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WHY DO DEMAND RESPONSIVE TRANSPORT SYSTEMS FAIL?

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ABSTRACT

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 *Intermode* 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.

(1) INTRODUCTION

Increasingly, conventional bus services do not meet the needs of a large section of the population due to increasing incomes and car ownership levels and the resulting dispersal of activity centres and trip patterns. One solution is public transport systems that can operate effectively with lower and more dispersed patterns of demand than the bus, i.e. paratransit, a concept Bakker and van der Maas (1) defines as describing '*transportation options that fall between private car and conventional public bus services. It is usually considered to be an option only for less developed countries and for niches like elderly and disabled people.* In the UK, paratransit [or Demand Responsive Transport (DRT) systems in the UK] emerged in the 1970s to serve a specialist niche market for people with mobility difficulties, such as the elderly and others with disabilities affecting their mobility. Such services are expensive to provide, but are viable because they were less costly or a considerable improvement compared to the alternatives available (e.g. individual taxis or specialist health authority vehicles).

After serving such specialist user groups for 30 years or so, DRT systems are starting become a mainstream public transport mode in the UK. Moreover, DRT has featured in a number of UK Government reports suggesting it could be used to tackle a number of policy objectives, while the use of Rural and Urban Bus Challenge funding has further encouraged take up. However, the long term future of a number of recently launched schemes remains in doubt.

Existing research on DRT has tended to focus on the means of delivery – i.e. what type of vehicle is most appropriate, how might the technology work, and should a service be fully or semi-flexible? However, there are a number of additional regulatory, fiscal, institutional and cultural barriers at government, local authority, operator and user levels that have not yet been comprehensively investigated which are as, or even more, important. Consequently, in 2002, the UK Department for Transport and the Greater Manchester Passenger Transport Executive commissioned the authors to determine the market potential for DRT systems in the UK (2). The *Intermode* project examines examples of 'good practice' DRT systems already in operation, identifies barriers hampering the development of DRT schemes and evaluates the potential for DRT as an alternative public transport system. In addition, it determines how DRT might be developed to serve journeys that are not currently well served by public transport, explores why DRT has so far failed to make much impact, and suggests how government and other public authorities might rectify this.

This paper examines mainstream DRT schemes from around the world that have failed, to identify the reasons for failure and draw lessons to help prevent similar outcomes occurring.

(2) 'FAILURE' IN A DRT CONTEXT

The rationale for studying failed schemes, is to learn how *not* to do things. The phrase 'enjoy failure and learn from it - you never learn from success' by designer James Dyson is pertinent. Other proverbs and sayings in a similar vein include: 'a farmer learns more from a bad harvest than a good one', 'failure is opportunity in disguise', and 'success of today resulted from the failure of yesterday'.

According to the *Collins Concise Dictionary*, the term 'failure' can be defined in a number of ways. In transport operational terms though, two major ways in particular seem pertinent. First, it can refer to "an act that fails" or "a loss of ability to function normally". Thus, a service failure is a service that does not work or else ceases to work. And second, failure can mean that "an event does not accomplish its intended purpose" i.e. a service does not meet its objective(s) or that it meets with "a lack of success". This paper then, focuses on DRT schemes that have 'ceased to work' and/or have 'not met their objective(s)'.

To do this, the paper draws mainly upon the results of several cases which emerged from the *Intermode* project where a DRT service failed to develop beyond the initial stages, or it was fundamentally compromised. A number of vignettes of key failed cases are reported together with a note of the lessons that each provides. This is followed by a marketing analysis of failure factors, with conclusions on how this might be avoided in planning and implementing future DRT services.

As already noted, (see, for example, recent papers on paratransit presented at Transportation Research Board annual meetings) most DRT research has tended to focus on the delivery issues to do with the 'nuts and bolts' of introducing and operating a DRT system rather than on strategic issues like why DRT has not become more widely offered. However, there are some notable exceptions to this.

For instance, Cervero et al. (3) draws on DRT development in California and suggests that the most serious obstacle to paratransit expansion has been the market place, whereby competitors (the car and other transit modes) receive huge subsidies that distort the economics of operation. Further, insufficient demand drives up the unit costs of liability insurance, permits, and other ongoing expenses. Interestingly, the authors find relatively few regulatory barriers to expansion.

