**Shaping the New Future of Paratransit: An Agenda for Research and Practice**

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**ABSTRACT**

The TRB-sponsored International Paratransit Conference, “Shaping the New Future of Paratransit”, held in Monterey, CA in the United States (US) in October 2014 represented the first coming together of the international paratransit community in conference format since 1997. The conference itself drew a worldwide attendance from a cross-section of operators, technology providers, policymakers and researchers. The presentations from the conference were organised around a number of themes which, when brought together, represented a substantial manifesto for the flexible and demand responsive transport community. This paper looks at a number of these themes with an analysis to highlight the key points and common strands of worldwide experience.

**INTRODUCTION**

The 1970’s and 1980’s witnessed both substantial conceptual and practical interest in paratransit across Europe and North America, as well as widespread implementation of paratransit services and strategies. Subsequently, the trajectory of paratransit (also often referred to as flexible transport systems, particularly in Europe) has waned, to the point where it is frequently relegated to a very narrow niche (often related to special needs) in the spectrum of collective transport services. More recently, technological advances have made feasible new and/or improved approaches for organizing and delivering local passenger transportation and the delivery of transport to more than simply disability or older clients. This means that paratransit or flexible transport is playing a part in the development of sustainable options for the future. With practice, policy and research in paratransit now being impacted by these developments, it is increasingly clear that a new set of possibilities is emerging although at different speeds in different places.

This paper summarises the TRB-sponsored International Paratransit Conference, “Shaping the New Future of Paratransit”, held in Monterey, CA in the United States (US) in October 2014 which represented the first coming together of the international paratransit community in conference format since 1997. The purpose of this paper is to analyse the key issues raised in the papers presented at the conference to highlight key points and common strands of worldwide experience to provide a coherent statement of current practice and research.

**What in the world has been happening in the last 15 years?**

From a European perspective the development and large scale adaption of flexible transport is characterized by the growth of open and integrated Demand Responsive Transport (DRT) (1). Small and medium sized applications are also of interest since this is where most of the trips are being taken, often in the voluntary and informal sectors. Whilst DRT seems to have made considerable progress, DRT is still seen as less attractive by large public transport organizations since trip volumes are low compared to main-stream.

In many cases DRT is seen as a solution where trip volumes will be low such as Specialist Transport Services (STS) or rural transport services. Both of these require high subsidy levels and erode public transport financing. DRT in the Netherlands is a significant example. Regiotaxi Gelderland (2) is a mostly open DRT service that also provides STS. Services are tendered at the municipality level. There is a nationwide call centre with planning and dispatch contracted to operators. Passenger numbers have been declining (to about 1.7M / pass p.a.) as STS eligibility requirements are tightened.

DRT which is integrated and open also occurs in the US. For example in Denver (3), 0.5 million trips were made in 2013 using web-based services and automated scheduling. There is a strong focus on first and last mile within the context of service co-ordination to include American with Disabilities Act (ADA) and general public services (urban and rural) but here the key challenges include developing the business case, overcoming stakeholder resistance and the need to achieve jurisdictional equity in low demand areas.

*Flextur*, the Danish model (4) is attracting widespread interest. Almost all of the DRT is planned and co-ordinated in the same system and produces 5M trips/pa country-wide. This is an open DRT system with different user groups accommodated in the same vehicle. Services are offered on a route, corridor or door-to-door basis. *Flextur* has been used to replace conventional public transport services in many areas. Future plans include the introduction of a single ticket for the booking under the heading of “one booking, one combined travel, one ticket”.

DRT has matured in the last 15 years but remains a niche form of shared transportation. European examples (especially the Netherlands and Denmark) show how DRT can be up-scaled to regional and national level for delivery in an integrated and co-ordinated manner. Whilst “hybrid” services can be effective it remains necessary to convince people how to use them. The movement from government funded services to services provided by private companies (such as Transport Network Companies (TNCs) – discussed later) is an interesting development which needs a considered response from the public authorities.

