NEW OPPORTUNITIES FOR ON-DEMAND SHARED-RIDE SERVICES TO DELIVER MODAL SHIFT AND INCLUSIVE TRAVEL

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ABSTRACT

On-demand shared-ride services promise new opportunities for modal shift and inclusive travel. This paper draws on evidence from the industrial-collaborative project 'Mobility on Demand Laboratory Environment' (MODLE) which has piloted a range of such services in and around the city of Bristol over the last three years. Led by Esoterix Systems, a technology SME, MODLE brought together local authorities, transport operators (bus and taxi) and employers in varied partnerships to explore different business and deployment approaches.

Using innovative techniques to uncover and map needs for such services, MODLE identified a series of potential markets for demand-led solutions. These included, (1) first and last mile access to high-frequency, high capacity bus corridors, (2) access to urban periphery employment locations (e.g. distribution and warehousing), and (3) urban trip attractors such as hospitals or enterprise zones that may be poorly served by existing public transport and have limited capacity (or desire) to extend car-based access.

The MODLE services utilised taxis and smaller buses, along with smart ticketing and sophisticated routing. A range of business models and fare collection approaches were adopted, including mobile-ticketing, employer subsidised fares and salary-sacrifice style schemes, with the partnership model of delivery offering key opportunities for effective delivery. The services launched successfully but exposed some challenges. These, in respect of routing, timetabling, demographics and cost, all of which are relevant for launching such services elsewhere, are explored in the paper.

Additionally, the MODLE pilots are reviewed against similar services trialled or launched in the UK and internationally to consider if such services can be part of a new transport landscape. This provides the opportunity to draw some wider conclusions about how, and where demand-led options might be beneficial, and what factors could contribute to their successful deployment.

1. INTRODUCTION

New transport services are seen to be necessary in response to wider societal changes. These include diverging levels of car use by age, reductions in public transport, and changing locations of employment sites. In response to these trends a wide range of new providers of mobility services have come forward looking to both emulate the rapid growth of technology-led mobility services such as Uber, and to serve perceived new markets of technology-aware travellers. Incumbent and legacy actors in the transport field are also exploring how some of these new technologies, and operating models might offer them new markets to pursue.

Often the solutions will be focused on small-scale and demand responsive systems to provide a more granular, flexible and adaptable response to mobility needs. Such responses being in turn facilitated and supported by technologies developed over the last few decades, and the ever-more pervasive reach of cloud-based and internet driven systems.

In particular, three types of flexible, demand-responsive service are emerging as being of relevance in urban situations. They also promise new opportunities for modal shift and in addressing inclusive travel. They are:

1. Interchange services which might provide a feed to transport hubs. Such services can also be seen to encourage modal shift for the link to the hub, or perhaps for the whole journey.
2. Destination-specific services, often undertaken in partnership with key organizations representing the 'destination', for example a business park, hospital or football stadium.
3. Network services which are aimed at augmenting the existing public transport network.

At the heart of all of these solutions is an attempt to match transport need (or demand) with transport supply. Whilst this might make use of technology to broker the coming together of supply and demand it will also require the fulfilment of the operational realities of vehicles, drivers, ticketing and scheduling in order to deliver services. How all of these elements are fulfilled and combined is the challenge being explored by many of these new mobility systems and is the focus of this paper. Specifically, the discussion focuses on real world challenges that non-traditional mobility providers such as technology companies can encounter in providing a transport service.

The next section will consider existing literature relevant to these issues, specifically the drivers and real life challenges acting on enterprises attempting to provide demand responsive transport (DRT) The paper will then draw on evidence from the industrial-collaborative project 'Mobility on Demand Laboratory Environment' (MODLE) which has piloted a range of new services in and around the city of Bristol over the last three years. In addition to the experiences of this project, findings are broadened by interviews with five other companies seeking niches within the opportunities offered by demand responsive capability. The paper finishes with conclusions about the benefits, challenges and successes of MODLE, and lessons for similar initiatives elsewhere.

