

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

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### **Abstract:**

This paper synthesises evidence from Workshop 4 'Realising the Potential Benefits of Demand-Responsive Travel' of the 16th International Conference on Competition and Ownership in Land Passenger Transport. The paper outlines key findings from 10 research papers presented at the workshop, which was structured into three broad topics, namely, A. DRT Development Challenges B. DRT User Perspectives, C. DRT Design and Planning Experience. Based on the three-day collaborative workshop, this paper synthesises the outcomes of discussions around these topics. The workshop established that DRT services are in their nature, an intermediary to fixed route services and fully flexible point-to-point transport by private cars. Thus, DRT has the potential to complement existing public transport services. There remain obstacles to mainstreaming DRT services, in particular high costs of operation, and high costs of adoption by users and apprehension among users about whether the DRT experience fits their needs. Policymakers, operators and researchers should concentrate efforts on overcoming these concerns.

### **1. Introduction:**

There were 20 participants in Workshop 4, from 12 different countries, namely Singapore, Australia, the United Kingdom, Chile, Sweden, United States, Switzerland, Ireland, France, Philippines, Spain and the Netherlands.

The workshop focused on determining how to mainstream Demand-Responsive Travel (DRT) systems in transportation systems around the world. In facilitating this discussion, we were guided by the following research questions:

- i. How do we define DRT services? What are the major DRT service types/forms?
- ii. What are the major challenges and barriers to the successful adoption and development of DRT?
- iii. What rationale/objectives do DRT service seek to address? What is the role of DRT in the transport ecosystem?
- iv. What are the major DRT benefits of services
- v. What service design factors/approaches act to impact the success and failure of DRT services
- vi. What regulatory/organisational factors impact DRT provision and how can they best be structured to achieve successful DRT development.

- vii. What are the important DRT user perspectives affecting usability and the quality of the passenger experience
- viii. What are the major success/failure factors affecting DRT performance?
- ix. What are the future opportunities/challenges to ongoing DRT service development.

Ten papers were presented in the workshop covering three groups of topics:

- DRT Development Challenges (2 papers)
- DRT User Perspectives (3 papers)
- DRT Design and Planning Experience (5 papers)

This report is structured as two parts. First, we summarise the discussions of the 10 papers presented. In the second part, we discuss the workshop outcomes. This is organised as responses to some of the research questions raised above, as well as recommendations for policy, research and Thredbo 17.

## **2. Presentations**

### **2.1. DRT Development Challenges**

- Why most DRT/Micro-Transit's fail – What the few survivors tell us about progress (Currie and Fournier, 2019)
- The importance of Policy, Institutional and Regulatory Frameworks to the provision of DRT and emerging other forms of shared mobility services in rural area (Finn, Nelson and Lorenzini, 2019)

In this section, we discussed the history of DRT systems, drawing lessons from the successes and failures of various systems. In particular, it was noted that the most sustainable DRT systems were often those that were set up with clear aims, implemented with a deep understanding of the problem that needed to be solved, and with a defined strategy for how DRT could be used to address the problem. For example, DRT systems that were operated to serve social aims, such as to provide transport for people with disabilities, were less prone to failure.

We also discussed the importance of regulatory frameworks that guarantee a minimum level of transit service in rural areas. Since rural areas have lower densities, DRT service may be a more viable transit system than fixed line systems. Coordinated regulatory frameworks may pave the way for sustainable rural DRT service.

### **2.2. DRT User Perspectives**

- What is the disutility of sharing a ride? - Willingness to share in DRT services (Gonzalez, Cats, van Oort, Hoogendoorn-Lanser and Hoogendoorn, 2019).
- The Desired Quality of Service Among Public Transport Users in Metro Manila Considering Dominance of Paratransit Modes (Tiglao, 2019)
- Perceived Accessibility if the private car is no longer an option (Lättmana, Friman and Olsson, 2019)

In this section, we discussed various dimensions of DRT service that affect user demand. In particular, we discussed the issue of sharing – the need for privacy and personal space can lower demand for DRT services. We saw how users in the Philippines prioritise vehicle condition, comfort, service and accessibility when it comes to “jeepney” services. Finally, we

discussed the importance of considering not just user costs but also user perceptions when trying to induce mode shifts.