**Paratransit Future Mobility and Lifestyle**

A variety of elements affect the demand side of paratransit and it is recognised that societal dynamics have a major impact on the demand for and perceived value of paratransit. Demographic change, evolving travel attitudes and choices, new technological innovations, consumer preference for ageing in community and the effects of past development patterns will profoundly influence the future of paratransit (5).

Older people remaining more active and younger people are demanding more transport, and for certain groups this means increased demand for paratransit. New technologies are introducing greater flexibility and control to persons influencing how they can move about, expanding the options for different mobility types (6). People are increasingly demanding mobility solutions that are customized, that translate into “on demand delivery”. This leads directly to and expands potential for paratransit, particularly as technological advances can address the demands of all age groups more effectively than in the past. This is discussed further below.

Paratransit in Germany has been in place since the 1980s complementing conventional public transport in areas and times of low demand. Paratransit is operated by taxi and private sector companies as subcontractors to public transport providers. In the social and health care sectors volunteers play an increasingly important role through Burgerbus – where “citizens drive citizens” (7). Burgerbus represents voluntary engagement with the local public transport sector, involving use of small buses and is reliant upon local organization. Established in 1985, there are now 250 schemes nation-wide. There is also lift-giving (rideshare) with private cars, for persons needing personal assistance, such as escorts. There is some special needs transportation, with lift-equipped vehicles, provided by volunteers. Volunteers address a continuing and growing need and responding to their motivations remains crucial for a successful outcome.

In developing countries the need for accessible transport has led to multiple paratransit types based on flexibility and creative entrepreneurship (8). Eighty percent of the world’s disabled persons live in Asia, Latin America and Africa where 90% of children with disabilities do not go to school and 80 - 90% of working age adults with disabilities are not employed. Paratransit responses include moto-taxis in Mexico, auto-rickshaws in Nigeria and Tanzania; three-wheelers in Ho Chi Minh City; and special prototypes in Ecuador, Peru, Columbia and Mexico. Most of Latin America’s moto-taxis have room for a folded wheelchair. Pedicabs and ciclo-taxis are other modes while non-motorized vehicles include India’s EcoCabs. There may be some potential for TNCs such as Uber, Lyft and Sidecar to play a role in providing accessible transport in less-wealthy countries; their responsibilities towards their ridership with disabilities are still evolving. Overall – smaller vehicles equal lower fares; cheaper cell phones can call the vehicle to the door; seat belts are needed to ensure a safer ride; lift-equipped vehicles or with the capacity to carry mobility aids are needed; driver training is needed to promote safety and courtesy.

How to identify the value and the real costs of the provision of paratransit in the context of larger policy topics remains a pressing question (9). Accessible transport can mean the difference between continuing in one’s own home versus moving into an institution. For society, the resource costs are only a part of the equation. Offsetting benefits includes quality of life measures, together with avoided costs, such as institutional care, and should be part of larger decision-making processes. Metrics must serve to identify the equivalent dollar value of social, economic and environmental benefits, even as they seek to balance various interests and tradeoffs. Developing along these multiple dimensions will serve to more strongly make the case for paratransit programmes and services.

Changing demographics world-wide with longer life expectancies, improved health care and new behaviours among older adults are driving the need for paratransport. The opportunities for technology are significant in supporting increased flexibility, in giving control to the individual (e.g. via text messaging for older persons), and in ensuring that resources are used with the greatest efficiency possible.

**The global variation in instItutional factors and their impact on delivering Accessible Transport via DRT**

Opportunities exist for close working between paratransit and other transit providers. One such example is Orange County Transportation Authority (OCTA) who established a complementary paratransit programme for fixed route (10). They have experienced rapid growth, explained by the implementation of policies to control costs, expanding options for ADA eligible individuals, providing incentives to use lower cost services and improving operating efficiencies through use of taxis. OCTA regulates taxi operations and sees taxis as a tool for paratransit growth management (e.g. through growth in accessible fleets).

