Demand Responsive Transportation & on-demand buses

Literature survey

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Databases: ASCE, Google Scholar, ResearchGate, TRID, TRB, TRR, ScienceDirect, Taylor & Francis, Springer, EBSCO.

Search Terms: On-demand buses, full demand service, customised bus, (China), paratransit (US), Demand Responsive Transportation (DRT), Demand Responsive Service (DRS), Dial-A-Ride Transit (DART), flexible transport services, dial-a-ride system, demand responsive transit, autonomous mobility on demand, customized bus service, many-to-many demand responsive transportation system, Dial-A-Ride Service.

1. A proposal of a transport system connecting demand responsive bus with mass transit

Uehara, K., Akamine, Y., Toma, N., Nerome, M. & Endo, S.
Consumer Electronics – Taiwan (ICCE-TW), 2014 IEEE International Conference

This paper describes a new transport system to promote use of public transit for reducing traffic congestions. In this system, people living in a suburban area can commute to a major urban area by the new demand responsive buses proposed by the authors and mass transits. The cooperation between the two transport modes provides reduction of the total trip time for passengers. The simulation results showed that the system users get a trip time reduction relative to existing demand responsive buses using the insertion heuristic for their path planning without connection of other transport modes. (IEEE Xplore)

2. A survey of Demand Responsive Transport in Great Britain

Davison, L., Enoch, M., Ryley, T., Quddus, M. & Wang, C.
Transport Policy, 2014, Vol. 31, pp. 47-54

Ever since the 1970s, Demand Responsive Transport (DRT) has been promoted as a transport solution in circumstances where more traditional services are not economically viable, although so far a range of barriers has prevented its widespread adoption. More recently, new developments in operational and vehicle technology, coupled with significant cuts to public transport subsidy budgets, promote a willingness to explore 'institutionally challenging' options such as integrating transport provision across a range of different

sectors. This has once more pushed the DRT concept forward as a possible option for saving money whilst retaining opportunities for accessibility. Accordingly, it is now useful to explore the current provision of DRT in Great Britain, in order to determine what type of services exist and to examine which are working well and why. Specifically, the paper draws on a national survey of DRT providers to examine the design, performance, rationale and likely futures of DRT schemes. Key findings suggest a growing role for stakeholders from the voluntary sector and the private sector, the latter resulting in a greater use of smaller vehicles. Linear regression models highlight that passenger numbers are influenced by the size of operation (in terms of seats offered) and by the use of smaller 'car' vehicles, particularly in rural areas. Increasingly, objectives highlight the importance of DRT in providing access and geographical coverage, though insufficient revenue presents a challenge in achieving this. The long term financial sustainability of such schemes continues to be questioned, with a limited number of schemes recognised as commercially sustainable. Naturally, therefore, cost and funding remain dominant concerns of DRT service providers. The organisational response to funding reductions has been diverse. The result is that DRT services have either been withdrawn or, in some cases, replaced conventional bus services due to DRT being a more cost-effective way of meeting local needs. (ScienceDirect)

3. Analysis of a new public-transport-service concept: Customized bus in China

Liu, T. & Ceder, A.
Transport Policy, 2015, Vol. 39, pp. 63-76

In recent years, an innovative mode of public transport (PT) service, known as customised bus (CB), has been springing up across China. This service, providing advanced, personalised and flexible demand-responsive PT, is offered to specific clientele, especially commuters. The present work analyses, for the first time, the evolution of this new PT concept across 30 Chinese cities where CB systems are currently in operation or under construction. Unlike conventional bus transit service, CB users are actively involved in various operational planning activities. CB personalises PT service by using interactive and integrated information platforms, such as internet website, telephone and smartphone. The analysis comprises three components: first, a comprehensive examination of the background of CB and its temporal and spatial distribution in China; second, an analysis of the operation-planning process, including elements of online demand collection, network route design, timetable development, vehicle scheduling, crew scheduling, real-time control, and fare design and collection: third, a summary of the results of the examination and analysis, presenting pros, cons and recommendations. The successful implementation of CB in China demonstrates that this new PT service concept can effectively meet the ever-increasing mobility needs of large populations nation-wide. Similarly, the present work can provide a valuable reference for policymakers, academic researchers, PT practitioners and others worldwide. (ScienceDirect)

4. Analysis of the global On Demand Bus transit market

Frost & Sullivan Institute, 2016

Delivering the convenience of taxis at a fraction of its costs along with the efficiency of the bus model, the on-demand bus transit model is expected to change the growth paradigm of the bus market as well as the entire public transit industry. Still in the growth phase, the

market is expected to gain significant prominence in markets across the globe. While North America is leading on the innovation front, emerging markets such as Asia-Pacific hold great potential. With business and revenue models constantly evolving, the on-demand bus market will robustly compete with other private transportation modes such as taxis, ride sharing, and carpooling. With the advent of autonomous vehicles, it is on-demand autonomous buses that are expected to gain precedence over other modes of transport, penetrating the transport industry strongly.