### 2.3. DRT Design and Planning Experience

- Impacts of replacing fixed transit lines by a Demand Responsive Transit system (Coutinho, Christoforou and van Oort, 2019)
- Resurgence of Demand Responsive Transit Services – Insights from BRIDJ Trials in Inner West of Sydney, Australia (Perera, Hensher, and Ho2019)
- Resource Optimisation and Seamless Commutes: On-Demand Public Bus Trial in Singapore (Teo, Latiff and Lin, 2019)
- Shared Autonomous Vehicles in rural public transport systems (Imhof, von Arx and Vu, 2019)
- How do you tell if a regional area may support an on-demand service? (Ho, Mulley, Lin and Royle, 2019)

Four of these five papers review DRT trials in various parts of the world while one paper (Imhof, von Arx and Vu, 2019) models the implications of a hypothetical autonomous DRT system. There were some notable similarities across the papers in terms of challenges faced. For example, all systems grappled with high operating costs. In addition, many DRT systems faced barriers to user adoption such as a lack of information and the inability of users to adopt the necessary technology to use the service. These were among the reasons for low ridership on these systems.

## 3. Outcomes

In this section, we summarise the workshop outcomes. We organise these outcomes around the relevant guided research questions listed in the introduction.

### 3.1 How do we define DRT services? What are the major DRT service types/forms?

DRT services are known by many names – para-transit, dial-a-ride, ride sharing, on-demand transit, flexible transport, dynamic routing, etc. These services vary in implementation from place to place. Thus, our first task was to identify the key characteristics that define DRT. We agreed that DRT services were more “flexible” in contrast to traditional transit modes, and that this flexibility could be in terms of the routes, timing or frequency of service and type of vehicle used. In addition, DRT services are intermediary in nature. In terms of frequency and coverage, DRT provides a level of service that is in between fixed, scheduled transit and fully personalised travel in private vehicles or taxis.

Figure 1, by D'Este et al., 1994, makes clear the intermediate nature of DRT systems.

### 3.2 What are the major **CHALLENGES** and **BARRIERS** to the successful adoption and development of DRT?

As mentioned previously, one of the greatest challenges to “mainstreaming” DRT is high costs. Currie and Fournier (2019) find that “DRT service life is exponentially decreased as cost increases.” Teo et al., 2019 show that a DRT trial in Singapore was less cost-effective compared to a fixed route service due to the high software development costs, which in the longer term should not be an issue, necessary to enable the on-demand feature of the service.

Related to this, the cost of DRT services to commuters is also often too high. In studying a DRT trial in Inner West Sydney, Australia, Perera et al., 2019 find cost to be the main barrier to using the DRT service among potential users is costs, as the price was 2.5 times more expensive than a competing fixed route service.