An international perspective on policies and approaches to deliver accessible transportation can be valuable (11).. In Europe, there are national foci on making regular public transport more accessible. Definitions of persons with restricted mobility vary widely as do approaches towards enhancing the paratransit service model (e.g. use of taxis, number of senior rides permitted etc.). The impact of an inaccessible built environment on delivery of paratransit services is illustrated by experiences in Mexico City where the variety of building standards (alongside abandoned and neglected infrastructure) has a major impact on door-to-door services (12). The lack of drop-off areas for paratransit users at BRT stations is a particular example of the need to raise awareness of universal design principles.

An integrated approach to STS has been developed in the Netherlands (13). Municipalities are important providers of STS and work together to transport school children and elderly. There has been a move towards “Do it yourself (DIY) solutions” (e.g. giving your neighbour a lift). A stricter assessment of whether a person is in need of STS is still required and “kitchen table” conversations are advocated as a means of establishing user needs when scheduling day care activities and the associated transport. The importance of appropriate decision making when planning flexible transport services is a universal issue (14) with little current understanding of service costing and viability.

Impacts of multiple transportation programmes (there are more than 60 different US federal programmes that fund specialized and human service transportation) include inefficient service delivery, vehicles that may be under-utilized, variation in service quality, and lack of information about available services, particularly for those who seek the information and the transportation. Understanding the cost base remains critical together with the need to increase partnering with other organizations and other transportation providers in the community including taxis.

As an example, San Francisco’s public transportation agency (Muni Transit) has developed a network of services beyond the required ADA paratransit services (15). These include: (a) Taxi-based services (regulated by Muni), including service for riders using wheelchairs; (b) Group van service – prescheduled, door-to-door service for riders going to a single location; (c) Ageing and adult group van services – prescheduled door-to-door service for groups travelling to nutrition or similar publicly funded programmes; (d) “Shop-a-Round Service” – to grocery stores for seniors and people with disabilities’; and (e) Van Gogh Shuttle – group travel to cultural and social events. Effective services require a policy shift towards prioritizing “ageing in place,” meeting service gaps particularly for older adults, using mobility management tools to ensure individuals have knowledge and chose the best and most cost effective transport option, and collaboration with city agencies and community organizations.

More formally there are a variety of strategies for Mobility Management (16). In Monterey, for example, services beyond ADA paratransit are for seniors and low-income residents. Measures include removing structural barriers (sidewalks, curbs, cross-walks), financial barriers (cost of public transit and taxis), and bureaucracy that impedes resource sharing; advocacy (legislative and public policy); and transit-oriented community planning (including an industry Mobility Management Centre). In Alameda County more than $2M for mobility management programmes was raised by a half cent sales text. Measures include: volunteer drivers, co-ordinated travel training, senior shuttles, subsidized taxi, grocery return trips, senior housing shuttles, wheelchair/scooter breakdown service, hospital discharge programme.

Choosing the most appropriate contracting and service management approach is critical in delivering a service. In a study (17) to identify and assess alternative service delivery models to improve administration, efficiency, responsiveness and (possibly) reduce service costs, while maintaining the high service quality and customer satisfaction, the assessment factors were: adaptability; geography of service area; nature and volume of demand; Agency paratransit expertise; and impact on service quality. Lessons learned from working with service models with contracting (18) highlight the need for attention to the following: Contract Term(s), procurement notices and schedule, procurement process, Request for Proposals (RFP) structure, payment structures, incentives and penalties, proposal evaluation, scoring and awards. Accurate cost reporting provides the foundation necessary to ensure an equitable and accurate distribution of costs among all participating agencies (19). This requires appreciation of the factors affecting cost allocation and resource assignment; cost drivers (understanding how customer priorities can affect costs); and activity drivers (understanding how system procedures can affect costs). Introducing a feedback loop using Key Performance Indicators (KPIs) of quality and quantity is recommended. A number of issues remain including whether short or long contracts are better. This is linked to how risk is allocated – to the contractor or to the contracting body. It is clear that there is no one size that fits all and that all these issues need to be considered as principles underlying a contract which provides effective management of DRT services.

