Workshop 4: Realising the Potential Benefits of Demand-Responsive Travel

Impacts of replacing fixed transit lines by a Demand Responsive Transit system

Felipe Coutinho, Zoi Christoforou and Niels van Oort

One of the challenges in transit planning is to design an economically performing, socially equitable and environmentally acceptable transportation network. In the smartphone era, Demand Responsive Transit (DRT) is gaining more and more attention from urban specialists as a promising solution for this new mobility (Weckstrom et al., 2017).

The first wave of dial-a-vehicle operations arose during the 60's and 70's in the United States (Strobel, 1982). The succeeding decades saw the diffusion of GPS, computers, communication technologies – including internet – and GIS solutions, that allowed enterprises to revisit DRT operations. But it was not until the second decade of the twentieth century and its intrinsic spread of smartphones that the world met what is being saw as the most favourable context for flexible and on-demand transit solutions (CityLab, 2015).
DRT is designed to fill gaps in transit systems when a regular system is not convenient or when the service offered lacks quality (Walker, 2017). In the case of low demand areas, it is a chance to increase accessibility in a more economically reasonable way (Peterangelo and Henken, 2017). However, the perfect business model is still an issue and the diversity of different pilot programs and services offered evidence this statement.

Given the speed with which technology and business models are evolving and the growing number of these kind of experiences driven around the world, we investigated the impacts of implementing DRT (replacing fixed public transport lines) to help the decision-making process of transit stakeholders and optimize their network design (consisting of both fixed public transport and DRT) and operations.

Our research consists of a few steps, namely defining DRT, providing an historical overview, developing an assessment framework of the impacts, analysing a case study in which a DRT system replaced fixed lines and finally to derive general insights for designing and operating these kinds of systems.

Mokumflex, our case study, is a pilot in Amsterdam in the Netherlands that ran for 12 months starting in December 2017. This all-day on-demand system, executed by cars and (mini)vans replaced two bus lines (one-hour headway each) that ran from Monday-Friday 6:00-24:00.

Preliminary results show that ridership faced a decrease of 65% in passengers transported, in spite of the extended time-frame, increased intricacy and reduced fare. Passenger satisfaction equally diminished, mainly due to long booking and waiting times and weak punctuality. Only 16% of the trips were actually shared, implying potential funding issues. However, direct economical savings were considerable and when compared to the previous system, the operational costs per month of Mokumflex were as low as 20% of the original costs. When it comes to pollution and road safety, the new DRT system showed the potential to save more than 95% of the old-line expenditure with them.

To conclude, the pilot showed multiple impacts of changing fixed transit lines into a DRT system, both positive and negative. In the final paper we will present an assessment framework to compare all the pros and cons to derive general lessons learnt.

Why most DRT/Micro-Transit's fail – What the few survivors tell us about progress

Graham Currie and Nicholas Fournier

It is common to read about exciting new ways of operating urban public transport systems in social and mass media including app-based demand responsive transit (DRT) systems and what is now termed 'micro-transit' (MT). This broadcast coverage involves a great deal of marketing 'hype' on how new technologies provide new opportunities to 're-invent' what is implied to be old, inefficient and in-decline fixed route transit systems using conventional technologies and fixed route scheduled services. These discussions almost never use financial and economic performance data of DRT/MT based systems and rarely if ever note that most DRT systems and many current micro-transit initiatives fail.
This paper reviews the performance of DRT/MT systems using a review of current practice and systems with particular focus on factors that have led to the few systems that still currently operate being able to survive and factors that cause failure. The aim is to isolate service, design and context factors that have enabled sustainability of these services. The paper is conceived to focus workshop 4 participants into better

understanding the realities of failure and success in DRT operations.
The paper includes a review of contemporary and historical performance of DRT/MT systems from both published literature and practice including case studies of systems explore the role of specific service design features.
Findings illustrate the overwhelming history of over 30 years of trials of adopting demand responsive operations into urban bus operations is one of failure largely driven by excessive costs and complex demand responsive vehicle operations and low ridership effectiveness, revenue cost ratios and high subsidies. New Information Communications Technologies provide high quality customer friendly ways to access and book DRT/MT services but fail to substantially influence the poor service effectiveness deficits of these kinds of operations. DRT/MT operations that have survived have almost exclusively involved bespoke niche many to one simplified operations using fare supplements to balance higher costs and/or involve substantially higher subsidies justified on the basis of the needs of niche markets. Areas for future research are identified.

