Abstract

New technologically driven, on-demand ridesourcing business models that provide low-cost alternative transport to car ownership and public transport - such as those provided by Uber and Lyft – are causing unprecedented disruption to the way urban mobility services are provided and used in cities around the world. Ridesourcing is part of the wider phenomenon of the 'sharing economy' that is making people re-think how they obtain services from different sectors such as the Transport (i.e. Uber) and Hotel (i.e. Airbnb) industries. New types of on-demand shared mobility services based on advanced ICTs (such as UberPOOL) are becoming popular in cities like London, UK. This has triggered debates among policymakers, transport planners and transport authorities; however, the impacts and consequences of these services on conventional public transport are still not well understood.

This research aims to provide insights into whether transport authorities and operators in London (UK) fully understand the impact of Uber services and more specifically UberPOOL. It presents empirical evidence on the effects, challenges and opportunities resulting from UberPOOL operations. We draw a picture of the situation from a comprehensive set of interviews with 31 different policymakers, experts, researchers and operators, complemented by feedback from 3 focus group sessions involving 28 different Uber drivers from across London. The findings show that UberPOOL is popular with students, those making social trips and long-distance journeys. It further highlights the need to develop specific transport policy measures and regulations for ridesourcing services which take into account input from all relevant stakeholders (for example, service providers, transport operators, users and drivers), as transport authorities are still poorly equipped (for various reasons) to manage and regulate such disruptive services. These findings help to answer some key research questions and provide a broad understanding of ridesourcing (and more specifically UberPOOL) operations in London.

1. Introduction

Conventional transport systems have a limited capacity and are becoming increasingly overloaded, creating increasing unreliable journeys and high levels of emissions in cities around the world. At the same time, new technology-driven, on-demand mobility business models that provide low-cost alternative transport to car ownership and public transport are causing unprecedented disruption to the way urban mobility services are provided, and used in cities around the world. For instance, it is reported that Taxi and Private Hire Vehicles (PHVs) accounted for only 1.3% of total daily trips in 2014 (GLA, 2016) and 1.4% in 2016 in London with as high as 12.1% of trips at night being made using a taxi or PHVs (TfL, 2017), which include ridesourcing services. The adoption of ridesourcing services is growing rapidly; for example, Uber reported 3.5 million users of its services in London – clearly a user base large enough to disrupt traditional travel habits in urban areas. In London, the number of PHVs has increased by 58% since 2008/09 to over 77,000 in 2016; meanwhile, the number of licenced PHV drivers has increased by 81% over the same period, (TfL, 2016). However, it is not yet well known how much of the recent changes in people's travel habits can be attributed to ridesourcing per se or if it must be seen as a subset of other tech-driven habits such as the use of smartphone applications for online shopping, uptake of teleworking or the use of bike and car-sharing services in cities.

(Lyons, 2018), explains that urban mobility has also been a long-term challenge for urban transport authorities that encounter limited capacity and investment, compounded by continuous demand from urban population growth – a problematic situation that could be transformed by new business models of vehicle use and ownership and the advancement of technology applied to mobility. (Lyons, 2018) (Garau, et al., 2016) reveal that there is no specific agreed definition of smart urban mobility in academic literature, however (Lyons, 2018, p. 6 & 7) explains that in the mobility context, the term smart is often interchanged with 'intelligent' and focuses on positive "manifestation of technologically based developments in transport systems, services and their use". Moreover, he summarises smart urban mobility as using technology to "generate and share data, information and knowledge that influences decisions", "enhance vehicles, infrastructure and services" and "deriving improvements for transport system operators, users and shareholders".

Furthermore, (Pangbourne, et al., 2018) shows that concepts such as mobility as a service (MaaS) – of which ridesourcing is considered an important element – provide fundamental challenges to urban transport authorities. This includes that of 'uncertainty' as to where technological developments and their impacts are heading, and how to deal with and assign liabilities between the various stakeholders including consumers, service provider, authorities and so on, in this uncertain context.

(Docherty, 2018) Explains that minimising the need to travel has been a key objective of many transport authorities but he argues there needs to be a thorough debate and discussion on how the transition to smart mobility might be governed so that its benefits to society and environment can be realised and negative impacts reduced. However, this is very difficult, he argues, when there is no 'real world' quantification of the impacts of new mobility services (such as ridesourcing). The work presented in this paper helps to fill this gap.

Ridesourcing is a new type of ridesharing which provides services making use of Geographic Information Systems (GIS) and global positioning systems (GPS) technologies on Internet-enabled smartphones to organise ridesharing in real-time, just minutes before the trip takes place (Chan & Shaheen, 2012). Furthermore, (Henao & Marshall, 2017, p. 200) define ridesourcing as 'the sourcing of rides from a for-fare driver pool accessible through an app-based platform and (SAE International, 2018) recently defined ridesourcing as *"prearranged and on-demand transportation services for compensation in which drivers and passengers connect via digital applications.* Digital applications are typically used for booking, electronic payment, and ratings. Principally, it is an emerging business model that is providing an alternative to car ownership and conventional taxis. The term ride-hailing is commonly used to refer to the same type of services.

Ridesourcing platforms - also referred to as Transportation Network Companies (TNCs) – allow individuals to use their car to transport others for a fee. Customers use a smartphone application to request a ride and to track the location of the requested vehicle. After the ride, payment is processed automatically via the app, and the customer rates the quality of service provided by the driver and the driver rates the passenger. The largest ridesourcing company to date is Uber, which operates in 72 countries (Uber, 2018) and is now valued at US$72 billion, fast approaching the likes of General Motors (Shared-use Mobility Centre, 2015). Lyft is another major player in the USA market and so is Didi Chuxing in China. According to (TCRP, 2016), ridesourcing has become one of the most

ubiquitous forms of shared mobility. Therefore, ridesourcing[1] is used in this paper to describe services such as UberX and the term *'Shared-Ridesourcing'* has been introduced to refer to pooled ridesourcing services (i.e. a ridesourcing service shared by more than one passenger for all or part of their trips, such as UberPOOL).

Ridesourcing is part of the wider phenomenon of the '*sharing economy'* that is making people re-think how they avail themselves of services from different sectors such as, for example, the Transport and Hotel industries, where new players such as Uber and Airbnb have arisen. In this context, new types of on-demand shared mobility services (e.g. UberPOOL), which use advanced mobile technologies and Information and Communication Technologies (ICTs) are becoming popular in cities such as London, San Francisco, Paris and Singapore. These developments have initiated debates among policymakers, transport planners and transport authorities about the role and impact of the new services. These debates have been further amplified by events such as the arrival of new shared ridesourcing services called 'ViaVan' in London, and the very high-profile decision taken in 2017 by Transport for London (TfL) to deny the renewal of Uber's London operating license. In spite (or perhaps partly because) of their rapid growth and the controversy that often surrounds them, the impacts and consequences of these services on conventional public transport are not well understood.

This research aims to provide insights into the extent to which transport authorities and operators in London (UK), fully understand the impact of Uber services and more specifically UberPOOL and present empirical evidence on the effects, challenges and opportunities resulting from these services. This paper discusses the current state-of-the-art on this topic and the key findings from the first phase of data collection and analysis, which included interviews with 31 different policymakers, experts, researchers, operators and service providers. In addition to feedback from three focus group sessions involving 28 different Uber drivers from across London to understand how such services are provided, used, regulated and managed in London.

The findings show that UberPOOL is popular with students, those making social trips and long-distance journeys. As well as, the need to develop specific transport policy measures and regulations for ridesourcing services that take into account input from all relevant stakeholders (for example service providers, transport operators, users and drivers), since transport authorities are currently poorly equipped - for various reasons – to manage and regulate such disruptive services. These findings add to the body of knowledge on this topic specifically in a European city context.

2. Literature Review

Shared mobility - the shared use of a vehicle, bicycle, or other modes - is an innovative transportation strategy that enables users to gain short-term access to transportation modes on an as-needed basis (Shaheen, 2016) (SAE International, 2018). The term shared-mobility includes various on-demand services, including shared ridesourcing. This aspect of transport is under-researched and there is particularly limited published literature on impacts of shared ridesourcing services. However, research undertaken in the USA by the shared mobility centre (TCRP, 2016) indicates that greater use of shared modes is associated with a greater likelihood to use public transport frequently and lower car ownership. This research also suggested that shared services generally complement public transport but compete on some routes at certain times of the day. However, it does not to provide evidence of impacts on a city's wider transport network.

Sustainable urban mobility has been described by (Lam & Head, 2012, p. 359) as being "the ease, convenience, affordability and accessibility of travelling to one's destination with minimal impact on the environment and others". Although shared ridesourcing has come to the mix of available urban mobility options in recent times, there remains the question, whether ridesourcing (or shared ridesourcing for that matter) – *which provides an on-demand mobility, that needs little or no investment from transport authorities* – helps to solve, or just exacerbates, a city's mobility problems.

An important challenge for policymakers and the transport industry is how these new urban mobility solutions such as ridesourcing are governed not only in terms of policy and actions of the local authorities (Dowling & Kent, 2015) but in a broader sense (Bulkeley, et al., 2016), dealing with

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[1] *Ride-hailing and Ride-sharing are commonly used instead of ridesourcing in previous literature. However, to keep consistency the term ridesourcing is used throughout this paper in line with SAE (2018) definition*

processes where problems are identified, and interventions formulated and implemented, that aim to achieve favourable outcomes and prevent unwanted ones (Dowling, 2018).