2. LITERATURE REVIEW

The emergent models of transport discussed in this paper have yet to generate published evidence of their effectiveness as a business model. Clearly change is afoot, as Enoch (2015) argues traditional forms of motorised transport are losing some of their dominance in relation to more recent developments in shared mobility and on demand services. There are few insights into first and last mile solutions and demand responsive transport that help position and interpret this shift to more flexible and shared ride services, from around the world.

It is important to understand how these emergent transport models fit within the existing transport landscape and travel behaviour. To support the arguments developed in this paper, we have drawn on a range of studies that elucidate this shift in landscape and behaviour. These reflect a number of drivers for change, including: developments in information and communication technologies; changes in public transport funding; the location of employment on urban peripheries and changes in younger persons' mobility. Alongside these issues, the pressing need to encourage people from their car to more sustainable modes is driven by local problems of congestion and air quality, as well as the broader climate change concerns.

The most obvious of these drivers is the development of information and communications technology (ICT), particularly leading to smartphone apps that can be used to book demand responsive rides and algorithms that can coordinate, and maximise the efficiency of, demand responsive supply. Thus, the new mobility services can be viewed as attempts to redefine the mobility landscape in order to reflect significant behaviours and 'expectations', enabled by such advances (Pangbourne, et al., 2018, p34). ICT development enabling individual services also leads to potential for these to become connected to 'integrated transport systems' (Crisp et al, 2018, p.10), and to potentially benefit from 'multi-modal' smart ticketing (Crisp et al., 2018, p.9).

Current exploration of demand responsive niches, in the UK at least, may also be being driven by trends in younger people driving less than older generations, a trend starting approximately twenty five years ago (Chatterjee et al., 2018). Between 2001 and 2011 this reduction in young adult drivers was accompanied by the same group increasingly using public transport (Melia et al., 2018).

Further motivation for DRT lies in reduced coverage of more traditional public transport leaving increasing areas of cities inadequately serviced by public transport. Campaign for Better Transport (2016) report that in England and Wales, between 2010 and 2016, local authorities reduced funding of buses by £78m and reduced or withdrew more than 2,400 bus routes.

The traditional bus routes that do remain are often spokes feeding a hub in the city centre. This pattern leaves unmet first/last mile needs in less central areas of the city, where substantial distance can exist between spokes. (Note the categories 'first/last mile services' and 'demand responsive services' do not equate, but often overlap). Such services, meeting these needs, can have a beneficial symbiotic relationship with traditional public transport to which they can provide access (International Transport Forum, 2017). It has been argued that such services may be able to dissuade car use amongst those living near to transit stops (Rasak, 2015). Conversely, if they are not

provided, residents in outlying areas of cities will continue making journeys entirely by car, undermining the use of public transport (Brons et al., 2009, Cohen and Kietzmann, 2014).

A further driver of exploration of DRT niches is the increasing movement of large employers to urban peripheral locations. Crisp et al. 2018, (p.51) suggest that if first/last mile services serve these employment areas and utilise whole-journey ticketing, these could be particularly effective in removing transport barriers to employment. Crisp et al., (2018, p.51) also note the potential benefit to job seekers of 'orbital bus routes' that reach suburban interchanges or serve 'high-volume transport corridors.' Historically, subsidised DRT services have often been used to increase social inclusion through providing access to jobs and other services more cheaply than could be achieved through traditional public transport (Wang et al, 2014, Laws et al., 2009, Mageean and Nelson, 2003).

An additional social driver to exploring DRT services is the reduction of car dependency with the desired benefits of reduced congestion, (see Laws et al. 2009), air pollution and carbon emissions. Although this social motivation may not be a financial motive for mobility providers.

Whilst these drivers encourage businesses to investigate DRT niches, there are also what could be termed real-world (in addition to ICT) challenges in creating, or supporting, actual services. It has been noted above that some have argued first/last mile services may dissuade car use. However, a significant barrier to uptake of these is affluence and particularly the associated high rate of car use. Thus, some evidence has suggested that living in an affluent neighbourhood may be negatively correlated with using shuttles to access rail stations for example (Deka et al., 2010).