The importance of Policy, Institutional and Regulatory Frameworks to the provision of DRT and emerging other forms of shared mobility services in rural areas
Brendan Finn and John Nelson

About one quarter of people in the EU live in rural and non-urban areas, meaning about 150 million people. About 75% of the territory of the EU is classified as non-urban, and even the 25% classified as urban contain many dispersed hinterlands and rural pockets. Mobility is one of the significant challenges facing rural and non-urban areas throughout Europe, resulting in societies that are highly dependent on automobiles and that lack public mobility services for those who cannot or would choose not to use personal means of transport. Many rural areas have experienced self-reinforcing downward spirals over the past two decades due to a combination of declining population, withdrawal of social and business facilities, and service cutbacks.

Provision of mobility services in rural areas is inherently different from that of urban areas since population and activity are more dispersed. With continued erosion of scheduled bus services, there has been increased use of Demand Responsive Transport (DRT) both as an alternative means of maintaining/enhancing public transport availability and as a means of providing dedicated services for socially-vulnerable groups. More recently, “new” forms of shared mobility have emerged, including car-pooling, shared-taxis, car-sharing and e-hitchhiking, although in reality these are usually just a more organised and often app-based version of long-used pragmatic mobility responses. There is also often a long tradition of volunteer provision of mobility services.

Despite the availability of these proven forms of shared mobility services, low technical complexity and their moderate cost, there is limited deployment throughout Europe, limited integration with the main public transport, and little or no cases of comprehensive use of the range of shared mobility options to meet the mobility needs of a rural area or region.

The SMART Rural Transport Areas project (SMARTA) identified that this situation is so pervasive across Europe (and elsewhere) that there must be underlying structural issues. SMARTA examined the Frameworks within which rural mobility sits in each of the 28 EU countries plus selected other countries. This covered policy, institutional, organisational, operational, regulatory and financial aspects. The premise was that lack of a proactive and supportive framework would both stifle wide deployment of the available interventions such as DRT and act as a significant barrier to emerging new forms of shared mobility. SMARTA has identified that virtually all European countries lack any explicit policy on rural mobility, lack targets or explicit obligations on levels of mobility provision, and that such policy and implementation/funding mechanisms as exists are fragmented across agencies (general public transport, education, health, …). Further, regulatory frameworks either do not make provision for DRT or many emerging forms of shared mobility, or severely constrain what may be provided.

Drawing on SMARTA this paper presents the context and findings from the set of studied countries. It then provides consideration of the forms of intervention that are most required to bring mobility levels in rural areas to what citizens actually require, and to establish a more supportive framework for DRT and other forms of rural shared mobility.

How do you tell if a regional area may support an on-demand service?
Loan Ho, Corinne Mulley, Helen Lin and David Royle

One of the biggest challenges in the development of a new route is identifying whether there is sufficient demand to make the business case a viable one. This is especially true of on-demand services since the traditional approaches to establishing demand that are used for fixed route services are less helpful and the supply side requires the consideration of the size of vehicle versus time to collect users trade-off.

This paper considers the question of how to establish business case for an on-demand service in a regional area where population density is typically much lower than in metropolitan or more urban settings. It recognises that with on-demand services demand and supply are inextricably linked. How wide a spatial area is considered will have an impact on demand but will also have an impact on supply in terms of the time taken to reach potential users.

This paper uses Coffs Harbour, located in the north coast of NSW, as one of the biggest regional cities in NSW as a case study. Coffs Harbour had low levels of service which were costly to provide but meant that the services were unappealing to all except those captured to public transport. An on-demand service was considered a potential improvement for citizens in the area and the incumbent operator prepared an operational plan for the consideration by Transport for NSW.

