Demand Responsive Transport

DETAILS

SECTOR | Transport and Energy

STAGE | Operations and Maintenance

TECHNOLOGIES | Passenger and Routing Platforms and Applications, New Vehicles (AV, EV, Shuttles)

SUMMARY

Demand Responsive Transport (DRT) are a flexible form of shared transport and infrastructure where the day-to-day service provision is shaped by the demand of the users. DRT does not follow a fixed timetable or route. Instead the most efficient route is calculated in response to user requests. DRT has characteristics of both buses and taxis but can take the form of a broad range of vehicular transport solutions; from familiar 'dial-a-ride' services typically booked by phone, to more recent dynamic applications that allow journeys to be booked through an application, adjusting the route to accommodate new pickup requests in almost real-time.

DRT is not a new concept. In developing countries, informal 'paratransit' systems are a significant form of urban transport. In developed countries, DRT had previously been employed as a rural community transport solution, used where conventional services do not exist, often due to their financial instability and requirement for heavy subsidisation. In response to the massive uptake of phone-based demand responsive solutions (e.g. Uber, Lyft, DiDi), cities are beginning to investigate how they can utilize DRT to improve shared use of public infrastructure, and the attractiveness and cost-efficiency of their public transport services.

Low frequency, low patronage transport services, which generally occur in sparsely populated areas or are due to under-developed transport service networks, must be heavily subsidised to maintain their service. These characteristics serve to encourage uptake of privately-owned cars for journeys. Due to the financial burden on local authorities, these services are at risk of being withdrawn. This would exacerbate the lack of accessibility to these areas with only those who can use privately-owned cars able to access the area, and in-turn increasing the physical road infrastructure load.

DRT can be used to solve an array of mobility related issues. They can act as first- and last-mile passenger and freight solutions particularly when combined with electrical infrastructure, as electric vehicles are suitable for short routes (*see also the Transition to Electric Vehicle Transport Networks and Electric Charging infrastructure use cases*). They can replace poor performing low frequency, low patronage services by shuttling users to the wider public transport network.

One prospective technological advance that is expected to greatly impact DRT are autonomous vehicles (AVs). With the introduction of AVs, user fares are anticipated to sharply decline as driver costs currently make up approximately 50% of DRT operational expenditure[1].

[1] "Going the Distance: Integrated Demand Responsive Transport in Cities", Arup, Accessed 15 May 2020.

VALUE CREATED

Improving efficiency and reducing costs:

- Replace low patronage routes with a dynamic service that responds to demand, which can reduce the overall costs of service delivery
- Reduce road deterioration and maintenance costs by increasing the number of economical vehicles on the road in place of heavier low patronage vehicles
- Reduce need for additional capital investment as use of existing road infrastructure can be optimized

Enhancing economic, social and environmental value:

- Reduce emissions by replacing inefficient fixed services with flexible, adaptable services that optimize service use
- Encourage mode shift from private car usage with convenient shared mobility options that are tailored to the user's specific needs

POLICY TOOLS AND LEVERS

Legislation and regulation: Strategic planning must be undertaken to decide on the provision of projects that will solve infrastructure gaps and future development requirements (modifying the use of parking, stops, stations, grid; monetising public infrastructure usage for private providers). Implement outcome-based regulation for the delivery of DRT services with a view to serve the integration policy and development/optimisation of mass transit infrastructure.

Effective institutions: Providers of DRT platforms and operators need to develop their solutions by taking a holistic view of the mobility ecosystem including network planning capabilities to improve machine learning and DRT dispatching algorithms. They must capture user expectations and utility preferences (as for Mobility as a Service (MaaS) – *see also the Mobility as a Service Use Case*) into their grouping algorithms.

Transition of workforce capabilities: Governments need strategic network planning, commercial and project management capabilities to understand and address the infrastructure gaps (physical, electrical and digital) to integrate such solutions with the provision of existing transport and energy services and develop the commercial framework to support the transition to outcomes-based delivery.

IMPLEMENTATION

Ease of Implementation

Local transport operators should make their data open source to enable innovation in this space. Without this data to draw upon, developing a service offering, including pinpointing areas of service and operations hours, will be unfeasible. As demonstrated in London, Citymapper's Smart Bus experienced several regulative hurdles that impeded the roll out and subsequent adaptation of their service offering. Regulations can act as a significant barrier to innovation and therefore local authorities should work in partnership with DRT operators to support new modes and operating models. The most successful rollouts to date have been well integrated into wider transport networks and provide first-and-last mile connections to train, metro and fixed bus lines.