Different forms of shared mobility have been around for some time, and a good example of that is Demand Responsive Transport (DRT), which provides an on-demand transport service that picks-up and drops-off passengers based on their needs (Mageean & Nelson, 2003), one form type of DRT is commonly known as flexible micro-transit (or flexible transport), which are generally technology-enabled and offer flexible routing and/or flexible scheduling of services using minibus vehicles. These types of services fit in somewhere between taxi service and public transport bus (Mageean & Nelson, 2003); (Weckström, et al., 2018) and aim to provide the closest to a door-to-door type mobility service, therefore providing a different alternative to car use (Sihvola, et al., 2012). DRTs are also used in some cases by transport operators to improve 'social inclusion' in areas where there are gaps that are difficult to cover by public transport (Brake, et al., 2007) but such services suffer many challenges including operational, institutional and economic hindrances (Jokinen, et al., 2019)

Empirical research on DRT in terms of operations or policy implications is found in current literature, for example (Brake, et al., 2007) undertook research looking at key lessons from flexible transport services and provides general guidance and some policy recommendations based on study of DRT services in the UK and cities around the world, where the emphasis is on adopting a *"decision-making framework"* to help identify how DRT services should be designed, operated, managed and key stakeholders, and suggests taking a more 'integrated approach' when providing such services. Furthermore, (Jokinen, et al., 2019), studied a particular DRT pilot (Kutsuplus) in Finland, looking at operational data and policymaking processes. The research cites 'high operational cost (one of the main reasons why service was stopped), longer-term fare and funding policy and enhancing decision-making processes' as key takeaways. Likewise, another study by (Weckström, et al., 2018), looked at the same case-study (Kutsuplus) from a users perspective and found that users of the service were diverse with differing socioeconomic backgrounds and travel habits with the majority of trip purposes being social/recreational that were under 9km. service integration (with other services), clear marketing awareness plan and identification of user target groups were some of the main suggestions for that research.

Research by (Mageean & Nelson, 2003) investigated other DRT operations in Europe and found that it has the potential to serve 'low demand routes', which would normally be too expensive for regular scheduled public transport services. Although DRT still needs some level of subsidy (albeit less than conventional public transport) and the 'more regulated' the operating environment is, the less the conflict with traditional modes. Moreover, (Mulley, et al., 2012) used international case studies to study the main barriers encountered when implementing DRT, focusing on institutional (i.e. policy and regulations), operational and economic barriers. They concluded that the main challenges are legislative circumstances; DRT not having "mainstream public transport" status; lack of substantial service integration; and insufficient awareness of DRT amongst both policymakers and public. Furthermore, (Davison, et al., 2012) investigated potential markets for DRT services and found that in many cases the type of DRT implemented was not suitable for the market served mainly due to lack of knowledge and stated that technology plays an important role in responding to market demand in terms of service provision (i.e. booking, real-time info etc.) and suggests merging the market via stakeholder collaboration and re-evaluation of stakeholder roles.

While, some lessons could be learnt from research on DRT services, such as those relating to service integration, stakeholder involvement and policy and legislative situations, it is not clear how transferable these findings and recommendations are to the present-day set up of ridesourcing services. This is because DRT is operated either by the public or NGO sectors, whereas with ridesourcing transport authorities and government entities, in general, have little or no involvement in its operations and service provision – it remains essentially a private sector organised service.

Research literature distinctively examining the operational and policy elements of ridesourcing, ride-hailing or ridesharing is limited. However, research conducted by (Hall, et al., 2018) investigated whether Uber services complement or compete with public transport in USA cities and assert that, in theory, Uber's effect on PT is unclear but found that Uber to be complementary to PT as it increased ridership by 5% after two years of operations, with the highest increases seen in larger cities and cities with small transport agencies and shows that Uber mainly entered cities based on population size, starting with large cities. The work concluded that the flexibility that Uber adds to the mobility offering in the city is an important factor as 25-40% of Uber pickup/drop-offs were, reported being near PT

stations, indicating that Uber could be helping to resolve first/last mile mobility issues. However, (Nie, 2017) found the introduction of Uber in Shenzhen, China reduced traditional taxi ridership (initially) on average by 25% within a year. However, this stabilised later and the traditional taxi services recovered largely due to availability of large dedicated taxi fleet with exclusive rights for street hailing and taxis using mobile applications for sourcing rides. While, (Pew Research Center, 2016) study suggests that PT usage to be considerably linked with Uber usage, stating 56% of weekly Uber users also used PT compared to only 9% of non-Uber users. Similarly, (Young & Farber, 2019) examined the usages of ridesourcing and found that users were mainly younger (20 -39 yrs. old) and wealthier (employed with household earnings of over $125,000 pa), therefore raising the question of equity since only 2.6% of users were found to be from low-income households. Most trips were at night or evening (over 31%), which is also when PT ridership is generally low. They also found an important link with PT in that 50% of ridesourcing users indicated having a monthly PT pass. Thus, concluding that ridesourcing trips were negligible in influencing ridership levels of core transport modes - when considering all trips made using all available modes – but they at the same time acknowledged a reduction in taxi ridership but an increase in active mode trips (by 20 to 29 years old, between 11 pm – 5 am), due to the use of ridesourcing services.

In terms of ridesourcing adoption and impacts (Clewlow & Mishra, 2017) studied seven metropolitan areas in USA using surveys, which found 30% of adults used ridesourcing with quarter of users using the service weekly or daily, where 37% of users cited "parking issues" and 33% "avoiding drink driving" as the main reasons for using ridesourcing instead of driving themselves. Moreover, a sizeable number of users (36%) were younger (18-29 yrs.) compared to only 4% being over 65, and the research suggests that more "college-educated", affluent Americans have adopted ridesourcing, twice as much as those from low-income households with less education. This is similar to findings from other research by (Young & Farber, 2019) and (Clewlow & Mishra, 2017) which found a net 6% reduction in public transport ridership and that whether ridesourcing was complementary or competing with PT varies depending on the type of mode. Buses were, found to be affected the most (6% reduction) with rail gaining 3% net increase. They also reported that most of the ridesourcing trips (49% to 61%) would have been made by PT, active modes or not made at all. On this basis, they conclude that ridesourcing is likely to contribute to an increase in Vehicle Miles Travelled (VMT).

While investigating impacts of ridesourcing services on traffic conditions in Manhattan, New York, (Schaller, 2017) found between 2013 -2017 the number of ridesourcing and taxi vehicles in the central business district increased by 59%. While passenger trips increased by 15% with most passenger trips occurring late afternoon/early evening (4 pm to 6 pm) and vehicles miles increasing by 36% while traffic speeds decreased by 15%, which all points to a significant impact on traffic conditions from ridesourcing and taxi. In addition, (Schaller, 2017) states that ridesourcing and taxi vehicles are driving in the city without passengers approximately 45 VMT out of every 100 VMT and suggests the need for new policy measures to tackle this issue. However, (Greenwood & Wattal, 2017) explored the public welfare implications of ridesourcing by examining how these services influenced drunk driving and related vehicle casualties and found that there was a substantial reduction (3.6% to 5.6%) in the rate of drunk-driving related deaths after UberX was introduced in California. Moreover, (Peck, 2017) investigated the effect of Uber on drunk-driving related car crashes in New York City and estimated a decrease of 25-35% in alcohol-related crash rates between 2011 and 2013, further highlighting the potential that lies within ridesourcing services in terms of public welfare benefits and saving of lives.

Research by (Chen, 2015) in the USA indicates that social and recreational trips are the predominant type of trips used for ridesourcing followed by work trips; trip lengths are shorter and more frequent with a higher occupancy rate. This research also shows that ridesourcing users tend to be younger (18 - 24 and 25-34); better educated and higher earning than the average USA population. The highest percentage (51%) of those surveyed as part of the study, reported their trip purposes were to avoid driving while intoxicated, whilst 46% stated it was for social/leisure purposes (e.g. bar, restaurant, concert, visiting friends and family), and 40% were getting to or from the airport. Only 3% of respondents indicated they use ridesourcing for getting somewhere faster than public transport (Chen, 2015). The main reasons why people chose to use ridesourcing was due to its Convenience, Speed, Cost (cheaper), Safety, Modern (trendy) and friends use it. Furthermore, 74% of respondents in another study stated they used ridesourcing services because it was more accessible than public transport (Zhao & Dawes, 2016). In terms of convenience, a survey conducted in San Francisco, where ridesourcing was first introduced, estimated average wait time of 2.5 minutes in comparison to 15 minutes for taxis (Rayle, et al., 2014). Furthermore, ridesourcing has some advantages over

owning a car, including avoiding the need for parking and the ability to relax or catch up on work rather than driving. Travellers for whom ridesourcing is a superior alternative to owning a car pay a higher per-trip price for car travel, which provides an incentive to reduce car usage in the same way as car-sharing (Brown, 2015) however, this study does not explore the wider transport policy implications.

(Rayle, et al., 2016) argues that ridesourcing service characteristics differ in terms of user types, wait times, and trips served compared to conventional taxi and habitual public transport users mainly rely on ridesourcing in certain situations (e.g. during bad weather), therefore allowing for a car-free lifestyle. Some 43% of respondents indicated, they did not own a car and 47% of trips started somewhere other than home (i.e. gym, bar, etc.) while, 40% were home-based. The main characteristics of a typical ridesourcing service are broadly interlinked and include 'users' (i.e. demographics), 'trips' (i.e. trip purpose, time/location) and 'service' features (i.e. cost and safety).

