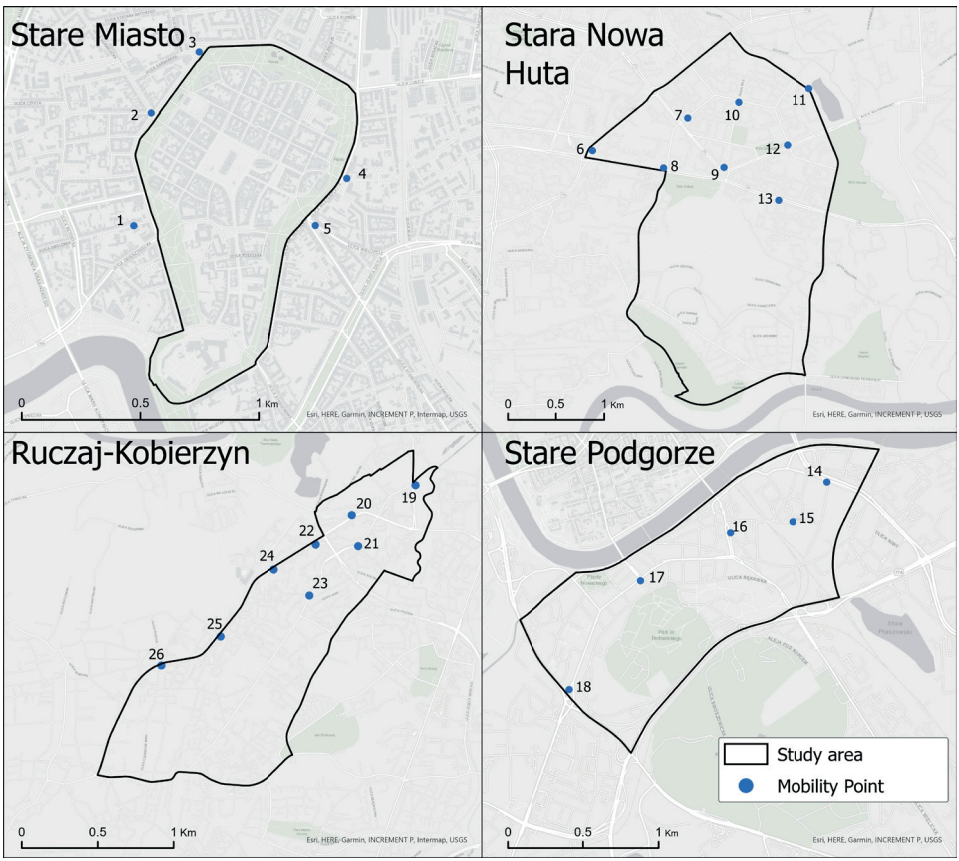

Fig. 4 – Area of the mobility points' assessment, 4 districts with all mobility points

Table 2 – Assessment criteria based on theory

Criteria		Definition	Element
Functional access (physical access)	Urban/social function (Wallis 1977, Lofland 2007 [1998], Lynch 1990 [1960])	The prevailing function of the immediate surrounding of the mobility point	The main function of the location
	Multimodality Nobis 2007; Krygsman, Dijst 2001)	The mobility point allows switching to public transport, store bike or private e-scooter, and is used by available shared e-scooter operators	Public transport stop
			Bike holders
			Active operators
Visuality (visual access)	Visual access (Carr et al. 2009 [1992]) and informational cloak (Wallis 1979)	A mobility point is clearly visible in the range of eyesight and clearly distinguished from the surrounding environment. A description is placed, informing the user about the purpose and proper use of the mobility point.	Totem sign
			Manual
			Flat sign
	Urban and architectural/ aesthetical order (Szczepański 1991)	The degree to which the design of a mobility point is coherent with the surrounding (assessed in a descriptive way)	The overall organisation with the use of street furniture (descriptive assessment)
Virtual access	Virtual layer	Information on the mobility point in the mobile application of the operator and the website of the municipality	Operator's app
			Municipality's website/app

Source: elaborated by the authors based on the literature (Table 1)

Table 3 – Linking the sought indicators with theoretical references

Concepts Indicators	Access (physical)	Access (visual)	Virtual cloak	Informa-tional cloak	Multi modality	Urban-architec-tural/aesthetical order	Main area function
Active operators	×				×		
Shared with public transport stop	×				×		×
Bike holders	×				×	×	×
Street furniture		×				×	×
Totem sign		×		×		×	
Operator: app		×	×				
Municipality: website/app		×	×				
Manual				×			
Flat sign		×		×			
Pictogram		×		×		×	

Source: elaborated by the authors based on the literature (Table 1, Table 2)

a series of indicators that often contribute to more than one analysed dimension. One indicator can contribute to more than one theoretical concept as is demonstrated in Table 3.