5. Crowdsensing-based transportation services — an analysis from business model and sustainability viewpoints

Heiskala, M., Jokinen, J. & Tinnilä, M.
Research in Transportation Business & Management, 2016, Vol. 18, pp. 38-48

Traffic and transportation are ongoing digitalisation. Travellers always carry smartphones everywhere they go. Smartphone-based crowd sensing can be used to collect and aggregate traffic information for services that contribute to smoother and more sustainable transportation and traffic — but only if the business model is profitable in the long-term. We analyse two existing crowd sensing services in traffic and transportation context (Waze, Moovit) and one being developed (Traffic Sense) using findings from business model (two-sided markets; data use), crowd sensing (technical overview, participant incentives), and transportation (efficiency, sustainable urban transportation) literature. Waze may alleviate traffic congestion by helping its millions of users to avoid traffic jams. Moovit makes public transport more attractive by making it easier and smoother to use for travellers. Traffic Sense service is developed in a research project. It uses crowd sensing to learn regular, multimodal routes of travellers. The information can be used to predict the general traffic and congestion levels based on the predicted intents of the crowd of travellers. Our contribution is to combine distinct but complementary viewpoints from two-sided markets, business models, crowd sensing, and transportation research to analyse the potential business and sustainability impacts of the emerging crowd sensing-based smart transportation services. (ScienceDirect)

6. Demand responsive transport: Towards best practice in rural applications

Grosso, S., Higgins, J., Mageean, J., Nelson, J., 2002

Demand Responsive Transport (DRT) is an intermediate form of transport, somewhere between bus and taxi and covers a wide range of transport services ranging from less formal community transport through to area-wide service networks. In recent years, the ability of DRT concepts to provide efficient, viable transport services has been greatly enhanced by the use of transport telematics and its successful demonstration in a variety of environments in EC-funded projects such as SAMPO and SAMPLUS. The potential of DRT has been further endorsed by the European Conference of Ministers of Transport (ECMT) in its resolution on accessible transport (July 2001). In the UK, the Government in its Ten Year Plan for transport has pledged to remove or (at least) relax constraints on the development of flexibly-routed bus services and to promote a greater role for community-based services, whilst recently-published research argues that flexible public transport services, provided by local authorities and bus operators in partnerships with employers, stores and leisure centres would help break down social exclusion. Additionally, the recent Rural White Paper contains proposals for the extension of fuel duty rebate (FDR) to community transport.

Finally, the recent successes of local authorities in winning substantial funding under the Rural (and indeed Urban) Bus Challenge programmes for the implementation of DRT confirms this new interest in flexible forms of transport. The paper begins with an introduction to Telematics-based DRT systems based upon organisation via Travel Dispatch Centres (TDCs) using booking and reservation systems which have the capacity to dynamically assign passengers to vehicles and optimise the routes. Automated Vehicle Locationing (AVL) systems are used to provide real-time information on the status and location of the fleet for the route optimising software. This paper concentrates on recent British experience and provides an introduction to rural examples of DRT drawing on case-studies from Gloucestershire, Lincolnshire, Surrey and West Sussex. In the main body of the paper a detailed description of on-going research in Northumberland is presented where the County Council is engaged in two DRT projects. Phone and Go is designing, demonstrating and evaluating DRT services at two locations in Northumberland; Click and Go is developing an internet-based system for pre-booking DRT (and other transport services) with special reference to health services. Current work is exploring the requirements for integrating the TDC with pre-trip planning facilities (such as the Northumberland Journey Planner) and real-time information generated by AVL and Automated Passenger Counting (APC) devices. The Northumberland experience points the way towards the concept of a Regional TDC with a multi-sectoral user base such as taxis, education, social services, patient transport services and community services. The paper concludes by identifying some key issues for policy-makers concerned with the future implementation of DRT in rural areas. (TRID)

7. Demand Responsive Transport: Towards the emergence of a new market segment

Brake, J., Nelson, J. & Wright, S.
Journal of Transport Geography, 2004, Vol. 12, No. 4, pp. 323-337

Investigates the recent British experience with telematics-based Demand Responsive Transport (DRT) services in rural areas. In recent years, the ability of DRT concepts to provide efficient, viable transport services has been greatly enhanced by the use of transport telematics as demonstrated in a variety of environments across Europe. The success of British local authorities in winning substantial funding under the Rural and Urban Bus Challenge programmes for the implementation of DRT has resulted in widespread interest in flexible forms of transport. It is thus timely to evaluate the impact of this substantial investment. Drawing on the experience of a number of UK schemes, the paper assesses the reasons for the new-found success of what is becoming a relatively well-accepted mode by concentrating on a variety of factors including: service characteristics (particularly route flexibility, flexibility of booking method and pre-booking regime), emerging markets and the overall contribution of DRT to increased social inclusion and inter-modality. Impediments to the development of DRT services are highlighted. The paper also discusses current research into the next generation of DRT services and concludes by identifying some key issues for policy-makers concerned with the future implementation of DRT services. (ScienceDirect)