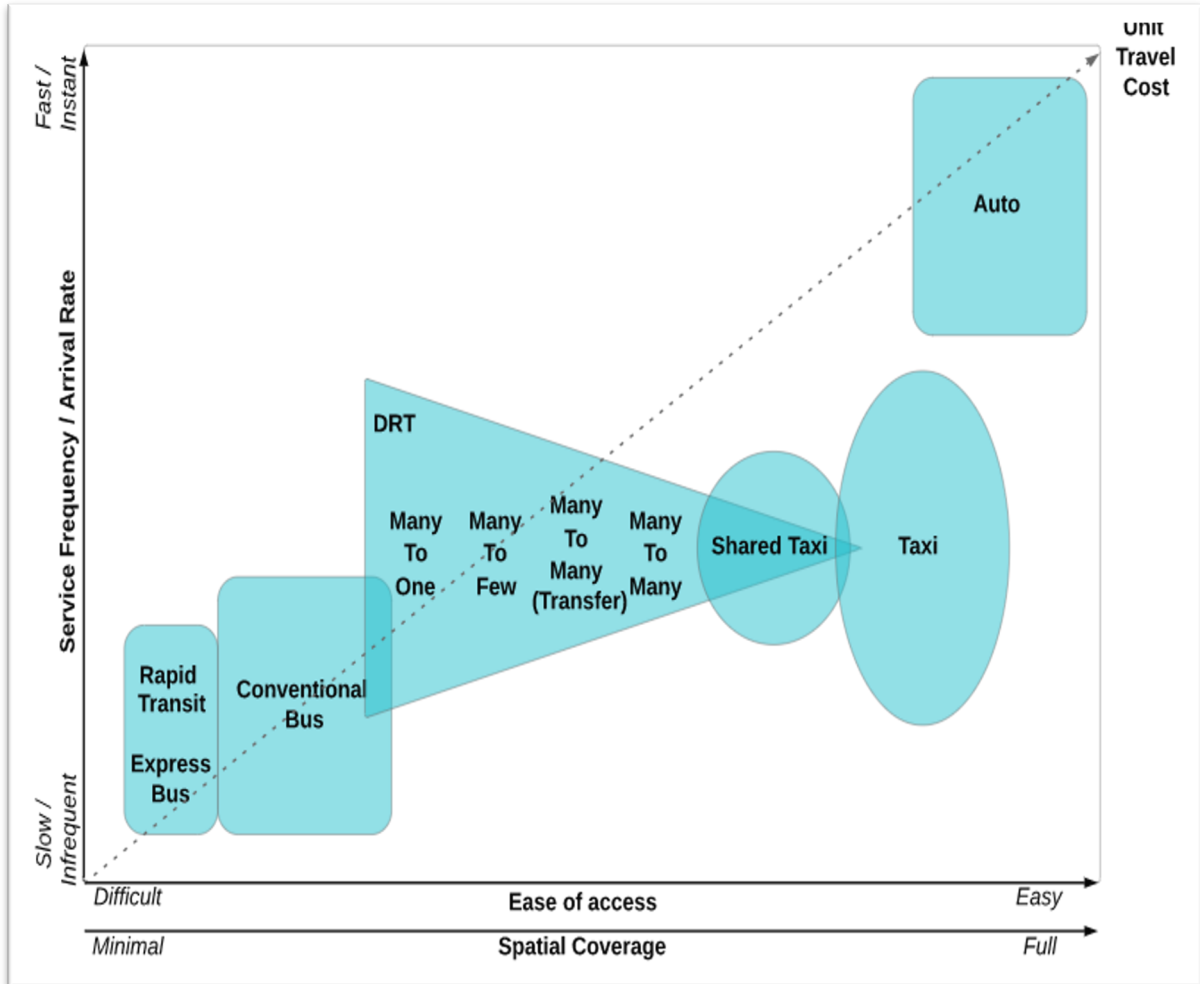


Figure 1: DRT in the Context of Frequency, Ease of Access and Coverage (D’Este et al, 1994)

One reason why commuters may face high prices is because governments lack an understanding of the costs and benefits of DRT services thus are apprehensive to provide subsidies for such services. They do not know if such subsidies would be a good use of public funds.

Another key barrier to users is the inability to learn and understand DRT services. This barrier can come from the need for some level of technological proficiency among users in order to access the DRT services. The barrier can also come from the complexity of the service, since DRT services are more complicated than fixed route service and less universally uniform in operations. Each service often varies from the next on different dimensions, thus users need to learn the different parameters of each individual service to be able to use it.

3.3 What RATIONALE/OBJECTIVES do DRT service seek to address? What is the ROLE of DRT in the transport ecosystem?

We adopt the 5 'E's objectives framework from Shelat et. al., 2017 in defining the objectives that DRT should fulfil. These five E's are effective mobility, efficient city, economy, environment and equity.



Figure 2: The 5 'E's framework (Shelat et. al, 2017)

Based on these objectives, we also develop, in Figure 3, a framework that recognises the different roles DRT plays in various spatial contexts. In the columns of Figure 3, we summarise spatial contexts from rural to urban, which coincides with where public transport services function to meet only social needs to where public transport relieves peak congestion, to where public transport serves as the primary mode for most residents of the area. In the rows, we define the spatial context from low to high regulation of DRT.