Tables 2 and 3 served as a basis for constructing the evaluation sheet, enclosed in (Table 4). For the purpose of further analysis, and to better distinguish the discussed aspects of the matter, the physical accessibility will be renamed to "functional access", visual aspects of the organisation of mobility points will be called a "visual access", and an additional category developed in this study will be named "virtual access".

4. Results

The own research, conducted among Polish cities with powiat rights (66 municipalities), reveals that currently or at some point in the past, e-scooters were operational in at least 36 of them[3]. Among the towns from this sample, 34 responded furtherly whether the parking spots (mobility points, that is) are in any way visually organised.

The vast majority of towns with e-scooter sharing services in no way visually organise such mobility points in respect to various providers. Only in 7 towns (Sopot, Gdańsk, Katowice, Cracow, Lublin, Sosnowiec, Chorzów) the respondents declared that such an organisation was introduced in the form of flat signs and/or road markings with pictograms – an image of an e-scooter. Such a flat (horizontal) marking is simply a painted rectangular outline of the given area dedicated to parking.

Two municipalities pointed out other solutions. One is Sosnowiec, which adopted a classic D-18 parking sign, while the other is Cracow, which is using totems on a part of the spots – being an example of urban furniture. During fieldwork, the authors also found specific holders dedicated to e-scooters. This case is discussed below.

It should be noted that in the collected questionnaires, no other towns chose the answer referring to urban furniture elements, like racks/holders or canopy/shelter. Nevertheless, such a construction has been announced to be made for the Służewiec business district in Warsaw (Mehmet, 2020). It would be comprised of seats, trees providing shade, as well as stations for mopeds and e-scooters, allowing to charge the vehicles.

[3] The main source of this data is the upcoming mini-report on managerial practices in the cities on poviat rights, being prepared currently in Urban Policy Observatory, Institute of Urban and Regional Development (Štraub, Pistelok 2022). The report will be available in 2022 at http://obserwatorium.miasta.pl/

Table 4 – Assessment sheet

				Multimodality: Physical access			Visual access and legibility		Virtual cloak		Informational cloak			
MH	Name of the street:	Study area	Main function of the location	Active operators	Shared with public transport stop	Bike holders	Street furniture	Totem sign	In app: operator	Website: municipality	Manual	Flat sign	Pictogram note	
1	Smoleńsk	C	Mix/res/public service	6	½	1	0	1	0	1	1	1	0	
2	Bagatela	C	Node	6	1	1	0	1	0	1	1	0	0	self-service device
3	Garbarska	C	Mix/pedestrian/ planty	6	0	0	0	1	0	1	1	1	0	
4	Kopernika	C	Mix/pedestrian/ planty	6	0	0	0	1	0	1	1	1	1	
5	Poczta Główna	C	Node	6	1	1	0	1	0	1	1	1	1	self-repair service device
6	Rondo Czyżyńskie	SC	Node/ residential	3	1	0	0	1	0	1	1	1	0	
7	Zgody	SC	UM/Residential	3	0	1	0	1	0	1	1	1	0	
8	Os. Kolorowe	SC	Transit/street	3	1	0	0	1	0	1	1	2×	0	
9	PC	SC	Node/main square	3	1	1	0	2×	0	1	1	1	0	
10	Żeromskiego	SC	Residential	3	0	0	0	1	0	1	1	2×	0	
11	Zalew	SC	Leisure space	3	0	0	0	1	0	1	1	2×	0	
12	Struga	SC	Residential/ transit	3	1	0	0	1	0	1	1	1	0	
13	Na Skarpie	SC	Residential	3	1	0	0	1	0	1	1	1	0	