Majority of existing studies on this topic are USA context focussed and their findings do not fully address the complex, policy and operational issues on ridesourcing services. As previously acknowledged by (Hall, et al., 2018), key policy questions on the effect of ridesourcing, remain unanswered and many transport authorities continue to struggle with, deciding how they deal with these new mobility services, partly due to poor understanding of the effects and lack of data availability. Furthermore, knowledge on operational aspects of ridesourcing including trip making characteristics, impacts on other modes and wider transport network is still limited (Clewlow & Mishra, 2017).

Evidently, lessons are learnt from earlier forms of shared mobility (such as DRT) and recent case studies on ridesourcing in the USA. However, current literature reveals significant gaps in how much is really known about the operational and policy implications of ridesourcing and more specifically shared ridesourcing (e.g. UberPOOL) and the effects of these novel services on cities' current and future mobility options and what approaches transport authorities and regulators should take in dealing with or managing such services. Therefore, this research aims to fill some of these gaps on the impacts of Uber services and more specifically UberPOOL on traditional public transport services, both in terms of policy and operations. It does so by undertaking empirical research using London (UK) and Uber services as a case study to understand the complexities of Uber operations in the context of a major European city.

2.1. Paper Objectives

This research expands on previous studies by examining Uber services in London (UK), both from an operational and policy aspects, using interview data from policymakers, experts and stakeholders along with focus group feedback from Uber drivers in London. This is the first research (that we are aware of), which explores Uber services (including UberPOOL) in a European city. Thus, this paper aims to (a) offer an understanding of, whether transport authorities and operators in London fully understand the implications of Uber services and how they are dealing with it; (b) identify key challenges and opportunities that are emerging from UberPOOL services in London, and (c) examine likely impact from ridesourcing on conventional public transport.

3. Methodology

3.1. Case Study

Uber services in London, UK were selected as a case study for this research because London provides a comprehensive case to understand impacts of shared and non-shared ridesourcing services. It has a single transport authority – Transport for London – with a well-integrated public transport system and major problems with emissions from road transport. Additionally, Uber is the largest ridesourcing operator in Greater London and the UK.

Furthermore, London has one of the most developed urban public transport networks in Europe (TfL, 2016), which includes all modes of public transport, cycle hire schemes, black cabs, private hire taxi services, car clubs and both UberPOOL and UberX are available in London, which has seen one of the largest growth areas for Uber in terms of registered Uber drivers and number of trips. In 2017, Uber reported over 3 million users of its services in London (Uber, 2017).

The Current London transport strategy (GLA, 2018), aims to achieve ambitious public transport and active mode share of 80% and at least 20mins of daily active travel (per person) by the year 2041.

The strategy contains 26 different policy measures and 108 proposals to achieve these targets. The strategy has several focus areas in delivering 'healthy streets' and a good 'transport mix', including reducing total traffic congestion (10-15% by 2041); 100% zero-emission taxi and private hire vehicles (includes ridesourcing) by 2033; 100% zero-emission public buses by 2050; and eliminating all road deaths and serious injuries by 2041. The strategy acknowledges the importance of flexible transport and the potential of demand-responsive services (as long as it does not adversely affect active travel) and the need to manage new mobility services. Furthermore, it provides specific policy measures for delivering coordinated public transport services that offer *"an attractive whole journey experience"* to help mode shift away from personal car use, whilst recognising the importance of supporting London's 'night-time economy' which is said to be worth 8% of the city's GDP and employs over 700,000 people. However, the current strategy fails to directly address ridesourcing services, in terms of operations, regulations and policy implications (other than to seek more powers from central government to control the number of private hire vehicles) and thus it is not clear where policymakers see ridesourcing playing a role in achieving (or hindering) the 2041 targets for London.

3.2. Methods

There are primarily two broad methods that are undertaken in empirical research – quantitative methods and qualitative methods. While the actual research (data collection and data analysis) may involve a variety of individual methods for both qualitative and quantitative approaches, there are basic differences inherent in the two. Quantitative methods are most suited in cases where a positivistic approach is undertaken (Moser & Kalton, 2017); (Patriksson, 2015), while qualitative methods are more conducive to a phenomenological research approach (Lewis, 2015), which is more suited to cases where the need is to obtain rich and contextual (sometimes subjective) inputs from the participants.

Qualitative research in transport has focused on issues such as the perspective of the commuters, policymakers and other stakeholders from the stance of a social-personal viewpoint (Cascetta, et al., 2015). For example, (Shaheen, et al., 2012) used expert interviews to explore personal car-sharing in North America as part of their research on the sharing economy. (Anderson, 2014), used ethnographic interviews to explore the motivations of and strategies used by ridesourcing drivers in California.

For this research, a qualitative approach was adopted using a combination of *focus group* and *interview* data as these were deemed the most suitable to obtain valuable data that includes expert opinions and insights from policymakers, Uber drivers, and other key stakeholders. Therefore, to achieve the research objectives and address gaps in knowledge identified in the literature review, several key research questions were developed including:

1. Do the transport authorities and conventional public transport industry understand the implications of shared ridesourcing (i.e. UberPOOL), if so, what are they doing about it?
2. What type of trips has Uber affected and how fast is the use of UberPOOL growing?
3. Who uses UberPOOL and what is the average trip cost compared to UberX?

As part of the data collection stage and interview template design process, the principal researcher undertook a pilot survey and interviews with 9 different Uber users and 5 Uber drivers in order to test the interview and focus group, semi-structured guiding questions; understand the ease of understanding the questions and get face to face feedback from drivers and users. The outcome of the pilot surveys and interviews were used to inform the final interview and focus group questions and templates.

To analyse the collected data from the interviews and focus groups, the data was transcribed from audio recordings and coded into NVIVO for analysis to seek meaningful patterns and themes that are relevant and helpful in answering the research questions.

3.3. Focus Group details:

Focus groups were used for this research as it allows participants to present their opinions and suggestions in a way that allows for the generation of ideas and evaluation of problems. This method is often used in the context of transport studies as it helps to reveal additional insights about a given problem and are especially useful in the context of policy-making (Shaheen, 2016). Focus groups are often employed to gain a deeper understanding of the given problem under research.

Therefore, these may be employed as complementary to other qualitative research methods, like participant observation, or in mixed-method research along with surveys (Gerike, et al., 2016). Furthermore, focus groups enable a researcher to get a live and dynamic view as to how a specific group thinks about the topic, the variations in the opinions of the individual participants and how other participants may influence them. However, focus group participants need to be selected carefully, to ensure that the participants are those who are involved in the problem or who have interest and ability to contribute information about the subject (Soria-Lara & Banister, 2017).

Focus groups were utilised for gathering data from the Uber drivers in London because this was the best way to collect sufficient data and views from a number of drivers in a limited timeframe since most of the drivers work different hours and have other commitments when not working.

The focus group participants were recruited through other Uber drivers in three different areas of London to ensure good geographical coverage. The drivers were all full-time Uber drivers and they served all areas of London throughout the week.

The recruitment process for focus group participants involved speaking with an Uber driver (during an Uber trip in central London) at the initial pilot stage about the possibility of taking part in a focus group to give feedback about the research topic. This resulted with the driver agreeing to take part in the discussion and further provided several Uber driver meeting-points (e.g. café) where drivers usually meet to take breaks. The driver also invited other drivers in his (social media) network to take part. The principal researcher approached the Uber drivers at these locations over a period of two weeks to explain the research and ask if they would voluntarily participate in a focus group session. Consequently, a total of 28 Uber drivers (in three groups) were recruited and dates, location and timings of each focus group session were discussed and agreed with participants. The Focus group sessions were conducted during weekdays in South, East and West London locations, between 13.00 and 16.00 when demand for Uber is generally low, where each session typically lasted 30 to 45 minutes.

Data was collected from three focus group sessions, involving 28 different London-based Uber drivers, – using a set of guiding questions – to understand their views about UberPOOL and Uber services in general including Uber operations, welfare, regulations, terms and conditions and about the service they provide. The guiding questions used are shown in Table 1, although participants were free to, and often did, deviate from these.

Table 1: Focus Group Guiding Questions

1. Among the users of Uber, what percentage use UberPOOL?
2. What is the cost of an average UberPOOL trip compared to the standard UberX trip?
3. Does UberPOOL trip cost less, even if there is no other pooler?
4. How does the Uber surge pricing affect the cost of UberPOOL trips?
5. What is the profile of those who choose to use UberPOOL?
6. Which areas in London do people tend to travel using the UberPOOL and UberX services the most?
7. On a typical shift, how many trips are UberPOOL trips compared to standard UberX trips?
8. When is the demand for UberPOOL trips at the highest point (i.e. days & times etc.)?
9. Do drivers always have to accept an UberPOOL request? Moreover, what are the consequences for drivers if they reject an UberPOOL trip?
10. How many times can a driver reject an UberPOOL request, before he/she is frozen out and is there a maximum quota?
11. What types of trips/journeys are being made using UberPOOL?
12. Have passengers commented on what transport option they were using before Uber?
13. Who do you think is the main competitor? Public transport, walk, cycle or taxi?
14. Why do you think people choose to use UberPOOL compared to UberX?
15. How do local/regional Transport Authorities currently deal with Uber operations? Are there any guidelines or limitations provided?
16. How are drivers' rights protected or regulated?
17. Has there been any issue arising from UberPOOL operations since its launch?
18. Do you have any views on how Uber is impacting conventional Public Transport?
19. What element of UberPOOL works well and what does not work so well?
20. Do you think UberPOOL has impacted walking & cycling trips? If yes, how? (I.e. are fewer people walking or cycling due to UberPOOL?)