The operation planning started with building up a pattern of demand. This involved interrogating census data for the area of interest, looking at different potential operating areas centred on a local 'depot' where the flexible transport would be located. Different speeds of bus operation were used to capture likely catchments, and assumptions were made as to the likely frequency that vulnerable users such as older people, unemployed, students and employed people might use an on-demand service on a regular basis. A second strand was to look at the supply side and to estimate the number of vehicle trips using assumptions about the distribution of trips, the percentage of the total at different time periods and published information as to how long vehicles of different sizes might take to provide the service, taking account of land use patterns.

The business case was built on the demand and supply framework with the use of sensitivity tests to look at demand and supply variations. An operational plan was thus developed to provide an on-demand service.

Shared Autonomous Vehicles in rural public transport systems

Sebastian Imhof, Widar von Arx and Thao Thi Vu

The research on the potential of Shared Autonomous Vehicles (SAV) for transport has so far covered mainly urban areas. This contribution focuses on how the potential of SAVs could be best exploited in rural areas, where lower demand and higher private car ownership hinder successful public transport systems. By using an experimental case study, two business models were developed, and the corresponding transport demand forecasted. One model replaces the current rural public transport by SAVs entirely; a second model is replacing the bus system by a SAV fleet, but not the regional train line. The comparison of those business models helps to understand the interplay between different transport modes in a rural context in view of providing more attractive transport services. This research is based on the current demand for public transport and examines the possible growth of demand to faster and more convenient trips due to the anticipated capability of SAVs to operate on-demand and highly flexible. Data source are an overall traffic model and the business figures of current public transport services in the research area.

The results of this research suggest that SAVs are an alternative to traditional bus and train systems in rural areas. In an autonomous door-to-door business model, both demand and revenue appear to be higher than in traditional public transport. In both examined business models, a cost-covering service may be possible. The increase in demand is an expected result of the flexible, customer- and demand oriented business models. Both examined business models differ in their necessary size of a new SAV fleet as the integration of the train passing through the research perimeter can reduce the kilometres travelled with SAVs. Major traffic problems in a service concept without an entire train service in the research area are anticipated at exchange hubs near bigger cities and at peak times, when a big amount of SAVs drop off or pick up passengers from trains. These problems can be diminished by integrating train services in the business model, allowing passengers to change their mode of transport in decentralized hubs within the region. Furthermore, the integration of the train system helps the SAVs to cover the first and the last mile within the region at a reasonable cost, while the rail service leads directly to the next city centres, offering good connection to long haul train services.

Combining the train and SAV service is out of today's view a good possibility to build upon existing transport infrastructure and to sustain or even expand the public transport network in rural areas. All estimations in this research build upon assumptions that are considered in a sensitivity analysis.

What is the disutility of sharing a ride? - Willingness to share in DRT services

Maria Jesus Alonso Gonzalez, Oded Cats, Niels van Oort, Sascha Hoogendoorn-Lanser and Serge Hoogendoorn

Urban mobility is changing rapidly with the emergence of a large number of on-demand services, such as individual ride-sourcing and car-sharing. These modes of transport provide tailored mobility solutions and can act as complements of conventional public transport. However, most of these modes are individual in nature. As a result, their impact to, for instance, improve congestion and reduce emissions is limited. Collective on-demand mobility solutions (i.e., Demand Responsive Transport (DRT) services) can have a higher impact due to their collective nature. Previous research has already proven the matching potential of current individual rides in very different cities worldwide due to the spatial and temporal similarities of the rides (Tachet et al., 2017). However, less is known about the behavioural component regarding sharing rides, i.e., whether individuals are willing to share their rides, what we call 'willingness to share'. Sharing acceptance is a prerequisite for DRT acceptability and success, yet research has not yet properly understood or quantified it.