8. Determining optimal buses for implementing demand response as an effective congestion management method

Dehnavi, E. & Abdi, H.
IEEE Transactions on Power Systems, 2017, Vol. 32, No. 2

Demand Response (DR) can be counted as an effective congestion management method in power systems. However, appointing the optimal buses for the demand response programs (DRPs) implementation is one of the main challenges for the power system operators. In this paper, a new procedure has been developed by which the optimal locations and times of DRPs implementation are determined. Optimal buses are identified based on the power transfer distribution factors (PTDFs), available transfer capability, and dynamic dc optimal power flow problem. Applying the developed method results in reducing lines' congestion, increasing customers, and independent system operator's benefits, improving load curve's characteristics, preventing line outages and black outs, and consequently increasing the network reliability. The proposed method has been applied on the IEEE 39-bus New England test system. Results indicate the effectiveness and practical benefits of the proposed method. (IEEE Xplore)

9. Determining the viability of a demand responsive transport system

Thompson, R., Sakulchariyalert, K. & Haasz, J.
Manuscript received January 30, 2010

Demand Responsive Transport systems providing a flexible point-to-point service based on casual requests are becoming more feasible due to developments in information and communication technologies such as mobile phones, global position systems as well as advances in optimisation methods. Since they promise to address some challenges of existing transport systems the question of their financial viability arises. This paper describes a model developed for investigating the financial viability of implementing a demand responsive transport system. This involves determining whether such a system can provide acceptable level of performance at reasonable cost.

10. Development and evaluation of new interface for registration of new bus stops for the on-demand bus system

Tsubouchi, K., Yamato, H. & Hiekata, K.
International Journal of Intelligent Transportation Systems Research, 2010, Vol. 8, No. 3, pp. 188-200

On-demand Bus is a new public transportation mode which has flexible schedule and flexible routes. Users can ride the bus only after making reservations. It is difficult for the On-demand Bus system without any operators to realise full demand typed service because there is no interaction between users and drivers to inform the concrete information about waiting spots. This paper proposes the new interface for On-demand Bus system through which users can register new bus stops by themselves. The developed interface, namely the developed system realises CSCW (computer-supported cooperative work), which is a collaboration with the Internet. By developing the new interface, the full demand typed On-demand Bus service is realised and users evaluate the service positively. (Springer Link)

11. Factors influencing productivity and operating cost of Demand Responsive Transit

Palmer, K., Dessouky, M. & Zhou, Z.
Transportation Research Part A: Policy and Practice, 2008, Vol. 42, No. 3, pp. 503-

Since the enactment of the Americans with Disabilities Act in 1991 operating expenses for demand responsive transit have more than doubled as demand for this mandated service has expanded. Many advanced technologies and management practices have been proposed and implemented to improve the efficiency of the service; but, evidence for the effectiveness of these actions has been based upon projections or small pilot studies. We present the results of a nationwide study involving 67 large transit agencies. We evaluate the impact of implemented technologies and practices upon productivity and operating cost. (ScienceDirect)

12. Planning Dial-a-Ride Services statistical and meta-modelling approach

Marković, N., Milinković, S., Schonfeld, P. & Drobnjak, Z.
Transportation Research Record: Journal of the Transportation Research Board, Vol. 2352

Accessibility of public transit is an important political and social objective for transit agencies across the world. To meet this objective, many transit agencies provide a specialised door-to-door transportation service, called "dial-a-ride" (DAR), for the elderly and disabled. Annual DAR ridership growth exceeding 5% is reported in many cities in the United States, and this trend is expected to continue because of the aging population. In response to increased ridership, DAR services have become the fastest growing fraction of many transit agency budgets. These trends motivate the development of models that support decision making in the planning of new DAR systems or expansion of existing systems. Several statistical models have been developed in the past decade that can be used to determine the necessary DAR system capacity. These models focus on peak period analyses and provide good fit when applied to simulated case studies. This study aimed to demonstrate the importance of considering the entire day of operations rather than only the peak period. Several factors were identified that have been omitted in the literature, and comprehensive statistical and meta-models were developed for determining DAR system capacity. The performance of two proposed models was assessed with real-world data from a DAR service. The proposed models are available to the general public through a web system that provides free decision support to practitioners involved in designing DAR systems. (TRB)

13. Efficacy of bus service reorganization utilising a hub-and-spoke topology and DRT to meet community needs: A case study of Tokigawa town

Yajima, M., Sakamoto, K. & Kubota, H.
IATSS Research, 2013, Vol. 37, No. 1, pp. 49-60