For example, in cities where public transport is available for the vast majority of trips, the role of DRT is to fill any remaining "gaps" where in the absence of public transport, the primary mode is single occupancy car trips by private vehicle or taxi. The type of trips that fall in this category include first-and-last mile transport, transport in low coverage pockets of the city and cross-corridor transport across areas of dispersed low density.

In rural or fringe areas with little to no public transport, DRT has a role in providing door-to-door service as well as transport for social needs such as people with disabilities, diminishing abilities (for example, the elderly) and the poor.

Based on the framework in Figure 3, we further summarise our conclusions as shown in Figure 4. Ultimately, we see the role of DRT services as providing service in locations and times where public transport service is below user requirements. In cities where public transport serves the majority of residents, DRT can serve all of the five E's. The primary target users are all current public transport users who may be at risk of converting to single-occupancy car-use due to the need or desire for greater transport flexibility. DRT may provide sufficient flexibility to apprehend such intents.

In cities where public transport serves to relieve peak-period congestion, DRT may serve a similar role of reducing congestion by encouraging single-occupancy car users to share. This will also improve environmental outcomes for such cities.

In rural and fringe areas, DRT serves the purpose of meeting social objectives such as providing mobility for those with low income, who are impaired, or geographically more isolated.

		Car Dominant		PT Dominant
		Social	Peak Congestion Relief	PT For Whole City Travel
	<b>Spatial Context</b>	Fringe/Rural	Many Service Gaps	Few Service Gaps
Developed Countries	<b>High Regulation</b>	• Door-to-Door	• Peak Only	• First-Last Mile

Figure 3: Objectives and Types of DRT services in various spatial and regulatory contexts  
 Source: Concept framework based on an idea from Nielsen et al (2005)