The composition of the different focus group participants is shown in Figure 1, which shows that focus group 1 had more, younger (age 26-30) and older (age 46-50) drivers, compared to focus groups 2 and 3, while focus group 3 had no representation for 26-30 age group. Length of service with Uber for participants varied, with an average of 2.9 years for focus group 1, 1.9 years for focus group 2 and 2.6 years for focus group 3. Although feedback during the focus group sessions indicated that there are a few female Uber drivers in London, there is no available data on Uber driver gender demographics and the local transport agency has no ridesourcing specific data. At a national level in 2018, there was a total of 4% licenced female drivers (Taxi, Private Hire Vehicles and licenced Chauffeurs) in England (DfT, 2018), which includes Uber drivers. While several attempts were made to recruit female participants including speaking directly with a female driver and making contact through Uber driver social media groups, none ultimately took part. Accordingly, all the focus group participants were male.
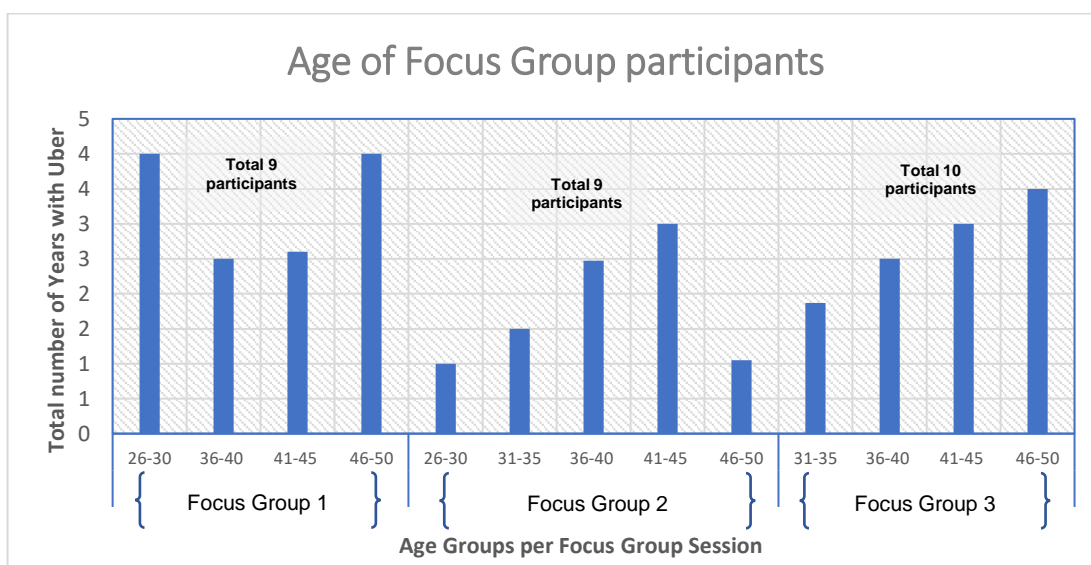

Figure 1: Composition of Uber Driver Focus Group participants

3.4. Interviews with policymakers and stakeholders:

Interviews were selected as a suitable data collection method because it allows the investigation of issues more deeply, as each participant can give detailed and subjective information. People can freely express their feelings, thoughts and attitudes without the fear of being exposed to others' judgement (as in the case of focus groups). In addition, the very nature of interviews allows the researcher to dig deeper if he/she wants, and to ask more questions to enable clarity (Larsen & Urry, 2006) (Urry, 2016). It is also easier to record information received in the interviews as it is delivered in a cogent one-to-one manner. Interviews also give a chance to the researcher to observe the body language and non-verbal cues of the respondent, thus giving additional contextual cues for data interpretation (Wethington & McDarby, 2015).

Interview data were collected from policymakers, experts, transport operators, researchers and innovators, using semi-structured interview format, which is a common data collection method and is frequently used interview technique in qualitative research (Kallio, et al., 20016) & (DiCicco-Bloom & Crabtree, 2006), mainly due to its versatility during the interviews. These types of interviews are valuable for accommodating a range of research goals and can incorporate both open-ended and more theoretically driven questions, to get data based on the experience of the participant as well as data guided by existing paradigms (Galletta, 2013). This was particularly useful for asking additional follow-up questions to gain further insights or explanations.

The recruitment of interviewees was done in different ways, mainly through industry contacts, or local transport authorities and operators, who were happy (when contacted by email or telephone) to connect the researcher with the correct person.

Following initial contact with all interviewees – either by telephone or an introductory email – all willing participants were emailed an interview template, research brief and consent form in advance and interviews were scheduled. The templates were developed prior to commencing the interviewee

recruitment process and were informed by the main research questions and initial pilot interviews, the list of guiding questions and 'what if' scenarios used for the interviews are shown in Table 2. The interviews were undertaken in a semi-structured format, either face-to-face, via Skype or by Telephone and locations varied (i.e. London, Milton Keynes, Edinburgh, Surrey, Stockholm (Sweden), California, USA etc.) and were completed over a period of 12 weeks.

Table 2: Interview Guiding Questions

1. What are your views/understanding regarding UberPOOL and its impact?
2. Are there any existing or planned regulations for ridesourcing services such as UberPOOL?
3. How do local/regional Transport Authorities currently deal with Uber operations and are there any guidelines or limitations provided to Uber?
4. Has there been any issue arising from UberPOOL operations since its launch?
5. Are there any local policies that help or hinder UberPOOL operations in London?
6. Is there any data to show the impact of Uber on congestion since its launch in London?
7. Do you have or know any plans for dealing with ridesourcing services as part of future transport system?
8. Are there any existing mechanisms to monitor the impact of UberPOOL on public transport or congestion? Are there plans to develop this?
9. How have you (transport authorities/policymakers) previously dealt with disruptive or big impact innovations?
10. How are drivers' rights protected or regulated?
11. What are your views about Uber services in general? Has Uber been a positive or negative addition to the City's transport system?
Interviewees were provided with the below *'what if'* scenarios to gather further insights and perspectives, where participants were asked: *"How they thought the following scenarios should be managed/dealt with from their perspective and what they thought ought to happen?"*   • Scenario 1: *"If the introduction of Uber is adding more cars to the road and creating more congestion and emission".*   • Scenario 2: "*If Uber is reducing car ownership in one hand but taking customers away from public transport (both bus and rail) on the other hand".*

Some 31 different transport policymakers, transport operators, innovators and industry experts were interviewed to understand what policymakers and the public transport industry know about and/or are doing about the emergence of ridesourcing services. Table 3 lists the different organisations that interviewees represented, this included Transport for London (TfL) which had representatives from four different departments.

Table 3. List of organisations

Organisation	Role of Interviewee	Organisation	Role of Interviewee
Transport for London (TfL)	Policymakers, Regulator and Experts	National Express	Operator
Department for Transport (DfT)	Policymaker and Expert	Stagecoach	Operator
Transport Systems Catapult	Innovator and Expert	Lothian Buses	Operator
Urban Transport Group	Policymaker and Expert	First Group	Operator
Transport for Edinburgh	Policymakers and Regulator	Tower Transit	Operator
International Association of Public Transport (UITP)	NGO, Experts, sustainable transport advocates	UC Berkeley	Subject Matter Expert/Researcher
Confederation of Passenger Transport (CPT)	NGO, Experts, UK bus industry advocates	University College London (UCL)	Subject Matter Expert/Researcher
Milton Keynes Council	Policymaker, Regulator and Experts	Imperial College London	Subject Matter Expert/Researcher
Uber (UK)	Ridesourcing service provider/TNC	Transport Studies Unit (TSU), Oxford	Subject Matter Expert/Researcher
Hertz	Innovator/service provider	Keolis	Operator

The composition of the interviewees was broad and covered all key stakeholders, including local transport authorities, regulators, operators and service providers (i.e. Uber), thereby allowing the researcher to obtain a diverse set of views on ridesourcing. The profile of the interviewees are shown in Figure 2 and Figure 3, which indicates that most participants were male, age 30 to 56 and had been in the industry for over 10 years.