In this research, we aim at filling this gap by quantifying the disutility associated with sharing the ride with (different numbers of) other individuals. We performed a stated preference experiment in May 2018 targeting the urban population in the Netherlands and obtained a valid sample size of over 1000 respondents. Respondents were presented with two (stop to stop) taxi-like alternatives: an individual ride and a shared ride. Shown attributes were in-vehicle time, trip costs, and the number of extra passengers (for the shared alternative). We used the BIOGEME package for the analysis (Bierlaire, 2003). Initial results show that the number of individuals in the vehicle influences the willingness of users to share the ride non-linearly. While the disutility of sharing the ride with one or two other passengers is very low, this value increases significantly when sharing the ride with four other passengers.

We expect that this willingness to share is also influenced by the individual's attitude towards sharing. Therefore, we will enrichen the discrete choice model with a latent variable model, (i.e., a hybrid choice model). This latent variable (which we measured by a series of sharing-related attitudinal Likert-scale indicators included in the survey) will, in turn, be explained by different socioeconomic and mobility characteristics of the individual. For example, we expect that current unimodal car users will have a more negative sharing attitude which will influence their willingness to share. In addition to helping understand the value of the willingness to share, this research will also shed light on how much the attitude towards sharing plays a role in this value, and for whom it is highest. DRT operators and authorities can use the findings of this research to better market their shared services.

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Can a smart demand-responsive service improve the accessibility of the elderly? A case study from the Netherlands

Peraphan Jittrapirom

Over recent years, the transport sector has undergone a significant transformation, driven mainly by technology advancements. This transformation has enabled new ways of offering transport services. For instance, Demand Responsive Transport (DRT) services can now be reserved with ease through a Smartphone App, which can also notify users of the arranged pick-up time and location. Such a service can add an additional option to the transport system, potentially enhancing people's ease of movement or even providing them with access to destinations previously unreachable. However, it is unclear whether the benefits of this enhancement are distributed equally over all groups in society, including those likely to have a limited level of accessibility such as the elderly.

In this study, we evaluate the impact of a smart DRT service in the Nijmegen-Arnhem region of the Netherlands. The service, called Breng flex, is an on-demand shared-ride service which began its pilot in 2016. The first evaluation of the service in 2017 reported a success, resulted in an extension of the trial

period until the end of 2018. To complement the first evaluation, our study focuses on capturing the service impacts on the elderly in particular.

We conducted 44 face-to-face interviews with users and non-users of Breng flex, using a pre-structured questionnaire. We also interviewed four local experts, who provided additional insights into the subject. The survey outcomes illustrate that the introduction of Breng flex did not improve the level of accessibility experience by the elderly. Also, the study finds that the "smart" features of the service, such reservation via an App, are less important to the respondents than transport-related features, such as door-to-door pickup service. We discuss the trade-off of such features for the case study and make suggestions in designing a mobility service that can improve the accessibility of the elderly.

Assessment of DRT Systems based on Optimal Routing Strategy
Jooyoung Kim, Seungjae Lee and Shinhae Lee

Recently, according to the change of socioeconomic structure and the congestion of the road environment, the perception of the road users has changed from the proprietorship to the sharing of the personalized transportation modes. However, it is difficult to provide personalized mobility service because existing public transit provides fixed schedule-based service. Demand responsive transport (DRT), such as shared mini busses are an established form of public transport. With advances in communication technologies and possible driverless operations in the future, DRT systems may become also an attractive additional mode in urban and inter-urban transport.

In this study, we analysis the effects of DRT system in order to solve the first-last mile problems based on a proposed DRT routing algorithm considering real time travel behaviour. The algorithm is modified from the DVRP (Dynamic Vehicle Routing Problem), in which a based DRT routing algorithm tend to minimize users' cost and providers' operation cost. The DVRP is so far only able to serve a single request per vehicle at a time. For DRT purposes, where several passengers are on board a vehicle at the same time, this needs to be extended. The routing algorithm can serve multiple request at a time and schedules picks ups, drop offs and rides according in accordance with the requests and as calculated by dispatch algorithm. The basic principle of routing is follows. The DRT vehicle moves to the attractive path and picks up the passenger if boarding is requested not just hanging around in case of DVRP. In this step, if the other DRT vehicle exists around the other passenger, the vehicle which could minimizes the passenger's total travel time picks up the passenger. The optimal routing algorithm developed in this study is applied to the activity-based model, which is a microscopic traffic demand estimation method and was implemented by activity-based model using an open source activity-based model package, MATSim (Multi Agent Transport Simulation). The reason for using MATSim as a simulation is that it combines a multi-modal traffic flow simulation with a scoring model for agents as well as co-evolutionary algorithms that can alter daily routines of agents. This process applied to some kind of mode choice and route choice repeatedly over several iterations until some forms of user equilibrium has been reached.