In a second study, this time of the viability of commercial paratransit in the United States, Cervero (4) reports that experiments with shared ride taxis and jitney services in Seattle, San Diego, Indianapolis and several other US cities in the 1970s and 1980s demonstrate the market demand for frequent, on-call and sometimes door-to-door services that are cheaper than taxis and sometimes even public transport. However, allegations of unfair competition and 'cream skimming' led to more local and state regulation of the sector, while labour protection legislation coupled with higher subsidies for transit placed private paratransit at a competitive disadvantage, limiting most systems to specialised, contract services such as for the elderly and disabled. Despite these barriers though, he notes that paratransit does still legally and illegally operate successfully in cities such as New York (commuter vans), Miami, San Diego and Atlantic City (jitneys), San Francisco (feeder buses), and shared taxis (Washington DC), while Airport Shuttles provide access to many of the nation's major airports.

Meanwhile Bellini et al. (5) uses Italian DRT experiences of PersonalBus in Florence, RadioBus in Milan, StradiBus in Cremona, ProntoBus in Bologna and DrinBus in Genoa to determine that the success of demand responsive systems is dependent on:

- The adaptability of the mode meet to users requirements about timetables and itineraries;

- The flexibility of vehicle fleet management to minimise empty vehicle trips;
- Applying new technologies to monitor vehicle locations, allow real time service planning and to enable information to be transmitted to users to and from the vehicles themselves;
- Selecting the best type of mode to match the demand;
- Maximising the level of integration with traditional public transport systems; and
- Improving the relative performance of demand responsive transport in terms of cost and comfort compared with car and traditional public transport alternatives.

(3) VIGNETTES OF FAILED DRT SCHEMES

The following section presents a series of vignettes of DRT schemes that have 'failed', 'no longer function normally', 'no longer meet their intended purpose' or have 'ceased to work'.

Dial-a-Bus, Milton Keynes, UK

Milton Keynes is a city designed to accommodate the free use of the car for all possible trip purposes (6)(7). Unfortunately, the resultant one-kilometre grid of 70 mph dual carriageway roads and low density and highly dispersed development (so as to spread traffic loads evenly) is very hostile to conventional bus operations, and so the Plan for Milton Keynes looked to the use of 25-30 seat minibuses with "the possible introduction of a more personalized public transport such as demand-actuated mini bus" (8).

In the event, a 'Dial-a-Bus' system began operating in March 1975 in the southern development area using 16 seater minibuses (9)(10). These operated in a 'service area' where door-to-door trips could be made. There were also ten 'stopping places' outside the service area (e.g. the railway station, the main shops and some key employment areas). Free street phones were provided to supplement bookings by ordinary telephones from home and workplaces, which were received at a dedicated call centre and then passed on by radio-telephone links to the buses. Trip requests could be made up to 30 minutes in advance, but buses could also be hailed on the street. When Dial-a-Bus started, the service area had a population of 4,300, which rose to 10,000 one year later.

Public acceptance of Dial-a-Bus was high and it rapidly became popular - even today longstanding residents recall it as being the only time that the city had a decent bus service. Frustratingly, the Milton Keynes Dial-a-Bus almost succeeded. It was well-designed and well marketed, with good on-bus branding and literature that was exceptional for its time, yet it failed due to a combination of:

- A high-cost, inflexible operator, unsympathetic to the concept of DRT;
- Insufficient political commitment to keep it going (in the face of opposition by the operator).

- Somewhat too flexible a service (not as great a problem as in Adelaide, but tending that way);

- Fares that were too low to reflect the quality of DRT (it was politically too difficult to insist users pay higher fares for higher quality);

- Hostile land use of Milton Keynes (dispersed design coupled with the patchy, partial development inside the service area and the widespread use of cul-de-sacs and curvaceous estate roads led to long journeys and to a large amount of bus and driver resources for each trip meaning that point-to-point journey speed, even on totally uncongested roads, averaged only 5mph, varying between 2mph and 25mph depending on trip requests and loadings; and

- Higher than budgeted cost, possibly the main factor in the demise of the Milton Keynes dial-a-bus. After cutbacks to off-peak DRT only, it managed to cover approaching a third of costs from revenue, Before it was probably on only about 15 - 20%.