The only stakeholder that was not represented in the interviews was that of ComoUK (formally Carplus), which is a shared and on-demand mobility provider, and Viavan who started offering shared ridesourcing services in London after the data collection was completed. However, views of ridesourcing service providers were represented by Uber UK, Hertz and Tower Transit.
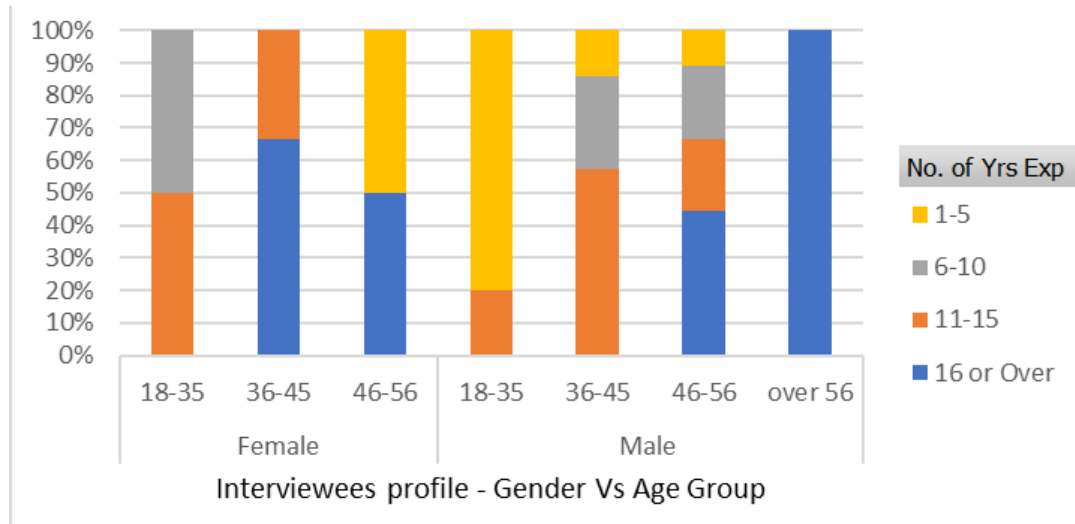

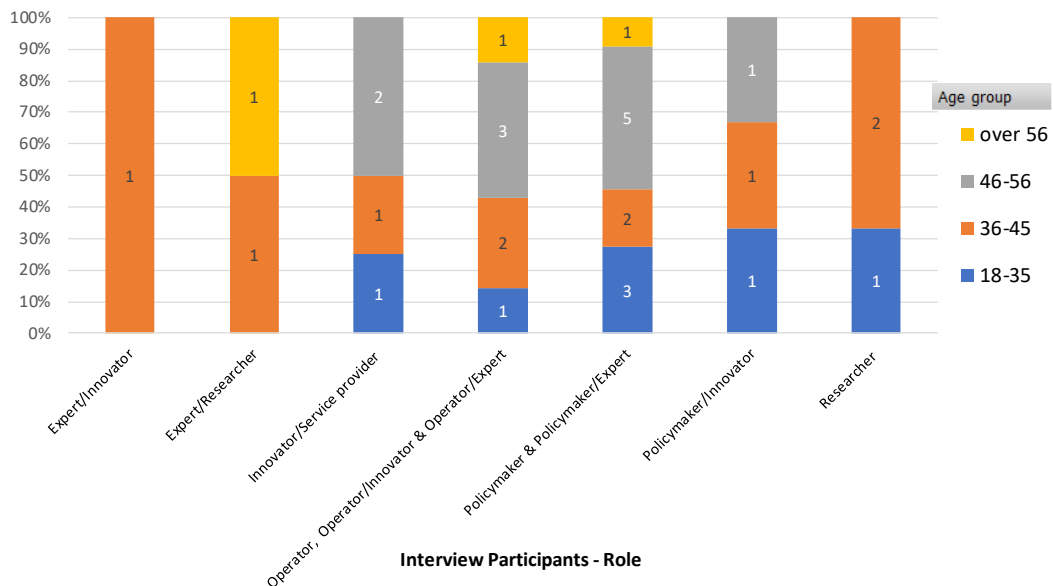Figure 2: Interviewee profile - Gender/Age/ yrs. of Exp.

Figure 3. Interviewee profile – Roles

Interview data is typically analysed manually or thematic content analysis using tools such as SPSS (Statistical Package for the Social Sciences) or NVIVO, which provides more accurate and thorough coding and interpretation of the data, reduces time used for the process, and also enables better management of the data and the analysis (Eboli & Mazzulla, 2007) and helps to organise the data more efficiently (Welsh, 2002). These software have been successfully employed in transport research, for example, (Carr, 2008) used software to analyse data collected from interviews in a case

study based research to assess employee interest in public transport for commuting to work. Accordingly, the data collected from the 31 interviews were analysed using NVIVO 11.

The relationship between the two data groups helps to answer key research questions from different perspectives, therefore providing a good understanding of how UberPOOL services (and ridesourcing in general) are affecting transport services in London - both in a positive and negative way - and the general attitudes from policymakers and other stakeholders, including the drivers. Figure 4 below illustrates how the qualitative data collection was categorised into four main themes and source of data used for each theme to help ascertain answers to the research questions.

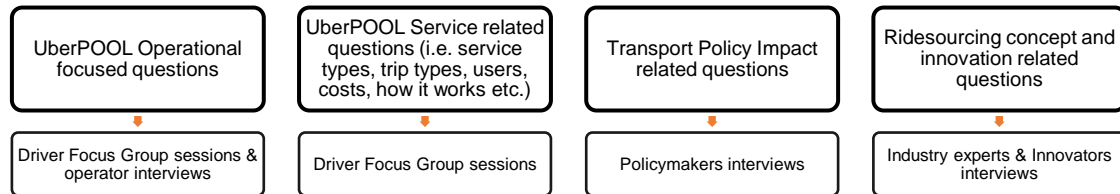| UberPOOL Operational focused questions	UberPOOL Service related questions (i.e. service types, trip types, users, costs, how it works etc.)	Transport Policy Impact related questions	Ridesourcing concept and innovation related questions
Driver Focus Group sessions & operator interviews	Driver Focus Group sessions	Policymakers interviews	Industry experts & Innovators interviews

Figure 4: Research data collection themes and methods used

4. Focus Groups: Results and Discussions

Results from the data analysis show that people use UberPOOL services because it is perceived to be cheaper and more convenient than alternatives and the biggest users of UberPOOL include students, visitors to London and people going to/from social trips (i.e. night out), which is similar to reports by (Uber, 2017) and earlier research by (Rayle, et al., 2014). Participants also reported that many people use UberPOOL to socialise during trips and in some instances to find a date – this appears to be a new motive for adopting shared ridesourcing. Data from the focus group sessions shows UberPOOL is relatively cheaper compared to UberX services and circa 20 to 30 percentage of the daily Uber requests per driver is commonly UberPOOL trips; however, drivers dislike accepting UberPOOL requests because they are paid less. The service is popular in the central areas but also for longer trips.

All data collected during the interviews and focus groups were anonymised, accordingly, the letter [D] with the number in the subsequent sections represents the driver identity number that was allocated during the focus group sessions - for example, D1 means driver number one.

4.1. Main reasons why people use UberPOOL

During the focus group sessions, participants were asked about *"the main reasons why people use UberPOOL",* and the most frequent responses are listed below in order of importance:

1. *Cost of UberPOOL compared to standard UberX, public transport, conventional minicab and black taxi*

Participants confirmed that UberPOOL was cheaper compared to standard UberX, public transport (certain shared trips), conventional mini-cab and black-cab. This important point was highlighted time and time again by the focus group participants including D9 who stated *"this could sometimes be cheaper than the public transport"* and D1 who stated *"this service is approximately 25% cheaper compared to UberX and even more cheaper than Black-taxi"* and D6 stating *"for the customer, it's cheaper, regardless of whether (or not) you have a second rider".* Analysis of focus group responses shows that participants considered this the most important factor. UberPOOL is offered as low-cost shared transport service, using private hire vehicles, which explains why it appeals to those looking for a cheaper taxi-type service.

2. *Convenient*

Participants collectively agreed the service is considered convenient, compared to public transport, conventional minicab and black taxi services, and they highlighted "convenience" as the second most important motivation for users. D1 stated, *"it enhances and supports public transport because of its convenience and the pricing as public transport is getting expensive and is getting harder for people to get a reliable transport from point to point so therefore UberPOOL is convenient, reliable and cheap"* - this was in relation to Uber and specifically UberPOOL service being able to fill gaps in the public transport network and in some cases providing linkage to public transport hubs as some of the busiest

pick-up locations were said to be near large stations. D4 stated, "*It's the convenience because it collects passengers from their homes, Pub etc.*" and D5 added, "*you get a lot of customers who say they used to use black-cabs when they go drinking because it was more convenient for them. But now Uber is cheaper and convenient, because even when you are completely drunk, and the person doesn't know where they are or where they are going, they can just press the request button where his/her location is picked up automatically by the system and the HOME button for where they are going*". The use of the Uber app for this service and knowing, upfront, the cost, estimated trip duration and being picked up generally at the passenger's location (or very close), were all indicated to be important elements of convenience, especially during late hours. In addition, UberPOOL services were said to be readily available in central areas of London and generally arrived quicker (within 2 to 4 minutes) compared to the public transport services, and conventional taxi and black cab service. UberPOOL was also very convenient and cost effective for groups of 3 to 7 people for certain trips such as airport and longer trips and during surge price periods when the standard rate for UberX goes up because of high demand for Uber services, which is very common at night.

3. Ease of request and payment

The ease of requesting and paying the service (via app) was cited as highly important and correlates with the existing literature (i.e. Rayle, et al. 2014 & Chen, 2015) and users of the service during the pilot survey. Drivers often received feedback that passengers used Uber services because of the ease of requesting and paying for the service, especially during social trips at night (nights out), where having the correct change and finding a conventional taxi office or black cab was said to be difficult. D3 stated, "*Customers often praise Uber services, for example, the booking system and the ease of ordering, ease of use and payment using the app instantly*".

4. Socialising during UberPOOL trip

Passengers specifically using UberPOOL to meet another passenger for socialising during trip was featured in all three, focus group sessions. Drivers stated some UberPOOL passengers would often mention one of the main reasons they prefer UberPOOL is to meet someone during the journey – mainly of the opposite gender – and would often try to pick up dates during trips. D10 stated, "*You also get some people that use UberPOOL, for socialising and getting dates. I had several customers who requested if I could only accept the opposite gender as the second pooler, so they try to get a date*". Information from Uber and mainstream media supports this, with some real-life examples of people who met during UberPOOL trips and some whom even got married as a result. In the era of dating and social media apps, some people still seem to prefer meeting in real life, while carrying out a key daily activity - travelling.