In designing a business model, a key focus is the need to accurately match service resources (driver shifts, vehicle deployed) to day-to-day demand in order to improve productivity and minimize unused capacity (20). A study by Deloitte compared business models currently in use to deliver DRT services in Denmark (21). Denmark has DRT programmes operating nationwide utilizing over 400 private operators with a total cost of about $750 million. Denmark makes use of two business models in delivering this service; the local model in which tendering (procurement) is conducted by individual municipalities and regions, and a co-ordinated model in which the tendering is managed by regional Public Transport Authorities (PTAs). There are 98 municipalities and 5 regions using the local model. The co-ordinated model is organized into five regional PTA's. The Deloitte study compared the cost effectiveness of the two approaches. The co-ordinated model showed a 15% savings versa the local model using both cost per kilometre and cost per minute measures.

Partnership is also important. Via Mobility Services, a non-profit door-to-door provider and the general public Call-N-Ride Service operated by the public transit provider has experience in co-ordinating trips and sharing resources in Longmont, Colorado. The project required co-ordination on the policy, operations and technology level (22). The overall goal was to allow these operations to transfer trip requests to partner agency vehicles that have unused capacity. The results were increased productivity for both services with plans to expand to include the ADA complementary paratransit system in the co-ordinated service.

Transport funding has historically occurred in silos. Funding is not increasing at the rate needed for ADA paratransit Non Emergency Medical Transport (NEMT). Co-ordination can provide more options for riders in one phone call and provides financial incentives for funding sources by spreading administrative costs among programmes. Developing partnerships among the various community organizations serving seniors and people with disabilities is a key theme, so that the responsibility for providing transportation is shared among the organizations. Contracting and the shape of contracts are important to provide transparency for operators and contracting parties alike. And for operators, having a secure and robust business model is essential for sustainability and cost effective delivery of service.

Accessibility is a multi-Agency issue and actions are required by transit Agencies and local authorities working together with service providers for successful outcomes. This is an approach that remains very variable, although more substantial progress can be found in Europe as compared with North America. In keeping with a greater focus on inter-Agency working education amongst all stakeholders is important if unnecessary tensions are to be avoided. This is also likely to encourage a move towards combined STS/open DRT where this is found to be appropriate.

**The building blocks – how to develop and maintain open and integrated DRT**

It is acknowledged that open access DRT schemes have great potential and that there are lessons to be learnt from working schemes that could help spread the message.

Clare Bus, Ireland (23) started in 2003 with funding from national government under the (then) Rural Transport Initiative. Clare Bus provides 4 types of service: “scheduled routes” with the ability to divert if needed; “scheduled early bird” where people (mainly commuters) make their own way to the route; “local shopper” to access shops, health care; and “community access”, filling the gap for community groups wanting transport for their members. The setup process included overcoming a number of challenges relating to vehicles, working in partnerships, improving the efficiency of booking scheduling and dispatch functions, fundraising and changes in the institutional frameworks. Clare Bus now operates over 170 services per week with 9 easy access buses.

In a much more urban setting, accessible transport services in Greater Manchester, UK, have developed over the past thirty years (24). Despite the sophistication of current service solutions continuing challenges have to be overcome, including the legacy of past limitations in respect of service design and the urban form. To-day there are two different DRT schemes in Greater Manchester: Ring and Ride (on demand door to door transportation) (approximately 900.000 passengers a year, carried out with 70 vehicles and 237 staff members) and *Local Link,* available to all residents in specific geographical areas where communities are at risk of social exclusion. *Local Link* is a mixed operation by Community Transport (57%) and taxi operators (43%). The focus is on employment trips.

The flexlines in Gothenburg are a well documented case (25) of an intermediate mode between STS and public transport. The flexlines provide accessible close to the door supply and, compared to dedicated STS, offer a more cost effective solution, with 4-6 passengers/bus-hour. Customer satisfaction is high (96% is very satisfied) and the drivers are an important factor of this. Currently, there are 20 service areas serving half a million population (urban/suburban) on an open to all basis with 300,000+ trips/year.