The purpose of this study is to verify the efficacy of a route/timetable reorganisation methodology focused on a hub-and-spoke schedule bus architecture as well as the introduction of demand responsive transport (DRT) in suburban or underpopulated areas in Japan to accommodate local requirements. We selected Tokigawa town for our reorganisation trial and there were many local characteristics that needed to be addressed, including town residents' demands for origins and destinations that were linearly arranged within the town but also scattered outside of the town, geographically far flung, and in this scenario, route reorganisation utilising a hub-and-spoke architecture proved effective. Particularly, by changing the timetable whereby long routes running longitudinally and across the town connected with spoke-style short routes, service frequency was increased

considerably without significantly increasing expenses. Also, by implementing a system to alternatively operate regular route buses and DRT with a fixed schedule and area for routes in the mountain area, bus availability for residents living in low traffic areas was successfully increased due to increased efficiencies. (ScienceDirect)

14. Implications of technological developments for Demand Responsive Transit

Teal, RF
Transportation Research Record, 1993, Vol. 1390, pp. 33-42

The initial development of demand responsive transit (DRT) in the early 1970s was highly ambitious technologically at the time. In fact, many of the early problems with dial-a-ride related to the cost and performance of the computer hardware and software technologies in use 20 years ago. As experience was gained with DRT, the technology for delivering this service became much simpler and relied much less, and in many cases not at all, on computers. In addition, during the past 10 years there has been a strong trend toward advance scheduling of trips on DRT systems, with ridership restricted to certain groups. This represents a fundamental shift away from the original premise of DRT, which was to provide an immediate response local transportation mode for the general public. Recent technological developments offer promise that DRT may be able to return to its technologically sophisticated roots, albeit at a much superior level of performance and cost-effectiveness. The advent of low-cost, high-performance computer hardware, generic data base systems, moderately priced scheduling and dispatching software, mobile computers, inexpensive card readers, hand-held data transfer devices, off-the-shelf automatic vehicle location technology, and electronic mapping software makes possible the development of DRT systems that are much more capable than the typical current system and yet are also relatively affordable. A few systems are now beginning to experiment with these new possibilities. As these efforts, and others, proceed along the development path, how DRT is organised and delivered is likely to change significantly, though gradually, from the current practice. (TRID)

15. Identifying potential market niches for Demand Responsive Transport

Davison, L., Enoch, M., Ryley, T., Quddus, M. & Wang, C.
Management, 2012, Vol. 3, pp. 50-61

In principle, Demand Responsive Transport services, or paratransit in US nomenclature, offer public transport providers a more flexible and potentially more cost effective delivery option than conventional bus services, particularly in situations of low demand. However in practice, there are many examples of promising DRT schemes that have failed, for a number of reasons. One recurring feature appears to be that the DRT operation introduced is not appropriate for the market served. This is due to a lack of knowledge as to what markets may be susceptible to DRT. This paper aims to help address this research gap by drawing on the findings of two qualitative research data collection efforts, exploratory in-depth interviews and focus groups, each including industry experts. Using a marketing framework, developments at the micro, meso and macro levels are explored to determine the circumstances necessary for developing ‘successful’ DRT market niches. Implications for managerial practice include integration of services to improve market penetration and in responding to market development opportunities aimed at the general public. Technology

plays the greatest role in responding to market niche demand, primarily in enabling flexible booking and providing real time information, supporting market development, product development and diversification opportunities. (ScienceDirect)

16. Innovative on-demand bus system in Japan

Tsubouchi, K., Yamato, H. & Hiekata, K.
IET Digital Library, 2010, Vol. 4, No. 4, pp. 270-279

The innovative on-demand bus system is developed and the result of field tests shows that the system is valid for different city types. On-demand is a demand-responsive transit service where the vehicles transport users after they reserve their seats, and the vehicle does not move if there is no reservation. On-demand bus is an existing technology and it runs all over the world, but the high running cost is a problem. The aim of the developed system is practical introduction of the system from cost viewpoint. Local government can start the service in low cost with cloud computing technology. In order to build up the cloud computing system, schedule calculation system and the communication device in the car are required. In order to validate the developed system, simulation and field test are held. The result of computer simulation shows that the developed calculation algorithm works well as designed. The result of field test shows that the on-demand bus service in three different type cities are provided through the Internet with cloud computing technology and it is evaluated to enable new public transportation system. (IET Digital Library)

17. Location recommendation based on location history and spatio-temporal correlations for an on-demand bus system

Raymond, R., Sugiura, T. & Tsubouchi, K.
GIS 2011 Proceedings of the 19th ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems, 2011, pp. 377-380