So, after the two year trial, Dial-a-Bus shifted to be a fixed route minibus service and was amalgamated with conventional bus services.

Translink, Shellharbour, New South Wales, Australia

Shellharbour is located near Wollongong, south of Sydney, New South Wales. The Shellharbour Council conducted a trial of a DRT from 1992 to 1993. This serviced a population of 47,000 and operated on a fixed base route with deviations on request using both full-sized and 29 seat buses. It was designed so that 95% of the population was within 200 metres of a bus-stop and aimed to test state of the art technology, including automated traffic light activation, real-time information, digital stop announcement systems and guaranteed transfers between services. A phoned request for a bus to deviate from a route could be made up to ten minutes before the bus reached the ‘deviation point’. A window of five minutes was then allowed for arrival.

While it was originally intended to use a fully automated booking system, technical difficulties meant that a low-tech demand response control system was substituted whereby passengers telephoned to book a seat (11). These journey details were then relayed to the bus driver using hand-held radio equipment. The system, as run, enabled bookings to be made up to one hour prior to the intended trip. Although real-time passenger information was not available, its cost was only a quarter that of the high-tech option.

However, when the trial reached its scheduled end date the service reverted to being a conventional line-haul service with some small modifications as a result of information gained from the trial. This was due to an over reliance on foreign technology, the lack of planning (due to the haste in which the scheme was implemented) and disappointing patronage (blamed on poor marketing). Crucially though, these difficulties reinforced the disenchantment of the already unenthusiastic local bus operator to the extent that it ‘persuaded’ the council to drop the DRT scheme and revert to a conventional bus service.

Dial-a-Bus, Adelaide, South Australia, Australia

A second Australian case is of a more ambitious 'many-to-many' DRT system over the Adelaide metropolitan area in South Australia which was designed to provide a door-to-door service on cross-suburban services that conventional bus services were unable to serve effectively (12). Fares were set on a straight-line distance basis and the operating characteristics were such that there was no route or timetable. Finally, the system was restricted in that the central business zone was not served and that on-street hailing was not permitted, conditions that appear to have been imposed to avoid competition with existing bus services and taxi operators.

Overall, the service only lasted for six days by which time it had become obvious that the productivity of each bus could never provide a realistic service. This was because the fleet size was too small to meet the demand of such a flexible operation model where the constraints of timetables and routes also removed the efficiency of public transport and the ability to effectively group trips. In addition, the technology installed – which relied on information being recorded manually and radioed to the operator - was too crude to cope with the complex pattern of demand. Worse, these already serious deficiencies were exacerbated by the system serving such a large population across such a large service area, and because of the operating restrictions already described. In summary, the service seems to have retained the institutional characteristics of many of the specialist (and small-scale) dial-a-ride schemes for people with mobility handicaps, which proved not to be capable of delivering a high volume general public transport service.

Plus Bus, Truro, Cornwall, UK

The Truro Plus Bus scheme is an example of the danger of simply trying to copy one successful DRT system assuming it will work in a totally different context and market. Truro Plus Bus was a shared taxi feeder serving a railway station and surrounding area. Based on the Dutch Trein-Taxi concept, the service was underwritten by rail operator First Great Western. It was initiated by a visiting Managing Director who decided that First should try out the idea in practice (Crossfield R, First Bristol, Bristol, UK, 4 September 2003, (unpublished data)). A local manager was given the task of developing the scheme, with passengers able to book a shared taxi to link with First Great Western train services. Truro Plus Bus was launched in April 2002 and was available from the first train in the morning until the last one at night – 5am to midnight throughout the week using just one six-seat Ford Galaxy. Fares were zoned, ranging from £2.20 ($3.70) to £13 ($22), the latter involving destinations up to 20km away being served. The service was finally withdrawn in May 2004.

This comprehensive service cost £1200 ($2,100) a week to run with fare revenue only covering 25%. From December 2001 until June 2002 there were only roughly 15 users a week, while the peak number was around 70. Around 245 passengers a week were needed for the service to break even. The low ridership seemed to be due to a number of factors. Most crucially, were reasons to do with the design of the scheme. For example, the market research was based directly on Dutch data that was not tested using UK subjects and in UK conditions. More significantly, the local manager failed to highlight that the Dutch system required subsidies from

the train operator (as did the other, successful, UK station link shared taxi run by Chiltern Trains). This meant that the fares were too low to recoup enough of the costs.