“Belbus” in Flanders (26) is considered as part of the public transport offer. The system replaces the scheduled off-peak routes or parts of them with low transport demand but is also a key instrument to meet the obligations imposed by legislation that states that each citizen is entitled to a minimal public transport package according to legal standards. The first DRT system was introduced in 1991 and has been expanding ever since. In 2014, "Belbus" covered 78% of Flanders, had 250 vehicles and carried 2 million passengers/year (of which 38% own a car).

A critical issue is how to make a combination of several schemes form an integrated and open DRT-system for all. Of those schemes discussed above, only Belbus was created directly as an integrated part of the public transport system with the others arising from the co-ordination of different types of special target groups’ transportation in one, open and accessible system. It is also the case that there appear to be many more examples in Europe than in the US. It is not clear whether this is simply learning from experience that is needed or whether there is something fundamentally different about frameworks in the US which appear to have flexible transport services start small and then build up – this is an area for further research. Experience confirms that building open systems needs time, research and much effort to make them work. Modern Information and Communications Technology (ICT) and personal devices provide new means to give passengers better information about (the planning of) their trips and this is discussed below.

**The Intersection of Healthcare and Transportation**

Recent years have produced the most sweeping restructuring in history of how healthcare is provided in the US. More medical care is now provided on an outpatient basis than ever before. Legislative changes, most notably the Affordable Care Act, have likewise reshaped how healthcare is administered and paid for. These seismic shifts impact how community and public transport provides access to doctor’s offices, regional medical facilities and other treatment facilities. NEMT is to outpatient care as ambulances are to emergency rooms – a fundamental element in the continuum of care with paratransitemerging as a key facilitator of access to health care for some population groups.

In the US, where ADA and NEMT intersect(37) Medicaid brokers are encouraging dually-eligible ADA customers to use ADA paratransit. This in turn increases demand and transit agencies become laden with high net subsidy. In Las Vegas demand for trips to subsidized employment centres was creating an unreasonable demand on the paratransit programme. The paratransit system found these trips could be paid for with funding from the Medicaid programme with the outcome that the plan reduced cost from $38/trip to $14/trip (28). This is replicated in many other states where transportation brokers operate NEMT programmes in order to help control costs and improve quality (29). Transit agencies and NEMT brokers work together to create efficiencies through data sharing, using data to develop and modify routes, adopting NEMT ridership to lower costs and promoting efficient use of vehicles by filling more seats and promoting prudent stewardship of taxpayer funding. Brokered models utilize networks of subcontracted transportation providers.

In Europe, healthcare workers directly call for and schedule many DRT trips. Benefits for staff include: quick access, easy to use, fast response-time, reliable system, high accuracy and few delays. In health care, timeliness is the key to efficient outcomes. Transport is a very small part of the health-care sector but an important building block in integrated large scale DRT (30).

With an ageing population, the relationship among paratransit providers, the healthcare sector and the NEMT brokers is important. Demand for NEMT transportation has grown and is outstripping the ability of communities to respond to the demand. More study of the impact this has on paratransit programmes and on developing new methods for providing this service is needed.

**Platforms/Architectures/Standards to facilitate open and integrated DRT**

As technology becomes more integral to the future evolution of DRT systems, particularly those using Mobility Management concepts involving multiple organizations and their (often different) software applications in a common scheme for providing transportation services, the issue of what is included in the core technology infrastructure becomes increasingly important. System architectures, technology platforms, and data standards increasingly determine what is possible to accomplish with DRT schemes designed to serve multiple entities and their riders. Only if the technology foundations are sufficient is it possible to implement innovations that improve the reach and cost-effectiveness of DRT services. The contention is that common data standards and robust technology-based service platforms and architectures are needed for technology’s benefits to proliferate rapidly in the DRT sector.