An on-demand bus is like a shared taxi that operates only when riders want to travel between the origin and destination locations. It offers many advantages over fixed-route buses, but the riders are bothered by the need to tediously enter such data as origins, destinations, and deadlines. A location recommendation system that predicts such data would help riders during the reservation process and help target potential riders when buses are idle. In this paper, a general and scalable framework for such location recommendation algorithms is presented. It is based on users' location histories and spatio-temporal correlations among the locations by combining prediction methods of the collaborative filtering algorithms, which are widely used in e-commerce, with a popular method in data mining called link propagation. Experiments on real-world data demonstrate that the accuracy of recommendations with the spatio-temporal information is better than those without. (ACM Digital Library)

18. Multilevel modelling of Demand Responsive Transport (DRT) trips in Greater Manchester based on area-wide socio-economic data

Wang, C., Quddus, M., Enoch, M., Ryley, T. & Davison, L.
Transportation, 2014, Vol. 41, No. 3, pp. 589-610

Providing public transport in areas of low demand has long proved to be a challenge to policy makers and practitioners. With the developing economic, social and environmental trends, there is pressure for alternative solutions to the policy of subsidising conventional

bus services. One potential solution is to adopt more flexible routes and/or timetables to better match the required demand. Therefore such 'on demand' or 'Demand Responsive Transport' (DRT) services (known as paratransit in the US) have been adopted in a number of locations. This paper seeks to explore the effects of area-wide factors on the demand of DRT by reporting the results of a statistical analysis of DRT service provision in the metropolitan region of Greater Manchester, the public transport authority of which offers one of the largest and most diverse range of DRT schemes in the UK. Specifically, this paper employs a multilevel modelling approach to investigate the impact of both DRT supply-oriented factors at the service area level and socio-economic factors at the lower super output area (LSOA) level on the average number of trips made by DRT per year. This hierarchical or 'nested' structure was adopted because typically the LSOAs within the same Service Area may share similar characteristics. It is found that the demand for DRT services was higher in areas with low car ownership, low population density, high proportion of white people, and high levels of social deprivation, measured in terms of income, employment, education, housing and services, health and disability, and living environment. (Springer Link)

19. Operational strategy of demand buses, using self-organizing map

Watanabe, T. & Uesugi, K.
Communications in Computer and Information Science, 2010, Vol. 112, pp. 46-56

The demand bus provides interesting moving means as one of new transportation systems, and the research issues about operational strategies of this demand bus system have focused on the trade-off problem between convenience and profit. However, the traditional researches have analysed the local features of demand bus systems because the strictly limited parameters are used to make its analysis means clear, but could not make the operational strategy of transportation systems explicit from a global point of view. In this paper, we propose a framework to deal with various parameters with a view to estimating the relationship between operational method and service area. Our framework consists of analysis phase and visualisation phase. In the analysis phase, we construct common database from many experimental data, generated analytically from the computations among several parameters. In the visualisation phase, we visualise the features about operational method and service area, based on the relationships among parameters. In our framework it is possible to evaluate the adaptability of bus systems with respect to operational method and service area globally. (Springer Link)

20. Optimization of transport plan for on-demand bus system using electrical vehicles

Kawamura, K. & Mukai, N.
KES 2009: Knowledge-Based and Intelligent Information and Engineering Systems, 2009, Vol. 5712, pp. 656-663

An on-demand bus system is now attracting attention as an alternative transport system for traditional fixed-route bus in Japan. In the on-demand bus system, buses transport customers door-to-door according to users' demands, a user can freely specify the position of bus stop in its service area, and the desired time to get the buses. In this paper, we propose a model of the on-demand bus system using electrical vehicles and evaluate its feasibility by computer simulation. The characteristics of the electric vehicles are not considered in the past researches for on-demand bus problem. The improper charge timing

decreases the acceptable rate of demands, and the lack of battery charge may occur while the vehicle is moving. In order to avoid such problems, we adopt the genetic algorithm to optimise transport plans. Simulation results showed that our transport model succeeded in the reduction of carbon-dioxide emissions by 80% and the running cost by 60% compared with traditional systems. (Springer Link)

21. Optimizing Dial-A-Ride services in Maryland: Benefits of computerized routing and scheduling

Markovića, N., Nairb, R., Schonfelda, P., Miller-Hooksa, E. & Mohebbic, M.
Transportation Research Part C: Emerging Technologies, 2015, Vol. 55, June 2015, pp. 156-165

This paper reports on a system developed to address the dial-a-ride problem and an implementation for Maryland where real-world practical constraints are considered in providing customised vehicle routing and scheduling for about 450 trip requests daily. The system, called Mobile Resource Management System (MRMS), allows for dispatch operators to quickly study different operational scenarios and, in a strategic setting, explore trade-offs between level-of-service and various system characteristics, including fleet composition, fleet size and dispatch rules. Such insights play a key role in making long-term investment decisions or estimating cost of servicing contracts that have service level agreements. Test comparison of manual and MRMS-based routes indicated an estimated annual operational expense reduction of $0.82 million, or about 18% of the total annual expense. In addition to the cost benefits, improved quality of service and the reduction in total vehicle-kilometres travelled leading to environmental benefits are demonstrated. (ScienceDirect)