5. Requested by mistake

Customers requesting UberPOOL by mistake were reported as a common occurrence during the early days of the service in London – when most people were not familiar with the service and did not think they would be sharing with a stranger. It was also common during night trips when people are looking for the cheapest Uber ride when they want to avoid high surge prices, and often they find out that they requested a pooling service when the driver stops to pick someone else along the journey. D5 stated, "*Some passengers order it by mistake because they don't know what UberPOOL means*" and D1 stated, "*Many people request UberPOOL by mistake. Moreover, the problem is many people do not know the technology itself. Some of them press accidentally*". Participants reported that this sometimes caused issues and that they often had to explain about the UberPOOL service and how it works in addition to mediating when issues arise between passengers. D8 stated, "*I took an UberPOOL passenger once and after a few minutes I picked up another UberPOOL customer who was in a hurry but did not realise that UberPOOL meant sharing. Then they started to argue in the car. I had to explain and mediate between the two*".

4.2. Core users of UberPOOL services

During the focus group discussions, the participants were asked, *"Who the main users of UberPOOL were"* and most common responses are listed below, in order of importance:

1. Students

Students were said to be the main users, and this was mainly attributed to many students not having a car and willing to share rides in order to save money on transport. Participants also indicated that many students travelled in groups using UberPOOL be it to and from college/university or social events/activities and many preferred the convenience of UberPOOL instead of public transport and owning a car with all the additional operating cost. D6 stated, *"students use it a lot"* and D5 stating *"Students use it a lot because it's cheap"*.

2. People making social trips

The use of UberPOOL to and from social events/activities (*on a night-out)* was often mentioned during focus group sessions. Some of the reasons given included to save trip costs, socialise to/from events/activities and because users were flexible on journey time. These trips are mainly made during the evenings and weekends according to the drivers. D1 stated, *"The users are mainly partygoers, those who go out at night"*.

3. Highly cost-sensitive users

Participants stated many UberPOOL users avail of the service to avoid paying the higher cost of standard UberX services *(especially during the surge price period)*, including many 'cost-sensitive' professionals who use UberPOOL to reduce trip cost. D1 stated, "*UberPOOL is all about saving money, so it's about distance. If a person wants to go a couple of miles, he does not need the hassle; they just use the normal standard ride (UberX). If he/she is going long-distance, he/she goes for UberPOOL option, that's where he/she can save money and on top of that if he/she is in zone 1 (central London area) and the surge price is high they use UberPOOL, because they will save a lot in terms of the surge and the base fare itself"*, additionally D9 said *"most of the people I know that use it are middle class"*.

4. Longer distance journeys

During all three focus group sessions, participants stated users often choose UberPOOL for longer distance journeys, which corresponds with other feedback from users during the pilot survey stage. Pooled longer distance trips using UberPOOL with three or more passengers would sometimes be cheaper, quicker and more convenient compared to public transport. Some drivers reported regular long-distance trips to airports or suburbs. D3 stated *"UberPOOL is used by those going longer distance"* while D2 added, *"there are also fixed group trips, for example, I take 6 people to Surbiton every week and they split the trip cost"*.

4.3. The trip cost of UberPOOL compared to standard UberX service.

Participants were asked about the "*cost of UberPOOL compared to standard UberX service"* and the most frequent response was that UberPOOL was cheaper compared to UberX by 15% to 25%, which is rather less than data published by Uber (see (Uber, 2014)), that states passengers could save up to 40% by using UberPOOL. The service was considered more cost-effective than public transport, for a certain number of passengers and particular trip types, for example, trips carrying more than 3 passengers going to the airport or going from central London to the suburbs late at night.

4.4. Further comments from Uber drivers.

Participants further explained (in some detail) that UberPOOL *as a concept was good for customers but bad for drivers` "because of the amount of commission the drivers pay to Uber for each UberPOOL trip, Uber takes 35% commission if two trips are pooled and 10% if it's only one UberPOOL trip (i.e. if there is no 2nd pooler), compared to the flat rate of 20% or 25% for standard UberX trip - and the time it takes to complete UberPOOL trip which is much longer compared to a single UberX trip"*. Other comments included:
- Drivers enjoy the flexibility of working with Uber, which allows them to combine work with other family or social responsibilities.
- Drivers dislike accepting UberPOOL requests and try to avoid it as much as possible before the Uber driver app (system) blocks them out for a few minutes. Many drivers have managed to secure an exemption from Uber, which allows them not to pick up UberPOOL trips. This seems

to be limited to the drivers who joined Uber early, who also benefit from paying less commission to Uber (i.e. 20% for standard UberX instead of 25%).

- Drivers generally receive good comments from passengers about the services they provide, including, some users stating, "*They have never used a taxi before Uber became available in London*". The reasons indicated by the drivers on why people prefer Uber services include ease of requesting via mobile app, simplicity of paying and using the service and the overall efficiency of the Uber service, which arrives within 2 to 3 minutes of requesting according to the drivers. D7 stated, *"They generally make positive comments about Uber and say it's an amazing and convenient system. Additionally, they say they used to use black-cab and local minicab, but that took too long. There are also those who used to use night bus after a night out, but now use Uber services due to convenience and safety and it is cheap"*. Furthermore, Uber users commented, *"they never used to take taxis/minicabs and Uber made it possible for them to use a taxi service"*.

- Drivers have concerns about the lack of unions and labour rights.

- The significant issues the drivers perceive regarding UberPOOL is that of safety, most notably intoxicated mixed groups of customers, and gender issues related to those. These issues are yet to be addressed by Uber or private hire vehicle regulators in London.

5. Interviews: Results and Discussions

The views and approaches from stakeholders varied widely, but all of those interviewed were unsure about how to deal with ridesourcing services and had no immediate plans for managing such services. Some of the public transport authorities and policymakers interviewed indicated that they are looking at the impacts of these new mobility services and some operators stated they are developing concepts that include on-demand services or collaborating with other Mobility as a Service (MaaS) initiatives. Feedback from a public bus operator in London suggested that the way public transport bus services contracts are managed in London (quite closely specified by TfL with relatively little room for innovation by the operators) influences how quickly operators innovate and themselves perhaps develop an innovative shared-mobility solution. There was a clear understanding among all interviewees about how UberX and UberPOOL services operate and most participants stated they have used the UberX service, although only some said that they had used UberPOOL. However, overall results from interview data show that the public transport sector has not caught up with the disruptions caused by new technology-driven mobility services such as UberX/UberPOOL, both from policymaking and operational perspectives.

5.1. Key findings from Interviews

The key findings from the detailed interviews were as follows:

1. Data collection and monitoring of impacts

There are currently no mechanisms in place in London to monitor the impacts of services like UberPOOL, or Uber in general and none of the policymakers, transport authorities or operators interviewed had short-term plans to undertake any monitoring. Therefore, the specific impacts of ridesourcing are unknown and unquantified at present.

2. Managing and regulating ridesourcing services

Transport authorities are unprepared for regulating or managing such disruptive services. There have been no new regulations or guidelines developed for ridesourcing services in London, and these services currently operate under the private hire vehicle licensing system which was developed in 1998 and 2000. These regulations are deemed generally outdated for ridesourcing services, because the way ridesourcing services such as Uber operate, is technically not a typical black taxi service - which can be hailed or stopped on the street without prior booking - or a traditional minicab, which requires a pre-booking. In addition, ridesourcing operators do not consider themselves taxi companies, but rather a technology company and drivers are self-employed. Therefore, the issues of regulation remain to be addressed. A key policymaker in London stated, *"There are no regulatory changes planned, at the moment"*. Then added, "*There comes a time where there is a whole proliferation of services which are completely unmanaged, unregulated, we then have to start thinking what powers we need to actually deal with this. You got to have some control. They are carrying passengers, offering transport for hire, people are paying fares, so it (kind of) fits into that whole public transport network and we really need to have management of that"*. Where another policymaker stated, *"it's not really carved out as a niche in the regulations whereas perhaps it should because it's*

almost treated the same way as just Uber standard, kind of like minicabs and it probably does need a slightly different set of criteria especially when you've got different fares being made. I think that then adds another layer of regulation"

For the most part, transport authorities were unsure of how to deal with ridesourcing services. Representatives from transport authorities stated, "*The taxi and private hire vehicles were working amenably alongside each other until Uber came along, we just didn't foresee it was going to take off the way it did". Interviewee* added, *"I think there has been a bit of a defensive approach because Uber has come along and we kind of got our fingers burned a bit because we suddenly got this massive number of drivers, Uber challenges everything we do, because they don't like regulatory barriers".*

Another policymaker added *"this is covered within the mayor's draft transport strategy; however, it doesn't sort of set clear plan for that specific element. Generally, shared occupancy is a good thing, albeit, it's still by road transport, and the main thrust of the mayor's transport strategy is to achieve that 80% sustainable mode share target, which is enormously demanding so everything has to be seen in that context".* Which further illustrates the need for both sides (transport agencies, ridesourcing service providers) to work together to better develop, regulate and manage these new mobility solutions.