				Multimodality: Physical access			Visual access and legibility		Virtual cloak		Informational cloak			
MH	Name of the street:	Study area	Main function of the location	Active operators	Shared with public transport stop	Bike holders	Street furniture	Totem sign	In app: operator	Website: municipality	Manual	Flat sign	Pictogram note	
14	Zabłocie	IC	Transit/ academia/ leisure	5	1	1	Other	1	0	1	1	1	1+P	self-service device, e-scooter holder
15	Fabryka Schindlera	IC	Culture	5	0	1	0	1	0	1	1	0	1+P	
16	Plac Bohaterów Getta	IC	Node	5	1	1	0	1	0	1	1	1	0	
17	Korona	IC	Node	5	1	1	0	1	0	1	1	1	0	
18	Mateczny	IC	Node	5	1	0	0	1	0	1	1	1	0	
19	Kobierzyńska	SUB	Transit	4	1	0	0	1	0	1	1	2×	0	
20	Grota Roweckiego	SUB	Transit/ residential	4	1	0	0	1	0	1	1	1	1	
21	Miłkowskiego	SUB	Residential	4	0	0	0	1	0	1	1	1	1	
22	Norymberska	SUB	Residential	4	½	0	0	1	0	1	1	1	0	
23	Zachodnia	SUB	Residential	4	1	0	0	1	0	1	1	2×	1	
24	Ruczaj	SUB	Residential/ campus	4	½	0	1	1	0	1	1	1	1	
25	Chmieleniec	SUB	Residential/ campus	4	1	1	0	1	0	1	1	1	1	
26	Czerwone Maki	SUB	Node/ Residential/ transit	4	1	1	0	2x	0	1	1	1	1+P	

Notes: C – centre (Stare Miasto), SC – secondary centre (Stara Nowa Huta), SUB – suburb (Ruczaj-Kobierzyn), IC – inner city (Stare Podgórze), P – letter P with the pictogram

4.1. Cracow case study

Cracow is one of the municipalities that adopted mobility points as a solution to improve the parking options of shared e-scooter vehicles and mitigate the problem of vehicles being scattered all over the town. As it is demonstrated in Figure 2 and Figure 3, there are currently 145 mobility points in various locations throughout the town. The map of the points is provided by the municipality and publicly displayed on the web page mobilnykrakow.pl, which is an official site under the administration of the Public Transport Authority in Cracow. Besides the location of the mobility points, the online map informs users about the latest updates made to the map, planned mobility points and zones, where the maximum speed of e-scooter vehicles is capped, or zones where it is forbidden to end the rental of a shared e-scooter.

From the first sight (Fig. 2), one sees that the mobility points are mainly situated in the central area of the town, with the old historical town (Stare Miasto) being the only location where it is prohibited to end the rental of an e-scooter. Other distinctive locations include the secondary city centre – Stara Nowa Huta, or some suburban locations, e.g. Ruczaj-Kobierzyn. However, discrepancies are noticeable after comparing the density of mobility points with the density of bike racks in Cracow provided by the Public Transport authority in Cracow (2021a, 2021b). Firstly, the network of public bike racks is denser, especially in the city centre, secondary centre and inner-city. Secondly, bike racks are also available at locations connected with leisure activities, such as natural landmarks and parks of Cracow. Cyclists who are using a bike on a daily basis to commute, do errands or for leisure have better conditions to accommodate their needs compared to users of shared e-scooters who plan to use the mobility points. What is similar in the spatial distribution of bike racks and mobility points is that for both, the density decreases as the distance increase from the city centre.

In total, 26 mobility points in 4 different various districts of Cracow were analysed (Fig. 4, Table 5). As we could see in the table below, the amount of chosen mobility points among the selected study areas do not differ greatly.

Tab. 5 – Characteristic of the study area

District	Mobility points (n)	Active operators (n)
Stare Miasto	5	6 (Lime, Hulaj, Bird, Bolt, Tier, Blinkee.city)
Stara Nowa Huta	8	3 (Lime, Bird, Bolt)
Stare-Podgorze	5	5 (Lime, Hulaj, Bird, Bolt, Tier)
Ruczaj-Kobierzyn	8	4 (Lime, Hulaj, Bolt, Tier)

Note: active e-scooter sharing services on 5th of May 2021

4.2.1. Functional access

In the studied sample (Fig. 4 or Table 4), most of the mobility points were located near the main routes (transit area), communicational nodes and in residential areas. In total, half of the points are situated in places that seem to have communication and transit as the main function. In Cracow, there are plenty of places that serve as "traffic generators" – specific nodes that either allow to switch to other modes of transport or are situated near core locations (Fig. 4, mobility points No. 2, 9).