22. Passenger demand prediction on bus services

Zho, C., Dai, P. & Zhang, Z.
Green Computing and Internet of Things (ICGCIoT), 2015 International Conference

Public transport, especially the bus transport, can reduce the private car usage and fuel consumption, and alleviate traffic congestion. However, when traveling with buses, the travellers not only care about the waiting time, but also care about the crowdedness in the bus itself. Excessively overcrowded bus may drive away the anxious travellers and make them reluctant to take buses. So accurate, real-time and reliable passenger demand prediction becomes necessary, which can help determine the bus headway and reduce the waiting time of passengers. However, there are three major challenges for predicting the passenger demand on bus services: inhomogeneous, seasonal bursty periods and periodicities. To overcome the challenges, we propose three predictive models and further take a data stream ensemble framework to predict the number of passengers. We develop an experiment over a 22-week period. The evaluation results suggest that the proposed method achieves outstanding prediction accuracy among 86,411 passenger demands on bus services, more than 78% of them are accurately forecasted. (IEEE Xplore)

23. How to Plan and Run Flexible and Demand Responsive Transport Guidance

Derek Halden Consultancy, the TAS Partnership and the University of Aberdeen: Transport Research Series

This report describes the findings of research commissioned by the Scottish Executive to review evidence on demand responsive transport (DRT) delivery. It considers the contribution that DRT can make to social inclusion and accessibility, explores the impact of pilot DRY schemes, makes recommendations on how future DRT schemes could be developed in Scotland and develops best practice guidance. It is considered that DRT cannot be planned in isolation from other transport. DRT development should form an essential part of an overall transport and accessibility plan, showing how each market including commercial taxis is being developed. DRT markets overlap, so the strengthening of one market may transfer trips away from others. Patient transport presents particular problems, and there are several possible ways to structure this in the future to ensure that people are not excluded from health care due to poor accessibility. Financing, improvement of services and continuance of existing pilot projects are discussed. Case studies of services are provided. (TRID)

24. Performance meta-models for dial-a-ride services with time constraints

Luo, Y. & Schonfeld, P.
Transportation Research Board 90th Annual Meeting, 2011

Explicit performance models of a transit system are often very useful for system design, optimisation, alternative comparison, and gaining insights into relevant system relations. In this paper, three performance meta models have been developed for many-to-many dial-a-ride service, in which flexible routes and schedules are provided and service quality is guaranteed by time constraints. The models predict minimum vehicle fleet size requirements, the average deviations from service times desired by passengers and the average passenger ride time ratios. A simulation-based response surface methodology is used to model the functional relations between performance and contributing factors through experiments and statistical analysis. A detailed vehicle routing and scheduling algorithm and passenger time constraints, which are oversimplified or omitted in most other analytical approaches, are incorporated in the simulation experiments from whose results our models are statistically estimated. A face-centred central composite design is used to determine the experiment design points. The metamodels are validated using an additional set of randomly generated data. The resulting models are relatively simple in structure, inexpensive to use and fairly robust. (TRID)

25. Route optimization using Q-learning for On-Demand bus systems

Mukai, N., Watanabe, T. & Feng, J.
International Conference on Knowledge-Based and Intelligent Information and Engineering Systems, 2008, Vol. 5178, pp. 567-574

In this paper, we focus on a new transport service called on-demand bus system. A major feature of the system is that buses pick up customers door-to-door when needed or required. Thus, there is no pre-determined travel routes for buses, and travel routes must be changed according to the occurrence frequency of customers. In order to find a more effective travel plan to the problem, we adopt Q-learning which is one of the machine learning algorithms. However, native Q-learning is inadequate to our target problem because the number of customers at pick-up points is time-dependent. Therefore, we improve an update process of Q values and a selection process of the next pick-up point, on the basis of time passage parameters. In particular, rewards are understated in update

process; on the other hand, Q values are overstated in selection process. At the last, we report our simulation results and show the effectiveness of our algorithm for the problem. (Springer Link)

26. Scheduling algorithm for On-Demand Bus system

Tsubouchi, K., Hiekata, K. & Yamato, H.
Information Technology: New Generations, 2009. ITNG '09. Sixth International Conference