In addition, the zones in which the service operates were far too large. Trips of 16-20km to Newquay and Falmouth on slow winding roads meant that the single vehicle was often still on a trip when trains arrived at Truro (possibly with people who have reserved a journey). It also meant that potential deviations could be significant. There were operational problems too. One was that rival train operator Virgin (whose trains also served Truro) refused to publicise the service on its trains, while even First Great Western train staff often failed to announce the Plus Bus before the Truro stop. However, the system had well publicised on-board train literature, at stations and around the area served by hotels, shops etc. Another problem was opposition from local taxi operators – they kicked and spat on the vehicle – meant that the vehicle was usually parked at its depot rather than on the station forecourt as originally envisaged.

Overall, it was assumed that the service would never make a profit, although it was thought that there was scope for subsidy to fall from 75% to a more palatable 30%, but even that goal proved too much in the event and the service was withdrawn in May 2004.

Corlink, Plymouth, Devon and south east Cornwall, UK

CORLINK is a joint project between Plymouth (in Devon) City Council and Cornwall County Council and was launched in July 2002 (Gliddon J, Plymouth City Council, Plymouth, UK, 22 May 2003, (unpublished data)). It is a completely flexible, demand responsive service covering two areas in south-eastern Cornwall in the far south west of England, and originally aimed at attracting commuters travelling into Plymouth from two very rural corridors to the west and north of the city. There have been several problems.

First, it has proved difficult to convey the nature of the service to elderly people. Second, there has been opposition from taxi operators with a DRT bus driver being physically attacked in one case. There have also been software problems - the system lacks sufficient flexibility – and communication problems possibly due to poor signal strength. Trips are now planned manually, and some areas are apparently resorting to faxing journey itineraries to drivers. A further problem has been the lack of co-ordination between Devon and Cornwall, with Cornwall County Council setting the fare structure. Finally, the bid was not properly researched beforehand so when it was awarded the target group of commuters did not use the system, and in any case the final amount awarded by the Government was only one third of that bid for. The partners have decided not to continue the service in its present form on the cessation of the Government's financial support.

Cango, Leigh Park, Havant, Hampshire, UK

Hampshire County Council on the south coast of England is notable for launching a number of Cango flexible bus services that have been in operation since July 2002 (Armstrong J, Hampshire County Council, Winchester, UK, 8 August 2003, (unpublished data)). These have enjoyed various degrees of success, of which the worst performer is that funded by the UK Government's Urban Bus Challenge in

Leigh Park low income housing estate, Havant. This route serves employment needs in the peak periods and then does hospital trips during the day, both connecting a roam zone centred around the Leigh Park estate with Havant town centre. It was set up because local businesses had complained of lack of bus services for workers, while local hospitals were also seen as being difficult to get to from the estate.

One problem is that the two hospitals and the business park interests (which participated in the bid) subsequently withdrew their support. Secondly, health is an emotive issue, and people have *perceived* needs, rather than actual demand. This has meant that uptake on three services was very poor (less than 100 people per week), partly because there is no regular pool of users for the hospital services – a big disadvantage. Another major problem is that the service cannot take people shopping, as it is not allowed to compete with the commercial network – and the estate already has a strong bus user ethos and there is a regular commercial bus service. Worse, there were also reliability problems and this lost a lot of users. And, while the services start at 06.30, the call centre does not open until 08.00, so early bookings have to be made the day before (instead of 30 minutes before), and if is service does not turn up there is no one passengers can contact. One final problem seems to be that the information seems too complex for the users in the estate – they simply do not understand the concept. Once again, further funding is not being sought to continue the service in its present form.

Shared Taxi Schemes, Blackpool, Lancashire and Swindon, Wiltshire, UK

In 1991, taxi operators in the Lancashire tourist resort of Blackpool established a taxi sharing scheme targeted specifically at tourist routes in the town. A fare of 60p ($1) per person was registered with the local authority and dedicated shared taxi bays were established. The service attracted enough custom to be fully commercially viable, with operators getting four to six passengers per trip. In 1996 fares were increased to 80p ($1.40), which further enhanced commercial viability and the service continued to prosper. However the local authority then changed its attitude towards shared taxis and viewed them as a threat to the town's buses. It refused to grant any further fare increases and the dedicated shared taxi bays were removed. With no fare rises and a diminished street presence, there was a combination of lower custom and a gradually lessening income. The service thus petered out.