TCRP Web Only Document 62 (31) describes results of a study by O’Neill and Teal on data standards for mobility management. The document makes fundamental distinction between discovery data—data which describes a paratransit service (for service area boundaries, hours of service, etc.)—and transactional data, which is data that two or more computer systems would share as part of transactions involving multiple paratransit services and their providers. The TCRP study recommends starting with a minimum set of standards for a core set of data elements, and building from there. For transactional data, 51 data elements are identified as important, and 38 of those elements are considered to be mandatory. For discovery data, 14 data elements are identified as both important and essential. It is not yet clear where the leadership will come from to move the paratransit industry towards a standard in data requirements; Federal government has no legal authority to lead the way (32).

DRT information is typically not presented equally to fixed route information, and often cannot be found at all on public transport agency websites. This can be remedied (33). General Transit Feed Specifications (GTFS) has become the de facto data standard for fixed route services, and could be extended to DRT services for knowledge discovery purposes. There are such proposals but it is also necessary for applications to be developed and made available that use proposed standards, as this will facilitate the acceptance of GTFS standards by Google.

Sweden developed data standards for paratransit services called SUTI in the mid-1990’s. This was necessary because most paratransit service was provided by taxi companies who had taxi dispatch systems, and there was a need to integrate the paratransit services they provided to the public sector, which were based on shared ride operations and a different approach to resource optimization than conventional taxi services.

Again in Europe, FlexDenmark has presided over a 5-fold increase in DRT trips per day over the past 7 years, to nearly 18,000 trips per day. The Flex concept combines trips from many different authorities, with different service needs, into a single service delivery system. The platform allows authorities to adjust their level of service, optimise planning and calculate the cost of the service for each authority based on how much service is delivered to their clients (34). The platform uses data standards (based on XML) to communicate with other systems. The FlexDenmark platform manages both supply and demand, determines costs of service, and handles all transactions from the inception to the conclusion of the trip delivery process.

The common themes here are two-fold. First, recognition of the importance of data standards to enable sharing and display of discovery data and to facilitate actual transactions, as in Sweden and Denmark. Second, the importance of a holistic, platform-based approach when considering how to integrate services among a multiplicity of service sponsors and providers. The FlexDenmark platform, which provides such an integrated approach, also utilizes data standards, reinforcing the notion that platforms and standards are mutually reinforcing. The Flex Denmark platform and the successful business model for DRT it supports point to the importance of assessing and developing technology-enabled business models for service organization and delivery in North America and Europe as a key element in improving the viability of DRT services.

**Technology enabling innovative service concepts**

ICT technologies are making it possible to implement innovative services that can improve the cost-effectiveness of DRT systems and reinforce DRT’s contribution to social inclusion. The role of ICT, including recent enhancements (from open data and cloud solutions to the mobile connections and social media) offers much for existing DRT architecture and schemes. Yet, knowledge of past DRT experiences (especially in Europe and US) shows that technology is often used for simplifying the complexity of the problems and tends to be considered as the overall solution. Therefore it is important to analyze and define not only the contribution that ICT can provide to DRT service management, but also to identify the support conditions for successfully implementing the appropriate ICT tools.

As a US example, the service operating in Wake County (North Carolina) (35) features the “one call one click centre” platform (RouteMatch software, mobile data tablets, interactive website, etc.). Functions include management schemes for user booking, trip assignment to the different vendors, IVR role, web access functionalities and the mobile tablet for real-time service tracking. Call centre efficiency and organization are the main challenges. The point of view of a public transport operator working to share the main ICT systems and devices among regular public transport services and DRT services (operated by two different contracted operators) is illustrated by Laval (36). Solutions include the virtual taximeter (for paying the service at the right price), the passenger information system (mainly for addressing the uncertainty about waiting time at the pick-up point) and the mobile app (for the information on the public transport network at the bus stops). An innovative method for defining DRT service schemes on the basis of the mobility needs and transport is illustrated by Jefferson County Call-and-Ride area (37). Clustering analysis, time windows, appropriate checkpoints identification and the flexible mode choice have been considered. Future work on further sensitivity analysis is related to fleet size and capacity, user specific demand, user cost vs. operator cost function.