As discussed, declining traditional public transport can leave unmet needs that DRT may address, but there is also a symbiotic relationship between the two service types in that there may be reluctance to use a feeder service, if the service being fed is disliked or unreliable. This is in a context in Great Britain where general bus patronage (with some limited exceptions), continues to decline (Department for Transport, 2017a, cited in Crisp et al., 2018). In addition to perceived unreliability of traditional public transport, another barrier to DRT use can be insecurity focused on interchanging between two services during the course of a journey (Hine and Scott, 2000, and Thompson and Brown, 2006, cited in Lindsey et al., 2010; Crisp et al., 2018). These concerns about reliability of services can be a particular deterrent for commuters needing to arrive at work punctually (Crisp et al. 2018).

Other factors that may deter the use of shared vehicles in a first/last mile context include excessive time spent waiting or walking (Zhang et al., 2015) any additional distance that a passenger may have to travel in order to accommodate another passenger's destination, and social discomfort arising from sharing a vehicle with strangers (Nguyen, 2013).

It may be these challenges that have prevented many demand responsive services from being financially sustainable. Uber Smart Routes, (Gray, 2015, Hern, 2015 for the Guardian), Sidecar, (Soper, 2016), Slide (BBC, 2018) Chariot (Techcrunch, 2019) and Kutsuplus (Sulopuisto, 2016,) are examples that have met with limited success and/or

have been withdrawn. As a result of these challenges, previous evidence is not clear on how commercially viable the types of DRT service discussed can become, with substantial numbers of enterprises seeking niches within this type of mobility, but significant numbers of these failing.

3. METHODOLOGY

The MODLE project was a 30-month project based in Bristol, aimed at exploring how services, on a spectrum of demand responsiveness, could help deliver improved sustainable accessibility for people in Bristol. The project was funded by Innovate UK. The project was led by Esoterix Systems, other partners included Bristol City Council, First Bus (the main bus provider in Bristol), Transport Systems Catapult, and Centre for Transport & Society (CTS), UWE Bristol, with whom the authors are affiliated.

The MODLE services discussed in the findings were Buzz1, Buzz2 and MYFIRSTMILE. Locations of these services in Bristol are shown in Figure 1. Buzz1 and 2 shared a number of characteristics. Buzz2 builds on the experience from Buzz1 and is an ongoing service, working towards financial sustainability. Both services have sought to connect would be or actual employees with peripheral employment sites to the North West of Bristol. Buzz1 emerged from a transport service previously operating in this area, 'The SevernNet Flyer', which had been initiated by a local social enterprise, funded by the Coastal Communities Fund of the National Lottery. The vehicles used were as standard buses.

Figure 1: Location of Buzz and MYFIRSTMILE services in Bristol area.

The Buzz services were marketed to local employers as a way to make their employment sites more accessible, to thus improve recruitment and retention of staff, and to alleviate on-site parking pressure. The Buzz services were not demand responsive in terms of daily changing the route according to demand, but were 'demand adapting' where ongoing analysis of demand suggested iterative adaption of the service. Buzz timetables were intended to integrate with start and end times of shifts in the area and to align with public transport services into the area particularly train services.

Businesses subscribed on a monthly basis for the employees, with variable prices depending on how many of their employees used the service. Each business then had a choice whether to recoup money from its employees or to subsidise some or all of cost for them. This could include the use of salary sacrifice. Buzz2 services differ from Buzz1 in that all employees using the service are charged an affordable per trip fare for their journeys with the employers making up any remaining shortfall in order to secure financial viability for the service.

MYFIRSTMILE (MFM) was a first and last mile taxi-based option connecting travellers from close to their home to a bus stop on high frequency bus route. The Henleaze area of Bristol was selected to be served by MFM through analysis of travel and demographic data. MFM used six to eight seater taxis. It picked up on a set route in the morning, delivering commuters to a bus hub, where regular buses could be taken, to important employment zones to the north of the city, or to the city centre. In the evening it returned people as and when needed directly to their pickup point. As with Buzz, analysis led to the service being iteratively modified. The MFM ticket was an integrated ticket with First Bus Inner Zone, so that the ticket covered both the taxi and bus legs of the journey.