It means that the examined mobility points are situated at important communicational nodes or streets adjacent to public places like parks and squares, or in residential areas (Fig. 5). However, by focusing on active shared e-scooter operators, it is possible to see that their spatial coverage decreases from the city centre, as those locations might not be seen as attractive for the operators (Table 5). This is interesting in the case of the secondary centre of Stara Nowa Huta, which is well integrated with the rest of the town, but there are only 3 active operators. In this study, Nowa Huta is actually "responsible" for such a high rate of residential areas.

The notion that, in most cases, the studied points contribute to multimodality is strengthened by the fact that they are located in the immediate vicinity of public transport stops (n = 16) or are accompanied by bike holders (n = 11). This means that crucial physical accessibility is addressed in a two-fold way: the e-scooter sharing system is both accessible and broadens access to various parts of the town.

One of the most interesting cases among those analysed was the Zabłocie mobility point (Fig. 6), situated in the eastern part of the Podgórze district (Fig. 5, mobility point No. 14). Location-wise, it combines academic, leisure, residential and transit functions. Aside from bike holders and a self-service repair station, it also offers scooter holders, which the authors have not noticed anywhere else in the sample.

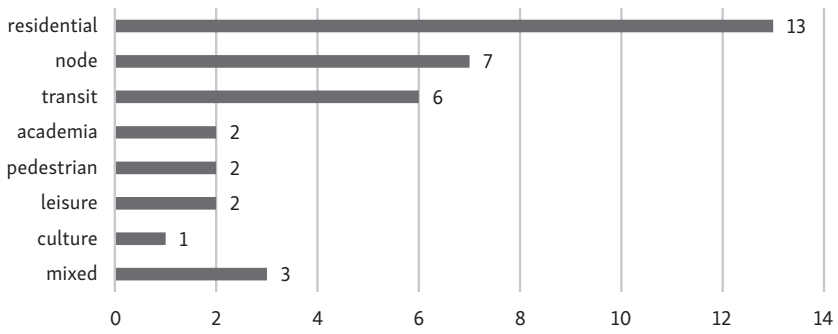

Fig. 5 – Location areas of mobility points

Fig. 6 – E-scooter holders at the Zabłocie mobility point (Figure 4, mobility point n. 14)