The new generation of ICT tools allow the development of an advanced cloud and modularity architecture with the objective to co-ordinate the main functionalities (ride management, booking, planning and dispatch) and decentralize the related control at local level (by web services, API and user devices, etc.) (38). But it is also important to be realistic and not provide a technology solution far in excess of what is needed.

One of the common issues emerging is the importance to “keep simple” the role of the ICT in the overall DRT system management and service provision. For the DRT architecture this means a consolidated central software platform able not only to support all the relevant DRT system functions (from booking and trip planning/assignment to the reporting and accountability) but also to co-ordinate the different actors involved in the DRT service provision. In this context, recent ICT innovations (mobile device, open data, large connectivity capacity, cloud architecture, etc.) could play a relevant role in increasing the overall information and accessibility of the user with respect to both the single DRT service and other public transport service options. This is discussed more below.

**Smart Connectivity Changes Everything**

Ubiquitous smartphones, mobile apps, big data, and cloud computing change the possibilities for paratransit. There are a number of different test projects underway that are investigating these possibilities.

 Simulations in research can help identify outcomes or solutions which cannot be trialled in real life. Research using a simulation of a DRT service that would allow travellers to choose among three modes, including minibus, taxi, and shared taxi and which dynamically optimizes the choices provided to travellers based on a mix of operator profit and consumer surplus. The simulation shows how economic welfare can be increased with little impact on profit. A test of the concept is planned for the Hino City district of Tokyo, on which the simulation is based (39).

 A pilot project is underway in Lawrence, Kansas to make “roadside ridesharing” (hitchhiking) a practical mode of travel by addressing the negative image of hitchhiking (40). Specific innovations include using smartphones to track riders and drivers, electronic payment via smartphone, branded destination signs, ID badges, and identification of safe locations.

The Kutsuplus pilot project in Helsinki is testing a new on-demand transportation concept (41). The service uses a fleet of minibuses to provide shared rides that are requested in real-time. No pre-ordering is required. Service is provided from near the origin to near the destination without transfers. Ordering and payment are by computer or smartphone. The ride request and dispatching process is cloud based and automated for scalability. A pilot operation using 15 vehicles and three operators in the Helsinki core area has worked well, but expansion is needed to determine if economies of scale can be achieved.

Advances in mobile communications and computing may enable new forms of on-demand transportation that make the original vision for paratransit of the 1970s feasible (42). Technology can shift the supply curve for on-demand service, enabling a higher level of service for a given generalized cost (or a lower cost to provide a given customer utility), shifting the supply-demand equilibrium to a higher demand level. Potential applications to public demand-responsive service include: assembling supply from multiple providers, dynamic service configuration, more seamless service booking and customer information, better scheduling, assembling a critical mass of travellers for niche markets, and use of data for improvements to service. Obstacles remain to achieving high enough demand densities for truly viable public services, but there are promising developments that give reason for optimism.

Successful applications of new technology have been demonstrated by TNCs (UberX and Lyft) and in dynamic carsharing (e.g. Car2Go) – can these be usefully implemented to improve the cost effectiveness and reach of DRT?Interest surrounds whether TNCs and carsharing have any environmental benefits, and whether the theoretical demand-responsive productivities that higher demand densities should enable will prove actually achievable in practice and how TNCs can be part of publically provided services, especially for those passengers with disabilities or without a smart phone. The most successful “new” services to date are private ones that do not provide public, shared-ride service, but may be useful to some customers of existing specialized paratransit services and these are discussed next.

**Using Entrepreneurial Service Providers to Achieve Public Objectives**

Entrepreneurship is a perspective – an attitude that fosters successful change. Creating an entrepreneurial environment and partnering with entrepreneurs can enable paratransit agencies to efficiently achieve and surpass key performance measures. Private entrepreneurial services offer important opportunities to public sector service organizers both in providing supply and also business practice.

Taxis account for one-third of San Francisco Muni’s paratransit services (43). Muni provides user-side subsidies for taxi rides, using swipe-card technology with debit accounts. This technology provides Muni with dashboard reporting and oversight capabilities and reduces the opportunity for fraud, at a greatly reduced administrative cost. In the 20 year history of this programme, the available taxi fleet is at 1,870, with 100 wheelchair-accessible vehicles. Rides are available on a same-day basis, the cost is comparatively low, and user satisfaction is high.