CTS filled a variety of roles in the project including evaluating the services that the project trialled. This included conducting surveys, focus groups and interviews with service users, non-users, and other stakeholders. To broaden understanding of the challenges in providing such services, fifteen other services relating to the DRT landscape were approached for interviews. They were approached on the basis of their addressing different niches within the sector, being different from each other and representing experiences internationally. Of the fifteen, five agreed to be interviewed. These services were:

FLX. This service provided by Go Metro is aimed at corporate commuters. It is being trialled in Cape Town, South Africa. It seeks to transport colleagues in efficient groups to their employer, with a significant focus on a superior journey experience compared to car use.

Pickmeup is a demand responsive minibus service, run by Oxford Bus Company and using Via's software platform. Partly motivated by serving peripheral business parks, it serves an extensive area of Oxford, UK.

Shotl is based near Barcelona, Spain. It sells an Uber-like platform (algorithm, passenger app, driver app, operator app) to authorities and operators running subsidised public transport, thus making money by effectively saving the authority

money, through increased service efficiency. Shotl software supports services mainly in continental European countries.

Shyft. This Oxford, UK, based company seeks to bring together service information about community transport and other underutilised transport supply, into one place, and then to push this information out into journey planners and other places where would-be passengers can be made aware of those services. Still in its early stages the service is not operational yet.

Snap provides coach journeys in the UK that don't just go from main coach stations. The services run a on a degree of demand responsiveness.

4. FINDINGS: SUCCESSSES AND CHALLENGES OF THE SERVICES

The MODLE project achieved some notable successes in its trials. Buzz1 and 2 identified a substantial potential for DRT services, in linking peripheral employers wanting a sustainable workforce with workers wanting to access these locations. Passengers were generally positive about the Buzz services. A further success in the Buzz model was the effective role employers took in facilitating effective communications between the passengers and the mobility providers.

MFM also achieved success in a number of respects: It provided useful real-life experience of how to market and launch this type of service, which was then successfully integrated into the existing public transport network. The service was provided through a successful partnership between the technology provider, local authority, the primary bus operator and a taxi operator and the learning from running the service has provided these partners with motivation to provide related systems in Bristol. Operationally the MFM service benefitted from the successful creation of a bespoke integrated ticketing system. The service operated as a relatively seamless journey for passengers, (with some qualification to follow). Significantly, MFM users reported a generally positive experience.

The other enterprises confirm some of the above as areas of success: FLX and Pickmeup have also identified employment sites as potential foci of demand and sources of revenue; Snap, FLX and Pickmeup report customer satisfaction with the journey experience; Shotl and Shyft, in different ways, attest to the potential of increased integration, through ticketing or information, of different transport services; and most of the enterprises can report successes in terms of ICT developments.

However, there appear to be substantial challenges in getting successful DRT services 'on the ground'. By far the most important of these is achieving financially sustainable operations. Buzz1 and MFM were not financially sustainable and achieving this has also been a challenge for the other businesses interviewed. Some of these businesses are in the early stages of development, and all could point to significant elements of success. However, they did not volunteer financial profit as one of their successes thus far. Buzz2 though, as an ongoing service has reached financially sustainability, although not from passenger fares.

Financial profit can only happen when customers will pay a cost for a service. Whilst some companies expressed strong corporate support for increasing recruitment and retention of staff by the service, not enough companies were willing to commit

financially for the cost to be adequately spread amongst them. One concern for companies with multiple employment locations was that if this service was offered in Bristol, it would be expected at other locations. For Buzz, companies could opt to process subscriptions via salary sacrifice, saving 30% of pay for their colleagues' travel. But this is only possible where it doesn't take the wage below minimum wage, which was a block for some of the employers concerned – and a 'catch-22' for the employees. The process of companies finding the budget to cover such services can be time consuming and precarious. Employees using the Buzz1 service indicated they would have paid for their use of the service, if it would have sustained it. This has been taken forward into the Buzz2 model.

The cost of MFM travel fell on individual users. Some, particularly non users, felt the initial daily fare of £6 (for taxi and bus) to be unpalatable. Another consideration around cost is service use by concessionary bus pass holders. MFM adapted to accept these, however in this situation local authorities become important in achieving a sustainable business model for operators. A tactic for charging amongst some of the other businesses interviewed is to start with a lower fare which is then increased. FLX took this approach, whilst Oxford University and other organisations, have paid for some of their affiliates to have some initial free tickets for Pickmeup, in the hope that this will lead to ongoing patronage.