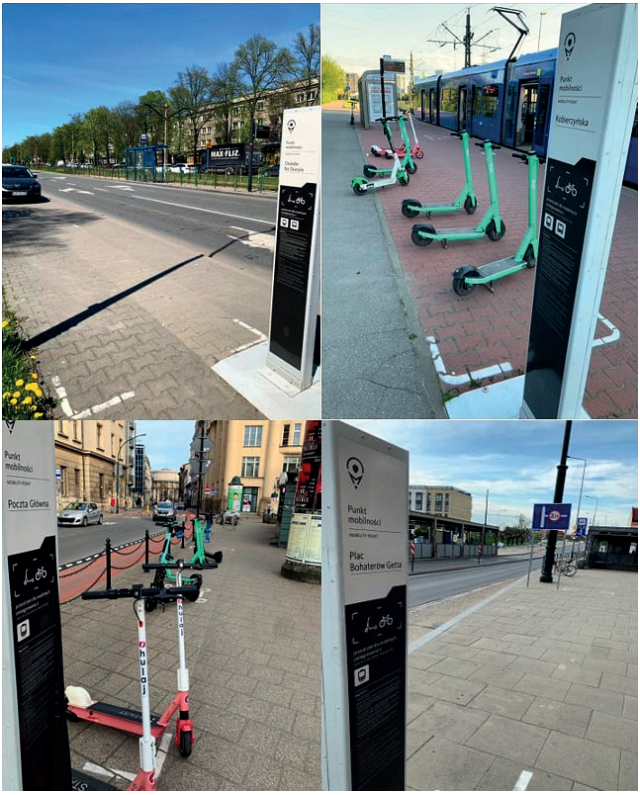

Fig. 7 – Various mobility points

4.2.2. Visual access

As for the visual aspects, all examined mobility points present a unified visual style that makes them a readable element of the urban space. The mobility points are signified in each case by totems (Fig. 7). Their purpose is not only to ease the orientation in the urban space when the user wants to pick up or leave the vehicle, but it also contains a short instruction. The manual defines the purpose of the mobility points, terms of use and indicates which modes of public transport (bus or tram) are available nearby. The totems are accompanied by a flat marking sign which delineates the area devoted as a parking space for shared e-scooters. In each case, pictograms are placed on the totems and take the form of a small picture of a scooter and indicate which modes of public transport (bus or tram) are available nearby. However, it should be mentioned that, in some cases, the mobility point has been located too far from the bus stop to assure fluent intermodality. Nevertheless, these elements of the informational cloak (being a whole system) play an important role in easing orientation around the town and identifying paths (see Szlogina 1980). In the analysed case, it is also not uncommon to put an e-scooter pictogram inside the flat markings. All of this directly represents the characteristics that the concept of the informational cloak refers to (Wallis 1979). A lack of such an oblong shape was delineated only in two cases (depending on the type of pavement, it seems). Nevertheless, all these characteristics comprise the ways of organisation in space (in the sense pictured in Marody and Giza-Poleszczuk 2004; Bierwiaczonek, Nawrocki 2012 or Table 1), when the given

Fig. 8 – A self-service repair point

area is appointed for where a private entrepreneur can locate his service in the public space.

Judging by the visual characteristics in a more aesthetical or urban-architectural context (Szczepański 1991), it should be said that the organisation of mobility points is sparse but adequate. The totems (apart from the gathered vehicles) are the only vertical mark of the spot and have an elegant, dark-blue and metallic colouring. However, such organisation, sufficient as it is, sometimes results in the points blending with their surroundings to a degree that it is difficult to notice them when looking around. The main finding, however, both from the survey and field research, is that the parking spots do not utilise the examples of urban furniture – seats, benches or canopy. As all of the analysed mobility points are located "in the open", their role in maintaining the aesthetical order or contribution to urban or architectural order is irrelevant.

An important quality is that the parking spots are not dedicated to specific providers – vehicles belonging to two or more operators can park there with no conflict over space. As it is can be seen on a number of totems markings (Fig. 7), the mobility point is also dedicated to more than one type of service. An additional feature, a self-service repair station (Fig. 8) can be also spotted in a few points (Fig. 4, mobility point No. 5, 14). Such a feature completes the mobility point area as well as adds to its functionality and multimodality.

4.2.3. Virtual access

Because the e-scooter shared mobility sector is not only present physically in the urban space, but also virtually by using the geofencing technique to define the various spatial zones for the e-scooter operations, the analysis assesses the mobility points from the virtual perspective, as well. This perspective has two layers. The first one includes the virtual practices of the municipality, while the second one covers the virtual practices of the operators of shared e-scooters. The results of the assessment show some contradictive findings. On the one hand, the municipality has at its disposal information about mobility points on the official web application (Fig. 9) where it is possible to find the exact location of mobility points in Cracow. On the other hand, applications of the operators of shared e-scooters do not contain this information as is illustrated in Figure 9 below, which presents the official web application to show mobility points and selected applications of shared e-scooter operators. The user can easily see where they are (not) allowed to ride an e-scooter or the position of available e-scooters, while completely omitting mobility points. This is true for all examined mobility points for each shared e-scooter operator during the time of this study.

As a closing comment, it should be added that sometimes the mobility points are accompanied by trees, providing some shade, or benches, as well as ticket