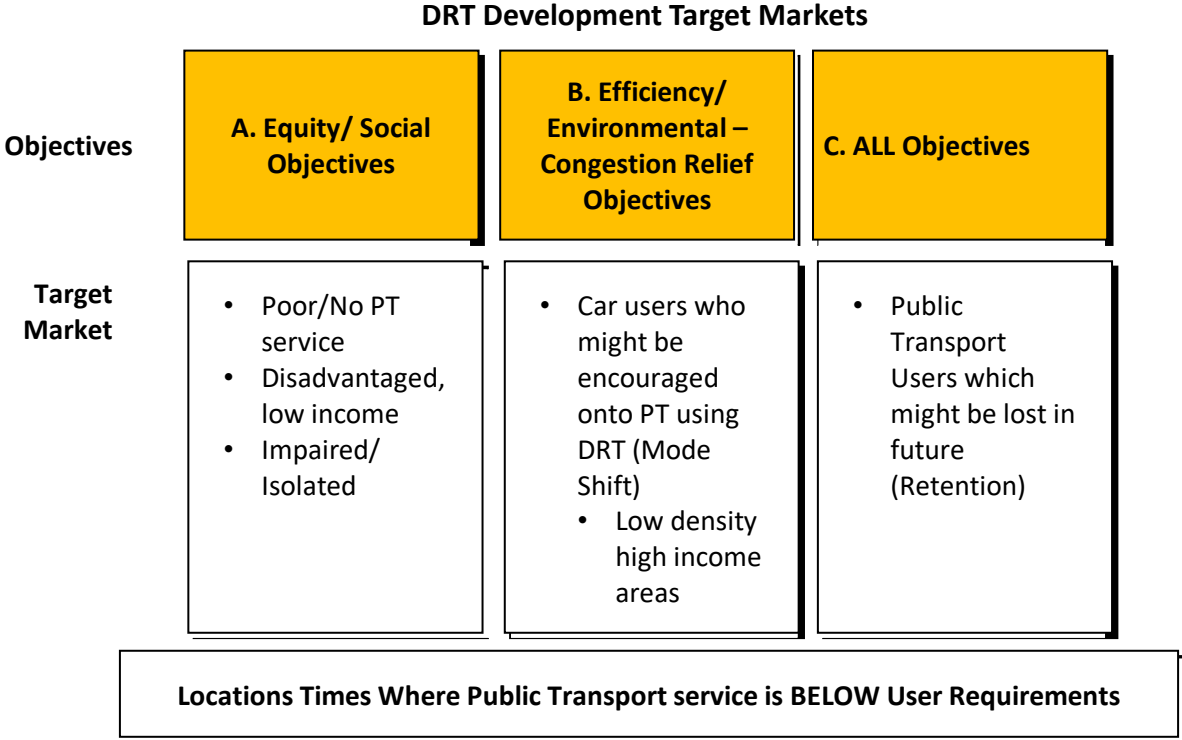


Figure 4: DRT Development Target Markets

**3 Recommendations**

We developed the following recommendations regarding DRT:

### **3.1 Policy**

- Policymakers should consider how DRT services could be integrated with other complementary transport modes through Mobility as a Service (MaaS) applications and/or a Flexible Agency for Mobility Service (FAMs). Such efforts will increase the demand of, and therefore viability of DRT services.
- Increased sharing of knowledge and experience on DRT services. This could be done through a centralised website that serves as a repository for DRT information.
- Policymakers embarking on any DRT project should begin with clearly defined objectives and sufficient resources to be able to achieve those objectives. There should also be a clear allocation of responsibility for the implementation of the project. Specifically, the roles of the public and private sector in the project should be clearly delineated.
- Policymakers should be pro-active rather than reactive with respect to DRT projects. This includes being well informed about advances in DRT technologies, ready to experiment with new DRT systems to meet user needs, and be equipped with the necessary knowledge to regulate DRT systems, in particular, privately operated DRT systems.
- In light of the inefficiencies associated with single-occupancy travel, namely, congestion, pollution and accidents, policymakers should limit such travel. Such policies would increase the demand for, and viability of, DRT services.
- In developing countries, there is a need for better coordination and regulation of DRT services to “formalise” currently informal DRT services in a manner that maximizes its benefits and minimizes social costs.

### **3.2 Research**

- A better understanding and greater quantification of the benefits of DRT services and the needs of users that can be fulfilled through DRT.
- Rigorous evaluation of DRT services post implementation, so that valuable lessons from DRT trials can be extracted and shared.
- Past and existing research on DRT should not be forgotten, but rather, used as starting points for new research. Researchers should develop ways to share and retain existing knowledge. There are clear examples from practice where lessons have not been learned and wheels are being reinvented.
- There needs to be better understanding of the user experience of DRT such as user perspectives on sharing and privacy.
- We need to identify conditions under which DRT may be attractive and sustainable, especially new conditions of which the sector may not yet be aware.
- We need to identify ways in which DRT could be used to shift commuters away from single occupancy vehicles.

### **3.3 Thredbo 17**

- The discussion should centre on how to design and operate more sustainable DRT services.
- Focus should be on evaluating and learning from the cost effectiveness of DRT services that have achieved sustainability.

- There should be a focus on new lessons regarding the conditions under which DRT is both attractive to users as well as more sustainable and effective.

#### **4. Conclusion**

In this workshop, we define and identify the opportunities for mainstreaming demand-responsive transit (DRT). DRT services are transport modes that are more flexible than fixed route and scheduled service in terms of any of three dimensions – route, timing/frequency of service, and vehicle type. DRT services should be in line with the 5 'E's objectives framework (Shelat et. al, 2017), namely effective mobility, efficient city, economy, environment and equity.

Given that DRT services are in their nature, an intermediary to fixed route services and fully flexible point-to-point transport by private cars, DRT has the potential to complement existing public transport services. DRT can meet transport needs that existing public transport services currently do not meet, and do so at a lower social cost than fully flexible transport options that currently dominate such spaces. Some examples of transport needs that DRT could fill include the transport of people with disabilities, the poor and people who need transport across lower density corridors where fixed route services are not viable.

Having identified the role that DRT can play in providing transport services, there remain obstacles to mainstreaming such services, in particular high costs of operation, high costs of adoption by users and apprehension among users about whether the DRT experience fits their needs. Policymakers, operators and researchers should concentrate efforts on lowering DRT operation costs, lowering user adoption costs, and formulating DRT services with the experience that best fits user needs.

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