This analysis can lead to see if DRT service can help to fill gaps where classic public transport fails to attract customers. It may help to reduce congestion though long-term effects, which should be assessed. Specifically, the effect of user aspects such as changes in mode choice, VKT, VHT and travel time savings due to reduction of congestion by introduction of DRT will be analysed according to the scale of DRT supply. Through simulation, it is expected to provide convenient, fast and cost-effective mobility services to customers and the optimal vehicle scale to providers, and ultimately to achieve a safe and efficient transportation system.

Perceived accessibility if the car is no longer an option
Katrin Lättman, Margareta Friman and Lars E Olsson

The paper focuses perceived accessibility, which regards individual perceptions of accessibility in light of individual prerequisites and preferences, travel options and perceived possibilities for travel. We have previously validated perceived accessibility in daily (actual) travel by the perceived accessibility scale - PAC (Lättman et al., 2018, Spec Issue from Thredbo15 in Research in Transportation Economics). However, in order to promote a sustainable transport system we also need knowledge of how car users perceive their accessibility when travel options are restricted to sustainable travel modes.

The study focuses two main objectives: 1) compare perceived accessibility of actual travel to "if the car is no

longer an option" and 2) compare perceived accessibility when restricted to sustainable modes among frequent car users and those primarily using sustainable modes.

Data was collected in 13 residential areas of Malmö (Sweden) in 2016 from 2711 participants, aged 18-95. Their main mode of travel was car (1141), bike (743), public transport (616), and walking (176). We used the previously validated instrument PAC to capture perceived accessibility in actual travel (α=.90), and an updated version of PAC for measuring perceived accessibility "if the car is no longer an option", among those participants that reported that they use the car for travel at least once a week. An exploratory factor analysis provided satisfactory internal reliability for the PAC travel index "if the car is no longer an option" (α=.88), with an explained variance of 74%.
Main objective 1: A t-test (paired samples test of the two PAC measures) showed significant differences in car users perceived accessibility for actual travel (M=5.72) compared to with restrictions (M=3.94) (higher numbers indicating greater perceived accessibility) ($t = 4.56$, $p < .001$).

Main objective 2: An ANOVA showed significant differences in perceived accessibility during restrictions between participants with different main modes ($F [4,1921]= 82.65$, $p < .001$). A Games-Howell post hoc showed that frequent car users perceived accessibility as significantly lower ($p < .001$) if the car would no longer be an option (M =3.31), than do cyclists (M = 4.75), walkers (M = 5.01), and public transport users (M = 4.71).

The results show that car users perceive their accessibility as significantly lower if restricted to sustainable modes. Moreover, there are significant differences in perceived accessibility when restricted to sustainable modes depending on current travel behaviour (main mode), where those already primarily using sustainable modes find accessibility greater than frequent car users. Although these novel findings may not come as a surprise, they emphasize the importance of including and analysing perceptions of car-users when designing sustainable transport systems. For instance, to assess the benefits of future public transport projects, where restricted car use may be one element, it is important to recognize the potential negative effects it may have on accessibility from the car user perspective. The paper will also discuss aspects of the built environment in order to explain, and counteract, perceptions of accessibility.