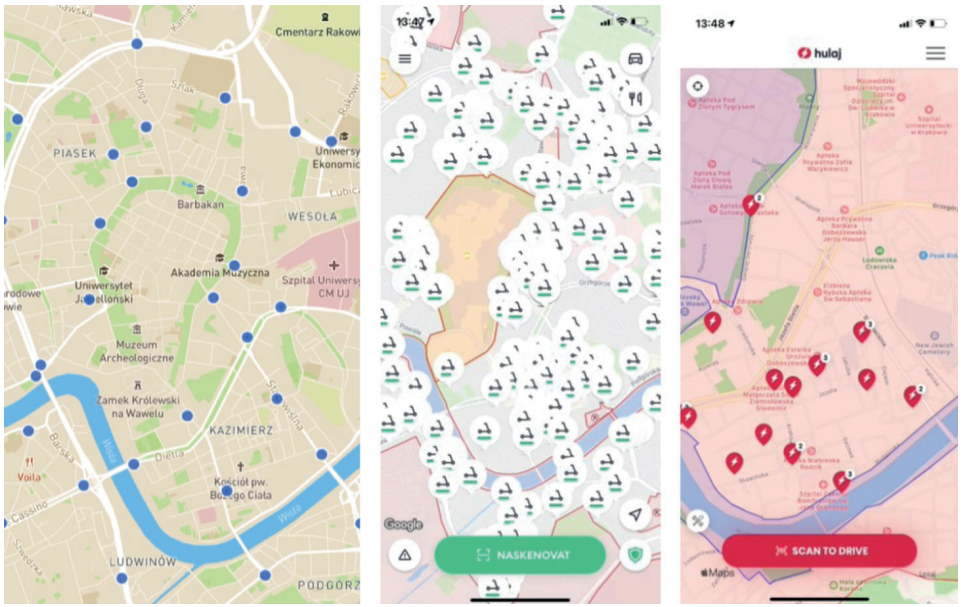

Fig. 9 – Web applications. From the left – mobility points (Public Transport Authority in Cracow), shared e-scooter operators (Bolt, Hulaj), accessed 5. 5. 2021.

machines, but it does not seem that these features were a primary driver for choosing that actual location for creating a mobility hub.

5. Discussion

Following the tensions between new form of mobilities and its implementation within the urban space (Jonas 2015, Ryghaug et al. 2020) where sustainable mobility solutions, such as shared e-scooter services are being used rather as a part of urban competition than actual strategy (Boussauw, Vanoutrive 2017; Reigner, Brenac 2019; Carr, Hesse 2020) this study shows concreate action of public authorities to improve the quality of public space by designing mobility spots. The study demonstrates that active participation of public authorities is necessary not only in formulating but also in exercising specifics transport practices in order to adjust the development of transport and mobility system accordingly to sustainable development, an important task for the transport geography research (Ryghaug et al. 2020).

However, as it has been presented, the practice of locating and organising the hubs in a way it has been adopted in Cracow does not solve in any way the problem with disarray and visual cluttering of the public space with shared e-scooters. The

town appoints official mobility points, while the operator relocates the abandoned vehicles to their own appointed hubs that seemingly "work" simultaneously. In extreme cases, the scooters can be found gathered in a spot just a few steps away from the official mobility hub. This means that the newly designed solution aiming to mitigate problems with shared e-scooters littering the public space and support the vision of sustainable mobility does not effectively do so and its impact on the sustainable development trajectory is, at least from this perspective, somehow questionable. The authors, therefore, recommend integrating official, municipal mobility hubs with those chosen and used by the operator when relocating abandoned vehicles, as well as to cooperate in this matter with the shared e-scooter operators, as it is happening, for example, in Paris, Oslo or Newcastle (Gauquelin, Schlebus, Faure 2020; Voi 2020; Štraub 2021).

As for the visual organisation of mobility points, although it seems legible and readable, further development in the form of positioning them with elements of urban furniture other than totems is recommended. Mobility points could then become a normal part of the urban public space, fostering and serving actual social functions (Lofland 2007 [1998], Table 1). An example of such a contribution could be a parklet installation (Pistelok, Salata-Kochanowski 2020). Constructed in such a fashion, mobility points would refer to the quality of "triangulation" (Rinsom et al. 2015). According to the experts, to triangulate is to "situate street amenities, services, and activities in ways that attract people to key nodes of interest, novelty or social potential" (Montgomery et al. 2015, p. 15). In other words, it is a practice of setting the elements of public space, so that they mutually "work" on the chosen effect, usually in the social sense. Such a solution could be one way for urban mobility to contribute to the quality of public spaces, which is a version of one of the questions Ravazzoli and Torricelli (2017) posed, and to some extent add to the legibility of the city image (Lynch 1990 [1960]). Meanwhile, municipalities are reluctant towards such solutions. The authors hypothesise that this is because it is unknown whether in Poland such a service is a temporary fashion or a promising and developing concept. Such actions as the ones proposed by the authors would create additional value and serve to harden shared mobility as a real alternative to traditional modes of transport (Oeschger, Carroll, Caulfied 2020).