3. Passenger safety

Transport authorities have concerns about passenger safety, mainly due to apprehension following media reports about passenger assaults including some convictions. Policymakers stated, "*We have concerns, but we are not aware of any incidents where people's safety has been compromised by the use of UberPOOL*". Another policymaker added, *"The safety and security risk has merit. There are some driver concerns. There is not the same level of driver controls as we have on black cab drivers who have undergone 'the knowledge' and have gone through a lot of driver training. It's not quite the same in the private hire sphere in general and so I think that there are probably some concerns*". This is in contrast, to the views from drivers who reported high levels of customer satisfaction due to having the ability to monitor the entire Uber trip, know details of the vehicle, driver and journey route via the Uber app, which can be shared with friends or relatives if needed. However, there is still the question of who is responsible when there is an issue between two UberPOOL passengers, which is an issue the drivers are struggling with since there is no clear guidance from regulators or Uber.

This was also raised by one of the policymakers who stated, "*I think probably the biggest thing is probably safety. It has, to be safety. If you're possibly a lone woman maybe in a car, then the driver almost becomes the person responsible for making sure that they arbitrate between passengers who are arguing or if someone does something inappropriate to a woman,".*

The issue of safety has been further exacerbated by the very high-profile decision taken in 2017 by Transport for London (TfL) to reject the renewal of Uber's London operating license, with safety being cited as one of many concerns highlighted by TfL. Although Uber has since been granted 15 months by the courts to satisfy all regulatory and operational requirements, that court case provided highly politicised media coverage (mainly negative) and amplified the debate about Uber operations and the perceived impacts it is having in London.

4. Transport innovation in policymaking

Policymakers indicate support for innovation but are struggling to keep up with the pace of change. This is partly due to the time it takes to develop policies and regulations and get it approved through the considerable layers of bureaucracy in central and local government but also the pace at which these new mobility services are being developed and introduced in cities is unprecedented. So not only are there, capacity issues but also administrative and political constraints. Policymakers stated that *"Trying to answer that is what we are working on as a team (in TfL) and the business as a whole, what is our answer? once we can answer that, then I think we could probably answer a lot of other related questions…."* and added *"I think ridesharing and being able to take what would be a journey in a single car and kind of pooling them into one car, say multiple cars into single cars is definitely helpful. We've set out a very clear vision that by 2041 we want 80% of journeys to be undertaken by public transport, walking or cycling within Central London as part of the mayor's transport strategy and the only way to achieve that is to start pushing people away from private car ownership so anything that can help with that is really helpful but it will entirely depend on where it is,".*

Another policymaker stated, "*Thinking about how we can get evidence is one of the things. I think there's a bit of difficulty as well because of the pace at which these disruptive things come along; they can get a user base very quickly,"*

5. Role of ridesourcing in future transport

Experts view ridesourcing as a key part of the future transport system, specifically in an urban context as it combines convenience, innovation and efficiency. One expert stated *"… the digitisation of private hire transport, which Uber has done, and smartphones enabled, definitely offers a new opportunity to change how we manage public transport and public transport subsidy".* Another expert added "*I think that ridesourcing services are much developed to offer flexible on-demand solutions that are more personalised and corresponding better to the way future generations travel and we can already see now trends of multi-modality"* while further adding *"… looking towards the future, I think these kinds of services will be much more integrated into the public transport system. I think what could be optimised in those cities that have very good cooperation with taxis or with other on-demand services, is the public transport system with shared ridesourcing and potentially shared autonomous vehicles".*

6. Bus operators

Transport operators view ridesourcing both as an opportunity and as a challenge. During the interviews, transport operators both within Greater London and outside highlighted the potential opportunities that on-demand mobility services can offer as part of a wider transport services offering, but also the challenges, which the likes of Uber bring in terms of affecting bus patronage and service profitability. Several operators explained that they have already started to think about what ridesourcing would mean for their business models and how they can work with service providers or develop their own shared ridesourcing solutions, for example, Arriva group, who are developing an on-demand shared ridesourcing service called Arriva-click, initially as a pilot, but with a view to future rollout. An operator stated "…. *We would look to collaborate with such services in the future, maybe as part of wider integrated transport services"* and further added "*when a new competitor arises, you up the game, you compete better, get your own product better, make your own product of buses more attractive. There is potentially some scope for being complementary, probably less so with buses than with trains".* None of the transport operators (which included some that operate across the UK and internationally), knew the actual impact of services such as Uber as they did not collect any data related to ridesourcing and whether PT passengers were switching to ridesourcing.

During the interviews, all participants were provided with a set of 'what if' scenarios to gain further insights into their views and key responses are reported as follows:

Scenario 1:

Interviewees were asked *"What should be done if the introduction of Uber is adding more cars to the road and as a result creating more congestion and emissions?",* and majority participants indicated that; Firstly, '*This should be managed using a combination of taxation and regulation. This could include congestion charge type levies ….'* Secondly, '*The number of private hire vehicles (i.e. Uber and mini-cab) should be capped'.* Currently, it is not possible to distinguish how many of the registered private hire vehicles in London are operating under ridesourcing services such as Uber.

Scenario 2:

Interviewees were asked, "*What should be done, if Uber is reducing car ownership but taking customers away from public transport?"* and majority participants indicated that:
Firstly, Uber-type services should be encouraged where they complement public transport services and reduce single car occupancy and car ownership, such as key first/last mile trips and areas where bus ridership is low or has limited services. A policymaker stated, *"…. Where I think we probably want to put more thought in the future and which might start to be incorporated more, is guidelines to local authorities to try to encourage these services to be complementary to public transport".* In addition, a public transport operator stated "…. *I think the reason for smaller more agile vehicles are not in direct competition to the big buses, I think they should be in places the big buses don't go at all, so I would say the latest CM2 from City-mapper (*an on-demand bus service provider) *saying we've actually studied this as a whole and people want to go from this place and that place and nobody served it or do it on the edges in the middle of the night or on the outskirts that's where the transport network companies (i.e. Uber) should support".*

Secondly, the efficiency and attractiveness of public transport services should be enhanced, especially bus services where ridership has been decreasing in recent years. Most operators and local transport authority interviewees hope that shared ridesourcing supports public transport usage in the longer term, although they are not sure how this will happen. Both policymakers and operators mentioned the importance of focusing on first/last mile trips, where ridership is already low on existing

routes and areas with limited access to PT. However, this is rather opposite of areas where Uber currently focuses and is suited to, which are high density, high demand areas, that are also the locations with the highest public transport accessibility levels i.e. zone 1 in London. Accordingly, if Uber is to support the provision of shared transport services in low-density areas where public transport is limited then policymakers need to recognise the need to work with public transport operators and shared ridesourcing service providers to establish a model that works for all parties involved and benefits the public users. This could contain incentives or subsidies to attract service providers, which are profit making to work in such areas.

Thirdly, collecting data specific to ridesourcing and its impact and undertaking pilot initiatives with the private sector and innovators was highlighted as an important part of the learning and developmental stage of shared mobility solutions.

There are linkages between the findings from the focus group and interview data analysis, including that ridesourcing is providing efficient mobility options, and it has the potential to considerably support mass transit, during large events, when there are train/tube strikes or cancellations and late at night. There was some debate amongst drivers and interviewees as to whether Uber actually supports the transport network during these major events or just clogs the roads thereby slowing buses, but the interviewees and focus group participants gave various examples of situations where there was a large event in central London or there was a particular problem with trains or the Tube (i.e. signal failure or Tube strikes), where Uber supplemented bus services significantly. Largely, public transport buses benefit from the use of extensive dedicated bus lanes and signal priority in central London, which private hire vehicles (including Uber) are not allowed to use. Moreover, the responses indicated the need for a joint-up approach on driver welfare (i.e. working hours, unions etc.), service regulations (i.e. the number of drivers, taxation etc.) and the need to collect impact data to support any new policy measures.

However, there was also agreement that one of the key benefits of this business model was the number of jobs created and ease and flexibility it offers in terms of working hours. Generally, there is apprehension from the drivers that authorities will start to over-regulate, and restrict this type of business model. Drivers are also anxious that authorities will favour the black-cab industry, who have been heavily campaigning to ban or limit Uber services in London. On the other hand, transport authorities and policymakers are concerned about passenger and driver safety, the growing number of Uber vehicles on the roads and the impact this is having on traffic congestion and air quality in the city.

6. Conclusion

Traditional transport systems have a limited capacity and are becoming frequently overloaded leading to increased emissions, and unreliable journeys. Although new mobility services are promoted as the answer to these challenges, earlier research shows there is limited understanding in terms of transport policy development, and how complementary (or not) these services are to existing urban transport services.

This research set out to investigate whether transport authorities and operators in London (UK) understand the operational and policy implications of Uber services and to offer new evidence on the effects, challenges, and opportunities arising from UberPOOL operations. We found sufficient gaps in current literature in addressing the operational and policy implications of these novel services in the context of a European city. So, this research adopted qualitative research methods using a comprehensive set of interviews with 31 different policymakers, experts, researchers, operators and service providers and data from three focus group sessions involving 28 different Uber drivers from across London to help understand how Uber is operating in London and what affect its services are having on traditional transport.