Modelling the impact of on demand minibus services on urban mobility - A case study of Singapore
Duy Nguyen, Diem-Trinh Le, Ravi Seshadri, Simon Oh, Kakali Basak, Christopher Zegras, Joseph Ferreira and Moshe Ben-Akiva

Public transport plays an important role in urban traffic system as it provides a basic mobility service for everyone. It is also one of effective transport modes in reducing air pollution, road accidents, particularly traffic congestion due to high number of passengers carried. With the rapid development of technology, a number of new transport modes have been introduced for the last decade. An on-demand bus service, which offers seamless and convenient bus journeys by operating a real-time, dynamically routed bus service, is a grand optimising resources and leveraging technology. This new public mode is expected to increase efficiency and reduce cost since it provides a wholistic and comprehensive service for commuters. Using a multi-model activity driven agent-based simulation, called SimMobility, this paper aims to understand the impacts of on-demand bus services on urban mobility, especially focusing on road user's travel time and travel distance. A specific area in Singapore is chosen as a case study for this study. Areas for future research are also suggested in the last section.

Resurgence of Demand Responsive Transit Services – Insights from BRIDJ Trials in Inner East Sydney, Australia
Supun Perera, David Hensher, Chinh Ho and Neil Smith

Demand-responsive transit (DRT) is a form of public transit that is characterised by flexible routes and schedules, and generally uses small to medium sized vehicles to provide door-to-door services in response to passenger journey requests. Historically, the cost of providing DRT services by either the private or public sector, has been high, in part due to limited patronage in many of the contexts in which it has been introduced, requiring high levels of subsidy. DRT has often been perceived as institutionally challenging due to the very rigid nature of many tendered or negotiated bus contracts (of a gross cost form). As a result, the supply of DRT services in many jurisdictions has been discontinued or avoided. The digitally inspired transformation in recent years has offered a new environment, in which customised services that are more user focused have emerged as of growing interest to governments throughout the world. Governments are

now actively encouraging the introduction of more flexible user-centric services, of which the provision of DRT services has moved to the mainstream as opposed to a niche market. Private bus operators are being encouraged to consider such flexible services either within their existing mix of contracted services or as additional offerings under a contract extension or as a market driven economically deregulated initiative as entry barriers are removed. In general, technological advancements has enabled DRT operators to deliver improved services for passengers with higher levels of operational efficiency. Furthermore, with the advent of car-based services such as Uber and Uber pool, and increasing costs of fuel and vehicle ownership, some segments of the public have been more receptive to considering alternative modal options to owning a car (at least a second car), with increasing willingness to consider using shared transportation services. As DRT trials increase, and ongoing services are modified with small injections of DRT services, it becomes important to understand the principles of operational success and financial viability which underpin the recent resurgence of DRT services, so as to avoid the concerns from the past. This paper documents the insights gained from the recently commenced DRT trial by BRIDJ in Inner East Sydney in Australia, which is linked to a recently won contract through competitive tendering that explicitly encouraged DRT in the bid service mix. In particular, this work illustrates the effectiveness of a multi-delivery of service model, involving DRT operating in conjunction with regular public transit vehicles, within a contracting model of service provision.

Integrating Car-Sharing With Park&Ride Solutions in the Context of Sustainable Urban Mobility Plans
Gintaras Stauskis, Marija Burinskiene and Rasa Uspalyte Vitkuniene

The development of pedestrian and bicycle transport infrastructure integrated multimodal public transport and combined transport trips are implemented in European cities following the 2007 European Commission Green Paper on Urban Transport, the 2009 Green Paper Action Plan and the 2011 White Paper. By 2030, the roadmap for a Single European Transport Area aims to achieve the EU has reduced by half the use of cars powered by conventional fuels in urban areas, and by 2050 - totally eliminate the use of these vehicles in European towns. At the national level, as planned in the European Commission document mentioned above, the major cities in Lithuania are developing Sustainable Urban Mobility Plans SUMP, which offer Combined Passenger Travel Promotion Systems among other "soft" measures through Park&Ride, Bike&Ride and other sustainable mobility concepts. The purpose of this research is to identify the innovative ways to manage car-sharing services creating a solution integrating it with the public transport system and with Park'n'Ride.