Financially sustainable levels of patronage for MFM specifically may have been curtailed by the demographics of the area served. The wards served, Henleaze and Westbury-on-Trym, have fewer people aged 25-35 and more people over the age of 55 compared to the rest of Bristol (Bristol City Council, 2018).Given the trend of fewer younger people driving than older this may have been unhelpful. In fact Bristol City Council statistics indicate this area is more affluent than average, and has much higher than average car ownership; only 13.1% (Bristol City Council, 2018) of households do not own a car, and 44.4% own two or more cars or vans. It may be that a similarly situated area, but with less affluence and associated car use, would have achieved greater patronage. In support of this, whilst a different service and context, Buzz surveys and interviews indicated that it was generally not car drivers who were using such services, but rather people who would otherwise walk, cycle or rely on a lift. Amongst the other businesses interviewed the FLX trial, like MFM, targets more affluent corporate commuters, it was unusual in reporting 60 to 70% of passengers converting from car use.

A further real-world challenge in providing services is routing and timetabling (unless the degree of demand responsivity precludes these). Some users of Buzz1 found the timetable and routing of the service problematic. Despite attempts to coordinate with shifts, this was not always successful. Sometimes coordination with shifts was very tight so that even minor delays led to passengers arriving late for their shift. A particular issue for some passengers was confusion following iterative adjustments to timetables and routes, and a lack of understanding about why these adjustments had been made. Buzz2 however evidences a more effective meshing with shift times than was the case with its predecessor.

For MFM the multiple routes and variable service model was difficult for some potential passengers to grasp. The effectiveness of the service's timetabling was also

dependent on connecting with buses. Some users reported anxiety around whether the taxi would drop off for the bus in time, and there were complaints about the unreliability of the bus services being connected with. The inconvenience and attendant concern can accentuate a preference for car use instead.

The other businesses interviewed did not report similar issues around timetabling and routing, as most of them did not run a service with a timetable or pre-set route. However, more generally, they did report problems around comprehension of services by potential customers. Oxford Bus Company for example spends significant amounts of time explaining the nature and benefits of Pickmeup to companies that could use it, and an important aspect in Shyft's work is to translate the benefits of the service into operators' language.

5. CONCLUSIONS

There is an increasing awareness of the role that more agile on-demand services might provide. MODLE has built up a considerable body of experience of how such services might be designed and deployed and has successfully launched three of these during the life of the project.

MODLE, FLX and Pickmeup share a focus on providing access to employment sites. DRT may be more effective at achieving this than at abstracting affluent people from cars, unless used alongside other measures (such as parking control for example). MODLE has generated important new evidence to add to existing data in respect of problems of access to employment locations, particularly for those without access to a car. It has also highlighted new and emerging issues around low-wage, low-skill employment locations such as distribution centres, likely to be situated on the periphery of a city.

MODLE has illustrated that employers, local authorities, operators and others can come together in partnership to deliver solutions that address the needs seen here. This provides a wealth of useful experience which can underpin future implementations. Partnerships, as needed to deliver the MODLE services, were also very important to the other businesses discussed. A study discussing these, and the adopted business models more widely, will be forthcoming from the authors of this paper.

Despite MODLE's iterative improvements in dealing with real life operational obstacles, Buzz1 and MFM were not financially sustainable services. However, the ongoing Buzz2 has reached sustainability, though not through fares alone. The other businesses interviewed did not volunteer reports of financial profit to date. This is the central challenge facing enterprises entering this type of mobility provision. Shotl's business model, based in continental Europe, is relevant here as it does not depend on financially sustainable services, but only on reducing the costs of subsidised services.

Whilst there were positive evaluations of the journey experience of Buzz1, Buzz2 and MFM, where and when a service runs and whether it is reliable appears to remain paramount. The important benefits of DRT then may primarily be in their geographical

and temporal relevance to the end user (particularly in combination with a lack of a more convenient alternative), rather than in improved journey experience.

In conclusion the MODLE project has explored and proven concepts, and gained valuable experience, relating to providing DRT services. Whilst real-world challenges await enterprises seeking to provide such services, the driving factors, as laid out above, continue to motivate interest in them.

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