Motorcycle taxis - ‘motos’ – are a significant part of the transport network in Mexico City. This study (44) focused on the Chimalhuacán neighbourhood in Mexico City, a low-income high-crime area where most motos are controlled by political parties. However, the operating system is not transparent and former regulations were loosely followed, with consequent concerns for safety. Although since July 2014 motos have been operating illegally they could be sustainable and productive mode with appropriate reforms.

Jitneys were studied in three congested cities in Africa: Cape Town, Dar es Salaam and Nairobi (45). The paratransit mode share of total transit use in these cities is 45%, 98% and 87%, respectively. Understanding current conditions and analysing strategies to reform business models, operation practices and environment, the fleet, public institutions and governance could improve the potential for economic development as well as address congestion.

TNCs are seen as threatening current paratransit business models and services by their offer of innovative opportunities to meet demand (46). In some cities, TNCs are taking market share and attracting drivers from the taxi industry, reducing taxi capabilities to provide paratransit rides. As TNCs rely on smartphone technology, a large proportion of paratransit users are not yet able to access their services. Agencies sponsoring paratransit services also are concerned about TNC potential liability issues including insurance coverage and oversight of vehicle mechanical condition and accessibility, driver suitability and training, potential for discrimination, and rates. Against this, TNCs and related concepts can work for seniors and people with disabilities (47) with whom they are already popular, especially for short trips. However, from an authority point of view, TNCs do not own any fleet and a supply of private accessible vehicles is lacking; training and consistency are issues with non-professional drivers. The TNCs have therefore found the solution to the difficulties of raising capital by leveraging private capital in the delivery of their services. Moreover, TNC operations have to be self-sustaining as the subsidy framework excludes them. However, there are some promising possibilities for the future including partnership with other providers, city-purchased vouchers, and bulk credit purchases and education through long-term care facilities and community organizations.

The market is putting TNC entrepreneurs and supporters against those concerned about the ability to continue transporting seniors, low-income residents and people with disabilities without the ability to use taxis for rides that do not fit on a dedicated vehicle manifest. However there are enough examples, such as Muni and elsewhere showing that if the taxi industry business model cannot adjust to the competition from TNCs, taxis could potentially disappear or decline to the point that these users are left without demand options, and this would certainly be detrimental to disability transport. In the very near future, paratransit practitioners and regulators need to study both the economics of the business models behind each of these paratransit modes as well as the infrastructure and environmental factors required to support safe, convenient and efficient operations.

**CONCLUSIONS**

The international paratransit community is in good shape. The conference demonstrated that there is a need for an expanded definition of flexible transport that incorporates the developments in liftsharing, car sharing and TNC-related responses. As our understanding of mobility changes so paratransit, with its ability to address changing demand-side factors through applying a mix of effective technology, informed policy-level decision-making, flexibility in planning and response to local needs, can become part of the overall mobility offerings. Technology is a key enabler, but no more than that; we are learning to understand technologies role in generating different transport futures, including customised solutions tailored to the needs of different market segments.

The conference highlighted the opportunities for sharing learning experiences between the US and European players. For example, it is more common within Europe to enhance viability through the sharing of services between older people and people with other mobility needs, to provide a dispatching platform that serves multiple DRT providers (both older people and healthcare) and in the use of volunteers to provide bottom up input into a community based service. On the other hand, the US foundation in the disability sector is an area in which learning can transfer to the European sector. A common problem between most jurisdictions is the silo nature of funding for transport and innovative solutions are required to develop partnership working and business models that will allow paratransit to flourish.

Users play a key role in this sector and user-led solutions are a key factor in successful paratransit solutions. As producers as well as consumers of data, users contribute to the overall transit information ecosystem. Barriers to implementation remain a concern and whilst the industry may understand the barriers, the users do not necessarily know about them. Marketing of the product remains essential.

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