Cost

Fundamentally the DRT business model relies on maximising vehicle occupancy. Many techniques to achieve this have been applied to ride-hailing fleets to increase the number of riders served by a given vehicle, such as operating during limited hours and locations during peak periods. Vehicle size and staffing are also key decisions, with driver pay making up 50% of the total DRT operations cost[2]. There are many opportunities for an established DRT service to capitalise on economies of scope, expanding to new customer segments.

Country Readiness

Demand responsive transport planning requires an understanding of the passenger demand and a viable solution on how the demand responsive services could respond to a dynamic demand. The more data there is about the demand, the easier it will be to plan the corresponding demand. Curbside/temporary parking drop-off-pick up demand and management should also be taken into whole of infrastructure strategic planning (this is not the case today and DRT services in some places cause major traffic disruptions).

Technological Maturity

Much of the technological elements of DRT already exist. The necessary algorithms to optimise routes based on user requests are already being employed by private mobility providers like Uber and DiDi, however they need to improve with machine learning to group more users. One prospective technological advance that is expected to greatly impact DRT is the autonomous vehicle (AV). With the introduction of AVs, user fares are anticipated to sharply decline as driver costs currently make up approximately 50% of DRT cost[3].

RISKS AND MITIGATIONS

Implementation risk

Risk: To ensure its viability, a DRT service must maintain its market penetration to be seen by the user as a 'go to' option instead of a temporary service. The user must be able to rely on the service. Long wait times or periods without service can lead users to favour alternate services.

Mitigation: To mitigate, the service offering should be flexible enough to be scaled up in response to growth in demand and to avoid spreading the fleet too thinly over a geographical area. The scaling up of the fleet will enable better optimization of vehicles, enabling users travelling the same direction to be allocated to a single vehicle. This will enable the high vehicle occupancy necessary to make the service cost effective.

[2] "Going the Distance: Integrated Demand Responsive Transport in Cities", Arup, Accessed 15 May 2020.

[3] "Going the Distance: Integrated Demand Responsive Transport in Cities", Arup, Accessed 15 May 2020.

Social risk

Risk: The public understanding of DRT is currently limited. Users have different expectations of the service or no knowledge at all. Current examples of DRT are typically implemented as niche services. They do not take into consideration integration with other modes in the wider transport network.

Mitigation: This integration with other modes creates a unique value offering for public and private stakeholders. Therefore, is it important that legislation does not hinder growth for innovations in this space. Governments should lead conversations with stakeholders to encourage collaboration for the public good. Communication and consultation with the public about the service and its role for the community can be an effective way of capturing user expectations and encouraging uptake.

Safety and (Cyber)security risk

Risk: Dynamic demand management relies on connected technologies to capture the relevant demand data. Therefore, risks related to data privacy and data sharing exist.

Mitigation: Those risks can be addressed through appropriate regulations on data privacy which ensure a secure system that protects user data privacy.

EXAMPLES

Example	Implementation	Cost	Timeframe
MOIA Hamburg	A co-operation between the city of Hamburg and Volkswagen, which now has a fleet of 450 EVs and approximately 7,000 stopping points. MOIA now also operates in Hanover.	An average ride costs between €6 and €7 per person.	The service has been operating since 2018. A major extension of the operating area and fleet was announced for March 2020.
Kutsuplus, Helsinki	Research started at Aalto University led to a pilot project that started in 2012. Helsinki Regional Transport Authority paid the drivers and operated the buses, which eventually grew to a fleet of 15. The project had two main objectives: to assess technological feasibility and user acceptance.	Kutsuplus was working towards being an economically feasible service. The average fare was €5 (~US$5.50) with an estimated two-thirds of their costs related to drivers' wages. Despite positive developments the small-scale operation needed substantial subsidies.	Launched in October 2012, Katsuplus ultimately ceased operations at the end of 2015, as it was deemed the cost to taxpayers was too high. The popular service was hindered by the investment cost required to scale up operations in order to optimize trips across the fleet.
Beeline, Singapore	Beeline was developed by the Infocomm Development Authority and Land Transport Authority. It was an application that enabled users to pre-book rides on express routes operated by private bus operators. The project aimed to explore how transport networks could be made to adapt to changing commuter demand.	The average fee per ride is between S$5 and S$6. Driver costs account for a significant amount of the operational costs.	Launched in 2015, with operations ultimately ceasing in January 2020. Like with the above examples, achieving the required fleet optimization requires a significant scale up in fleet size and geographical service offering. The LTA instead decided to redirect resources to their core transport offering in 2020, citing the high technology costs associated with the Beeline service.