Usually urban residents living in peripheral areas choose a private car as a means of transport due to poorly designed public transport route planning and a low frequency of service. Average 55% of Vilnius public transport service is considered ineffective due to the low density of Vilnius city and the spread of the city to the periphery. Since 2013, the public transport network in Vilnius has acquired certain hierarchy influenced by the urban structure of the territory, the structure of the labour and the dwelling areas in the city. The transfer from the vehicle to the public transport is provided in all transport zones by Park&Ride and Bike&Ride systems. Offering the car-sharing service to the newly built or sparsely populated urban peripheral districts is the next step allowing residents to access Park&Ride services and continue their journey by the public transport.

This shift would benefit all participants of the mobility system: a car-sharing company would service more customers and would improve its public image, the customers without a car or with only one car in the family would have an alternative means of mobility. In addition, the city by implementing this solution would compensate the unprofitable routes to the urban areas where passenger flows are low. The article presents and discusses the results of operating the first pilot site in Vilnius City where car-sharing service was for the first time combined with Park&Ride service and all together these services are plugged it into the public transport system. The innovative integrated solutions are developed and tested with the help of the analysed pilot project, and the scope of these changes could be increased and multiplied in the mobility system of Vilnius and other European cities.

Resource Optimisation and Seamless Commutes: On-Demand Public Bus Trial in Singapore
Francis Teo, Annabelle Latiff and Alan Lin

The On-Demand Public Bus ("ODPB") trial in Singapore was piloted by the Land Transport Authority ("LTA") on 17 December 2018, to evaluate the feasibility of operating public bus services based on real-time commuter demand and along dynamic routes, instead of following fixed routes and pre-determined timetables. The trial enables LTA to leverage on new technology solutions to meet commuters' changing travel demand. This paper seeks to explore the potential benefits of an on-demand model whereby on-

demand services operate as public bus services alongside fixed and scheduled bus services that have low demand, from a resource optimisation and service level perspective for both commuters and local transport authorities, using the empirical example of the ODPB trial in Singapore. The LTA awarded the contracts to Via Transportation, Inc and Ministry of Movement Pte. Ltd. ("SWAT") to develop the ODPB system. Two public bus operators, viz. SBS Transit Ltd and SMRT Buses Ltd, were engaged to operate the ODPB services.

Using a mobile application, commuters will be able to book an ODPB ride by requesting to be picked up and dropped off at any bus stop within defined areas during the ODPB operation hours. For the trial, commuters are offered two types of on-demand services - the Weekday and Night ODPB services. Trial areas for the weekday ODPB service were required to have at least two low demand bus services so that there is room for commuters to be better served if the low demand services were converted to the on-demand model. Two such areas, Joo Koon and Marina-Downtown, were selected for the trial. During the trial, commuters would still have the option of taking the regular bus services but at lower frequencies. Singapore currently has late night services that operate on Fridays, Saturdays, and eve of public holidays to provide bus connections between the city and major housing estates during the after-hours when the regular bus services and the Mass Rapid Transit have ceased operations. The Night ODPB service is introduced to provide a similar connection from the city area to the Bedok and Tampines residential areas, to offer commuters an alternative travel option.

This paper first examines the concept and objectives behind the ODPB trial in Singapore, as well as how the key performance indicators for the ODPB trial were designed and compares how they differ from that of fixed and scheduled bus services. This paper also explores operational issues faced during the ODPB trial, such as the challenges of managing multiple contracts involving several stakeholders. Lastly, this paper sheds light on the benefits (and disadvantages) of ODPB services operating alongside fixed and scheduled ones as public bus services, based on results from the trial, service levels experienced by commuters, and feedback received from various channels.

The desired quality of service among public transport users in metro Manila considering dominance of paratransit modes
Noriel Christopher Tiglao

Institutional or formal transport includes public transport services often referred to as planned or scheduled transport services. This means public (or private) companies of a formal structure that provide services according to the regulations defined by the relevant urban transport authority. On the other hand, paratransit, often referred to as 'informal' or even 'illegal' transport, operates on the fringe of the institutional transport system, sometimes even taking over as the main component in the system. Paratransit is generally presented as services that do not fit with the idea of a modern urban public transport system and are as partially responsible for problems of traffic congestion, pollution and road accidents in cities where it is particularly widespread. Such is the case of Metro Manila where the public transport system is dominated paratransit modes such as the Jeepney, GT Express and Tricycles.