In Table 1, the authors aimed to show the proposed links between the key characteristics of public space and the phenomenon of e-scooter sharing schemes. As it was shown, such an "ideal type" of public space is beneficial, as it contributes to the public sphere, access, control, organisation of space and public interest. In particular, the three latter qualities can be referred to in the research discussed in the hereby article.

Control over space and its organisation can be discussed together. By spatial organisation and appointing mobility hubs, the municipality exercises its mandate over the town's space, showing control and aiming to maintain basic spatial order.

It also places the question within the debate over what is public and what is in private disposition – so that the best public interest can be preserved where these two spheres overlap (Bierwiaczonek, Nawrocki 2012; Ercan 2010; Kohn 2004) or Table 1.

Public interest is a direct representation of one of the municipality's tasks in Polish law, ensuring safety and public order (Kancelaria Sejmu 1990). In this sense, it is natural that the town makes the effort of appointing and organising mobility points so that such order can be imposed. The problem is that, as this study shows, the actions taken do not really solve the problem of cluttering and disorder. However, such prerogatives are already present in some form in the existing Local Government Act, where, in chapter 4, it is explicitly stated that the municipality is allowed to produce regulations "necessary to protect the life or health of citizens and to ensure public order" (Kancelaria Sejmu, 1990, p. 50). It is recommended that local authorities also reflect on the possibilities of the existing law and exercise it.

The above recommendations can be to the great extent referred to the mentioned conceptualisation of public space management as coined by Carmona, Magalhães and Hammond (2008). The creation of specifics regulations would serve to regulate the uses and conflicts that arise in the field of functions. This could be extended by encouraging cities to sign appropriate informal agreements with operators where parties can agree on mutual expectations through dialogue (rather than rigid rules). Such agreements could also serve to better "coordination of interventions" (Carmona, Magalhães, Hammond 2008, p. 67) in cases where vehicles are still parked incorrectly or left on pavements and squares. Mobility points created in the form of urban architecture could at least be a good start in ensuring that adequate parking infrastructure is created. Such mobility points could be integrated into the public space by means of triangulation and, as such, serve as an "ongoing resourcing of public space" (Carmona, Magalhães, Hammond 2008, p. 67).

6. Conclusion

The authors aimed to show that every time a new phenomenon appears in the urban space, eventually the question of public space qualities and accessibility comes into play. E-scooter sharing schemes are a relatively new phenomenon in various towns and cities across the globe and they can still be analysed and discussed from the perspective of classic sociological and urbanistic concepts. In this article, it has been done by juxtaposing the matter to the concept of an ideal type of public space (Table 1).

The conducted fieldwork shows that the spatial organisation of mobility points is determined by certain functions of the areas where the mobility points are

located. They are characterised by spare but quite legible visual identification. However, it sometimes may be seen as insufficient, affecting visual access.

In terms of the informational cloak, the visual dimension is unified and accurate. However, taking into account the aspect of virtual accessibility, which is an essential layer of shared micro-mobility solutions, shortcomings of a managerial nature will emerge as the user of the mobile application realises that both the municipality and the shared mobility service provider visualise the areas/points that the vehicle can be parked or rented from. This creates a double standard and does not help to preserve order in the streets, as the incorrectly parked or abandoned vehicles can still be relocated to places that are not the official municipal hubs. The appointed official mobility points do not significantly solve the issue of incorrectly parked e-scooters, which, however, is not due to their organisation in the public space, placement or distribution, but rather due to insufficient managerial practices, which would ensure that the operators of shared e-scooters would implement them into their service operation. This fact, on a broad level, questions the current role of mobility hubs in Cracow as an instrument supporting the development of sustainable mobility.

What we are witnessing now is that the interests of public authorities and private operators do not completely overlap. Although there are cases where the debate across the sector has resulted in fruitful managerial practices, further research should continue consisting of mapping the landscape of the shared micro-mobility solutions and how they function in the urban space.

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