Firstly, in answering whether *'transport authorities and the conventional public transport industry understand the implications of shared ridesourcing and how they are dealing with it'*, we found there are no mechanisms currently in place to monitor or assess the impacts of ridesourcing services in London, which results in a genuine lack of knowledge among policymakers and transport authorities on how they approach these services, in terms of regulations, operational guidelines, integration with other modes and future transport systems. Public transport bus operators appear to be more proactive in terms of looking at on-demand shared solutions that may complement some bus services or fill gaps in the network such as Tower Transit with the CM2 (night-rider) service *(an on-demand night bus service from City Mapper and operated by Tower Transit with the Impact Group) that operates between Aldgate East and Highbury & Islington via Shoreditch and Dalston. This service relies on*

user data, where City Mapper uses an analysis software tool to identify gaps in cities' transport networks, based on the demand, they pick up through their app (Citymapper, 2018) and ArrivaClick service *(another on-demand and flexible luxury minibus service by Arriva bus that takes multiple passengers heading in the same direction and books them into a shared vehicle using an app)* that operates in Liverpool and Sittingbourne (Arriva bus, 2017).

In Greater London, most of the public bus operators indicated the lack of innovation and integration with new mobility solutions was mainly due to how public transport bus services are setup, which is a fixed-term and fixed-route contract regardless of the number of users for each route. So, operators are looking to Transport for London (TfL) – that contracts all-public transport bus services in the city – to guide how services are planned and provided, in the era of new (shared and on-demand) mobility services. After the data collection stage for this research, there has been a high-profile legal case involving Uber and the non-renewal of its licence in London, which has been highly politicised and received global media coverage. As a result, TfL recently issued a draft policy paper on ridesourcing, which indicates that policymakers and regulators will take steps to address some of the policy and regulatory gaps that exist.

Secondly, when looking at the '*effects of UberPOOL on trip types and pace of growth in usage*', we found that travellers in London are using UberPOOL services for a variety of journeys including social trips and airport trips. Furthermore, transport authorities believe (without data or tangible evidence) that Uber, in general, is adding more cars to the road network and therefore is helping to increase traffic congestion in London. It is not yet clear which type of trips Uber has substituted, since there is no quantitative user data available for London, however the focus group data reveals that Uber serves many first and last-mile trips - which also correlates with findings from earlier literature (for example Hall et al. 2018) - and users often comment to drivers, they previously used black-cabs, conventional taxis or public transport (bus/tube) for their trips, although to what extent is unclear. Further user and trip data is required to fully understand the impacts on trips and mode shift in London and will be reported in a subsequent paper.

Uber availability and usage has grown rapidly since it was launched in London with over 3.5 million registered users and 40 000 drivers.

Thirdly, while examining '*Who uses UberPOOL and its costs*', it was found from driver reports that the most frequent users of UberPOOL in London are students; passengers making social trips; passengers who make longer journeys; travellers who are looking to meet someone along the journey and cost-sensitive travellers who use the service to avoid paying higher Uber fares during surge price periods. UberPOOL is 15% to 25% cheaper compared to standard UberX, which is somewhat lower than the (up to) 40% figure quoted by Uber, however, this makes it less popular with drivers because of the UberPOOL commission structure and the time it takes to complete an UberPOOL trip compared to standard UberX.

It was widely acknowledged, during the interviews, that these disruptive and novel services are popular with users and are providing convenient and cost-effective mobility to users, but lack of data, pace of change, understanding of its specific impacts and (to some extent) political-will, have all contributed to inactivity amongst policymakers, public transport operators and regulatory bodies in Greater London. Therefore, based on the findings from this research, the following key recommendations are made, that are intended for transport policymakers, regulators and the operators:

1. Organisational Learning
During the interviews, we found a wide gap between internal organizational capacities at transport agencies (i.e. the regulation, transport planning and Taxi/PHV departments), and the challenges from new disruptive transport innovations such as ridesourcing. Therefore, to bridge that gap and better equip transport agencies to deal with such new challenges, we recommend that transport authorities and regulators (such as Transport for London), enhance organizational capabilities to enable them to manage, regulate and work with new mobility services. This should involve closer cooperation across sectors, thereby working with innovators, experts, and service providers when devising training and capacity building activities, in addition to working together on pilots and R&D initiatives, which investigate the viability and suitability of new mobility services.

Moreover, we recognise the need for developing guidelines for use by PT operators and ridesourcing service providers to enable better integration between ridesourcing and PT modes and

therefore help to achieve London's transport objectives. This should include guidance for bus operators on how they can make better use of shared ridesourcing to fill some gaps in the network or provide services in low demand peripheral areas, in addition to integrating payment and guidance for ridesourcing providers on how they can support the main transport system with emphasis on encouraging (or maybe incentivising) them to prioritise shared services. For example, integrating ridesourcing payment methods with the London Oyster (Electronic PT) card, then passengers who have transferred to/from shared ridesourcing (such as UberPOOL or ViaVan) on to the PT network (in specified areas and or timings) could receive a discounted fare. The amount of discount and where/when should be determined between TfL and ridesourcing service providers. This could further be extended to include specific user groups, timings, locations or situations when there is a problem with the PT network (i.e. Tube strikes)

The lack of data remains an issue for policymakers and transport planners as highlighted in the literature review and our findings. Therefore, we recommend that transport authorities develop data collection and monitoring mechanisms for ridesourcing services, simply to understand exactly how these services are functioning within the city and thus develop evidence-based policies and regulations. This could involve agreements with service providers such as Uber to provide regular data to TfL as part of their licencing agreements, or transport authorities could establish a periodic data collection as part of the existing national travel surveys. Understandably, there are privacy and data protection issues to overcome, so the data from ridesourcing companies - which could include geo-location, trip and occupancy data - should be anonymised and encrypted if needed. This effort requires close collaboration between key stakeholders but should be led and facilitated by TfL as the ultimate transport authorities for London.

2. Policy and Governance
It is clear from the findings that Uber services are popular, and they serve a significant number of trips in London, therefore we recommend that transport authorities develop specific policies for ridesourcing services and more specifically for the shared ridesourcing services, not to deter these types of services but rather manage and integrate them into the city's transport system. The process of development should involve input from important stakeholders such as service providers, transport operators, users, and drivers. This will help resolve issues related to the lack of collaboration and ensure views from all stakeholders are considered. Such new policies should address issues of integration with other modes; how the public sector and private work together to provide such services and reducing emissions from ridesourcing vehicles. London aims to achieve 80% of all trips in the city to be made using PT or active modes by 2041 and has set targets to reduce emissions, which offers an opportunity for policymakers to consider the role of new shared-mobility services (e.g. UberPOOL) in achieving these ambitious targets, without negatively affecting the active modes targets. Policymakers should develop incentives (such as reduced levies on shared services and zero-emission vehicles, off-peak trips, trips that served areas with limited PT coverage and those that serve the elderly and disabled and by providing lay-by areas near transport hubs to facilitate first/last mile trips) to induce collaboration between the ridesourcing companies, transport operators and transport authorities.

At present there are no specific regulations covering ridesourcing in London, as these services operate under the PHV regulations, which even the regulators admit requires an overhaul. Accordingly, we suggest developing new ridesourcing regulations, perhaps as part of an updated PHV regulation, which should provide classifications of different service types, how they are provided in a different context – for example, greater flexibility could be given to service providers in suburban areas compared to inner urban areas. Additionally, the new regulations should address driver standards, driver welfare including maximum working hours without breaks, and define clear responsibilities for all those who are involved in providing ridesourcing, for example in the case of shared ridesourcing (i.e. UberPOOL), responsibilities need to be clarified when incidents occur between two/three passengers (poolers) and what the driver should do in such cases.

One of the biggest issues faced by Uber drivers in London is the absence of an organisation that represented their profession and interests, unlike the London black-cabs, who have the Licenced Taxi Drivers Association. We, therefore, recommend establishing ridesourcing driver association, to represent the over 40,000 Uber (and other ridesourcing) drivers in London and work with regulators and ridesourcing companies such as Uber to discuss important issues relating to driver welfare, working hours, rules and responsibilities of drivers and passengers during shared journeys. An

association could also assist with disputes relating to complaints against drivers, which (according to driver's feedback), often results in unilateral decisions by Uber to suspend or even terminate the driver from using the Uber app.

Research limitations.

This research yielded valuable data, information and insights to contribute to the body of knowledge available on ridesourcing. However, as with other studies of this nature, there were limitations including that this research heavily relied on interview data, which has its limitations in terms of independent verification (the researcher has no choice but to take at face value what the interviewees say) and potential for biases such as selective memory, self-attribution, and possible exaggeration.

Moreover, the principal researcher could only interview those who accepted the invitation for the research interview. Although interviews were held with representatives from all key stakeholders in London, there were several senior management staff who could not take part and organisations such as ComoUK, who could not partake in the research. In addition, there is a major lack of reliable published research data on ridesourcing and its impact on transport policy and operations. Furthermore, transport authorities and operators currently do not collect data on any ridesourcing services in London (i.e. Uber) and service providers such as Uber do not share data, which makes it difficult to assess the implications from these services.

This is the first research that investigates the multifaceted implications of ridesourcing services (including shared ridesourcing) on public transport in European city context using data from policymakers, drivers and other key stakeholders. Accordingly, the findings presented in this paper contribute to the existing literature on the subject.

The impacts of ridesourcing services such as Uber may depend on the city context in terms of size, densities, and level of PT available. Therefore, the best policy interventions are likely to vary, however, cities with similar travel and transport features to London may benefit from the findings and recommendations in this paper. During the next phase of this research, quantitative ridesourcing user data will be collected and analysed to help shed light on the usage and user characteristics of Uber services thereby provide additional understanding of ridesourcing services and their impacts in cities such as London.

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