There is a need for urgent reform in view of declining share of public transport and the drastic increase in private car use as well as the increasing social cost of traffic congestion and serious inefficiencies in urban mobility systems. There is plenty of scope for improving public transport services but well-thought out reform strategies should be informed by a thorough understanding on the needs of the public transport users from a quality perspective, the attempt of which has never been done before.

In marketing studies, the concept of service quality has been widely discussed and quality has been defined as 'the consumer's judgement about a product or service's overall excellence or superiority'. Further, there is agreement in marketing literature that service quality show to what extent service performance matches consumers' expectations. Thus, if service performance matches or exceeds consumers' expectations, they will have favourable assessments toward service quality. In public transport research, the definition of service quality in the marketing field is also adopted. Perceived quality studies that try to determine the satisfaction levels of public transport users provide a powerful tool to public transport authorities and operators in creating marketing policies aimed at retaining current users. However, such studies do not consider perspectives of nonusers. Thus, a new concept of "desired quality" has been recently developed. The "perceived quality" refers to what the users perceive based on their own experiences in using public transport. The concept of "desired quality", however, addresses what the public would like to receive from

their transport service based on their expected quality. Evidently, both the users and nonusers have certain expectations that stimulate their desires. Their desires are represented by certain characteristics of the public transport service that maximize their utility.

The study establishes the desired quality of services of public transport users in Metro Manila considering the dominant role of paratransit modes. The research methodology involves the conduct of focus groups to choose the most important variables for the users, the design and use of unlabelled stated preference surveys and the calibration of discrete choice models based on various categories of users and potential users.

Demand Responsive Transport: Delivering public transport in Australia
Sue Wiblin

Demand-responsive transport (DRT); a real-time, shared service that uses technology to create the optimal route and, provides unparalleled first and last mile access to public transport and/or major points of interest for all members of the community. That is the promise of DRT. End to end journeys, social inclusion, refocused and repurposed funding from public transport authorities.
Our conference report will present findings based on data from Keolis Downer's four demand responsive transport service in Australia including the award winning Keoride service currently transporting approximately 480 passengers per day with a ride-share average of five passengers per trip.
• Patronage, ride share and financial data the demonstrate DRT can be delivered with similar subsidy to other public transport services
• Customer and client insights: successful DRT requires more than good technology, it must be underpinned by public transport fundamentals
• Reducing congestion: customer data revealing DRT takes cars off the road
• Scalability of DRT – integration into the transport network is critical to success
• Emerging trends – autonomous shuttles and demand responsive technology

Public transport is the most efficient mode for moving large numbers of people. As populations grow and budgets are constrained, public transport authorities need to invest in new, shared transport services to increase access to mass transit and to improve connectivity for communities where quality of life is compromised by location and the use of fossil fuel powered private motor vehicle is the only option.
Why is this critical? The Australian Automotive Association (AAA) recently released a comprehensive report on road congestion. The report confirmed average driving speeds declined significantly in Australia's capital cities between January 2013 and June 2018, and without corrective action, congestion problems will continue to intensify resulting in Australians spending even more time in traffic.

The Bureau of Infrastructure, Transport and Regional Economics estimated that congestion cost Australia $16.5 billion in 2015 and warned without major policy changes, costs are predicted to reach between $27.7 and $37.3 billion by 2030. But it's not only the economic costs, congestion pushes up emissions damaging public health and the environment and longer journey times negatively impact the liveability of our cities and quality of life.

And this is a global trend. Projections released by the UN show that urbanization (the gradual shift in residence of the human population from rural to urban areas), combined with the overall growth of the world's population could see an additional 2.5 billion people living in urban areas by 2050. To avoid gridlock, cities will need more connected, flexible transport options that enable end to end journeys.

DRT is a flexible, scalable, reliable, technology enabled shared mobility mode that enhances the appeal and convenience of public transport. Keolis Downer believes this type of service will become an integral part of the transport ecosystem creating seamless end to end journeys and reducing reliance on private vehicles.