On-Demand Bus is a Demand Responsive Transit (DRT) service that passengers will be transported by the vehicles after they reserve a seat. The vehicle won't move if there is no reservation and the efficiency is expected as a new transportation service. It allows potential passengers to request service via the Internet or mobile phone, with requests for ride being processed by a server computer. The requests compose of pick-up location, delivery location and desired delivery time (or pick-up time). The computer executes two main algorithms which are vehicle-choosing algorithm and routing algorithm. Using the vehicle-choosing algorithm was used for decision about which vehicle will accept the new request. And the routing algorithm was used to design the new route and schedule for the vehicle chosen to serve the new request. After calculation, the system will report to the customer whether the request is accepted or not. If it is accepted, the vehicle will pick up and deliver him to his destination within a guaranteed time – not later than the desired delivery time (or not earlier than pick-up time). We also carried out an experiment to evaluate the developed algorithm worked as we designed. (IEEE Xplore)

27. Synthesis of information related to transit practices. Topic SB-30. Current practices in providing Demand-Response transit

Mariela, G.
RiP Project 41691, 2017

In the last several years, a number of public agencies have decided to provide demand-response transit service - either on-demand with a particular technology solution or near-term scheduled transit service for point to point travel. This trip could occur from a targeted service area to targeted service areas, point to point, or from a particular location only to a particular transit centre or transit stop. Distinct from agencies that have decided to partner with Transportation Network Companies like Uber or Lyft, or that have partnered with private transportation companies like Chariot, many agencies have decided to provide this service either with their own-vehicles or through a traditional transit contractor (like Transdev or Keolis) to maintain better control over performance standards and cost per ride. Providing demand-response type service is not new, but the emergence of new technology platforms and the ubiquity of smartphone access has made the possibility of demand-response transit to be more operationally feasible and more viable from a revenue perspective than in the past. The goal of this study is to provide an overview of the current state of practice regarding the experiences of transit agencies that are currently deploying or have deployed this type of service in the past and will gather information on the following (not an exhaustive list): (1) vehicle type (and how that decision was made); (2) labour arrangements - whether service was provided in-house or contracted out through a traditional transit vendor; (3) What service areas, routing and other requirements are provided, and what methodology was used to determine them?; (4) What technology platforms they may have used to deploy these vehicles, and how they have accommodated those who don't use

these platforms?; (5) cost and revenue projections and actual results; (6) performance metrics; and (7) marketing and outreach efforts Information will be gathered by a literature review (e.g. agency reports, peer reviewed journal articles, web articles) and a survey on a broad range of North American transit agencies. The report should include case examples that will gather information on the state-of-the-practice, emphasising lessons learned, current practices, challenges, and gaps. Suggestions for case examples include: (1) Hillsborough Area Regional Transit Authority's HyperLink; (2) Santa Monica Big Blue Bus (Blue at Night); (3) Santa Clara Valley Transportation Authority (VTA) Flex; (4) Alameda-Contra Costa Transit Flex; (5) KCATA (Bridj pilot and now RideKC); and (6) Dallas Area Rapid Transit FLEX A discussion on future research and gaps of information shall also be included in the report. (TRID)

28. The impact of socio-economic factors on the demand for demand responsive transport (DRT) in Greater Manchester: a multilevel modelling approach

Wang, C., Quddus, M., Enoch, M., Ryley, T. & Davison, L.
Transportation Research Board 91st Annual Meeting, Publication date: 2012

Providing public transport in areas of low demand has long proved a challenge to policy makers and practitioners, and with developing economic, social and environmental trends then the pressure for alternative solutions to subsidising conventional bus services. One potential solution is to adopt more flexible routes and/or timetables to better match the required demand. Therefore such on-demand or DRT services (known as paratransit in the U.S.) have been adopted. This paper seeks to explore the effects of area-wide factors on the demand of DRT by reporting the results of a quantitative analysis of DRT service provision in the metropolitan region of Greater Manchester, the public transport authority of which offers one of the largest and most diverse range of DRT schemes in the UK. Specifically, this paper employed a multilevel modelling approach to investigate the impact of various socio-economic factors on the DRT trip generation. It is found that the demand of DRT service was high in areas with low population density, high proportion of white people and high levels of deprivation. (TRID)

29. The key contributing factors of customized shuttle bus in rush hour: a case study in Harbin City

Cao, Y. & Wang, J.
Procedia Engineering, 2016, Vol. 137, pp. 478-486

Recently, the policy to reduce private car sharing and switch the private car users to public transportation has gained much attention. Research has shown the accordance that developing public transportation to promote sustainable transportation. However, sometimes the subway and bus transit with high congestion level do not match the comfortable degree of demand, and the transit with fixed routes cannot satisfy the flexibility of transport. Hence, the customised shuttle bus becomes a new way of public transportation. Most studies on the implementation and application of customised shuttle bus are only for large cities. However, limited studies have been conducted on the key contributing factors of customised shuttle bus in medium city. In this paper, Harbin City, the capital city of Heilongjiang Province, is selected as the case study. The contingent valuable method is employed and 332 individuals complete in the SP (Stated Preference) and RP (Revealed Preference) survey to measure the individual willingness to choose customised shuttle bus. Key contributing

factors that are expected to influence customised shuttle bus are analysed by logistic regressions. The results show that there are four key contributing factors that influence people to choose customised shuttle bus, which are private car, distance between home and work place, travel satisfaction level and work overtime. Finally, some suitable proposals for the implementation of customised shuttle bus are proposed, which are helpful to make public transportation policy in Harbin and other developing cities. (ScienceDirect)

30. The passenger demand prediction model on bus networks

Zhou, C., Dai, P. & Li, R.
Data Mining Workshops (ICDMW), 2013 IEEE 13th International Conference

Public transport, especially the bus transport, can reduce the private car usage and fuel consumption, and alleviate traffic congestion. However, when traveling with buses, the travellers not only care about the waiting time, but also care about the crowdedness in the bus. Excessively overcrowded bus may drive away the anxious travellers and make them reluctant to take buses. So accurate, real-time and reliable passenger demand prediction becomes necessary, which can help determine the bus headway and help reduce the waiting time of passengers. There are three major challenges for predicting the passenger demand on bus services: inhomogeneous, seasonal bursty periods and periodicities. To overcome the challenges, we propose three predictive models and further take a data stream ensemble framework to predict the number of passengers. Our performance study based on a real dataset of five months' bus data demonstrates that our approach is quite effective: among 86,411 passenger demands on bus services, more than 78% of them are accurately forecasted. (IEEE Xplore)

31. Traveller response to innovative personalized demand-responsive transit in the San Francisco Bay Area

Khattak, A. & Yim, Y.
Journal of Urban Planning and Development, 2004, Vol. 130, No. 1

Urban sprawl makes conventional transit less competitive and points to the need for more innovative and flexible demand-responsive transit systems in the future. To increase their efficiency, such systems can take advantage of the emerging advanced public transportation systems technologies, e.g., vehicle location and information systems. However, little is known about how consumers might respond to such systems and what they desire. This paper explores the demand for a consumer-oriented Personalized Demand-Responsive Transit (PDRT) service in the San Francisco Bay Area. Such a system could provide services to the traveling public for journeys to work and to non-work destinations. Results from six focus group meetings and a computer-assisted telephone survey of commuters and non-commuters are reported. While about 60% of those surveyed were willing to consider PDRT as an option, about 12% reported that they were “very likely” to use PDRT (N=1,000).(N=1,000). Many were willing to pay for the service and valued highly the flexibility in scheduling the service. Spatial analysis of the survey responses suggests localities where a PDRT may be field-tested. (ASCE)

32. Traveller willingness to use flexible transit services in China: Case study of Qilu Software Park

Yu, J., Xiaolin, L., Shuliang, P. & Chen, G.

Journal of Urban Planning and Development, 2017, Vol. 143, No. 2

This paper examines traveller's willingness to use flexible transit services prior to their deployment in Chinese cities. A total of 2,403 samples were collected in Jinan Qilu Software Park (the Park) by a self-reported questionnaire survey, which include three types of questions, namely, questions on demographic information, public transit customer satisfaction, and flexible transit service–related information. Through correlation and spatial analyses of travel characteristics and profiles of potential flexible transit service users, this paper reaches the following research findings: (1) around 60% of the respondents in the Park are willing to use a flexible transit service. Women, enterprise employees, and people with higher education and income levels are more willing to use a flexible transit service; (2) respondents are willing to pay an average fare of 4 Chinese Yuan (0.60 U.S. dollars equivalent) per trip to use a flexible transit service; and (3) respondents express a higher preference (65.5%) for a service that has the fixed-route attribute but with easy-to-access locations for pick-up/drop-off points. In addition, different types of flexible transit services are needed to accommodate specific spatial and temporal travel attributes of users. (TRID)

33. Why do demand responsive transport systems fail?

Enoch, M., Potter, S., Parkhurst, G. & Smith, M.
Transportation Research Board 85th Annual Meeting, 2006

In developed countries, Demand Responsive Transport (DRT) (loosely termed 'paratransit' in US parlance) emerged in the 1970s to serve the specialist niche market of people with mobility difficulties. DRT systems are starting become a mainstream public transport mode and this paper examines mainstream public transport DRT schemes from around the world that have failed, in order to identify the reasons for failure, and draw lessons to help prevent similar outcomes occurring. Research for the Inter-mode study developed detailed cases of 72 DRT projects. A number of key failed cases are reported together with a note of the lessons that each provides. This is followed by a generic analysis of failure factors based on a marketing approach. It is concluded that DRT projects are often not realistically costed or designed with a full understanding of the market they are to serve. There is a very dangerous temptation to offer too flexible a service and to include costly technological systems, when they may not be needed. An incremental approach, if possible, appears sensible. DRT also requires more marketing effort and skills than is traditional in conventional bus operations, but above all, it requires new skills in working in partnership. It is concluded that the latter area is where the root of DRT failure is often to be found.