Another taxi operator initiative documented in the *Intermode* report was proposed in Swindon, (to the west of London) where the intention was to set up a taxibus scheme from the railway station in the town to one of the suburbs in order to supplement their income during 'slow periods', when a driver may wait for up to an hour for a fare. However, on approaching the local authority, they were discouraged from establishing the scheme due to a whole raft of charges. For example, the local authority suggested the taxi drivers would need to pay £250 ($420) for a roof sign. Ironically, the drivers did not need to inform the local authority at all, as a Section 12 Taxibus service needs permission only from the regional Traffic Commissioner. Such a case well illustrates the confusion generated by current UK regulatory and licensing regimes, as well as the sometimes unhelpful behaviour of the regulatory authorities.

Small-scale taxi operator-led initiatives can be vulnerable to hostile local officialdom. Although these services did not require any subsidy from the local council, the council's regulatory role (whereby they approve shared taxi fares) gave

them the power to kill a commercial DRT service. There was also some confusion as to regulatory and licensing requirements. This is almost the reverse of the previous cases where lack of co-operation from a conservative operator was behind the failure of a DRT scheme. Here innovative operators were undermined by the hostility of local authorities to the development of a DRT service. This shows that, even for a commercial DRT service, an understanding and active support by the local council is vital.

Shared Station Taxis, Marylebone and Kings Cross, London, UK

When London's new high-speed Heathrow Express rail service opened in the late 1990s, there were many complaints that there was hardly any point in using a fast rail service if travellers then had to queue for an hour at city-centre terminus of Paddington Station for a taxi (Galvin M, Computer Cab, Harrow, Middlesex, UK, 17 November 2003, (unpublished data)),(13). Therefore, a highly successful taxi sharing scheme emerged (both in terms of satisfying customers and revenue generation) which led operators to try the same formula at two other London rail termini Marylebone and Kings Cross Stations. The Paddington taxi sharing scheme uses a ticketing system. Tickets are sold at £4.50 ($7.50) per person plus a group cab (taxi) fare. The cost of the ticket plus the group fare comes out less than an individual cab fare, so the passenger gains. For the cab driver, s/he gets a higher fare for taking a group. Marshals, paid by Licensed Taxi Drivers Association (LTDA), make up the groups. The ticket income pays for the Marshals.

This is a system that works well for high volume taxi operations, but at Marylebone and Kings Cross Stations there was insufficient volume to be able to match up sharers to destinations in central London and provide income to pay for the Marshals. In consequence both schemes ceased to operate.

Commercial, on demand shared taxi (as opposed to pre-booked) appear to need a high volume of demand concentrated in a small area in order to work. A less flexible service (pre-booked, fixed running times etc) could work at lower levels of demand. Unfortunately this was not understood when the attempt was made to transfer a scheme from a high/concentrated demand situation (Heathrow Express at Paddington) to other London stations.

Shared Station Taxis, Ipswich, Suffolk, UK

An earlier similar scheme serving Ipswich station in the east if England also failed but for different reasons. This began operating on a 12-month trial basis from the railway station in June 1988, but did not, ultimately, continue. Balcombe et al. (14) found this failed largely because there was a lack of understanding about the scheme amongst the public; there was resistance to the psychological barrier of requesting shared rides and by the perceived low probability of finding other passengers with whom to share.

Regiotaxi KAN, Arnhem, NL

Regiotaxi KAN is unusual in that it is at risk of failure due to it being far too successful at attracting passengers. In brief, the funding system is such that the regional government is having to find large additional amounts of subsidy to finance

far more journeys than envisaged because national Government grants are based on the performance of the previous year. Consequently, the bus operator is not actually accepting all of the subsidy it is due and there is no marketing activity being conducted at all so as not to make the problem any more acute (Zuijderland A, Novio Express, Arnhem, Netherlands, 12 February 2003, (unpublished data)).

Shared Taxi Scheme, Dublin, Ireland

Finally, there may be other reasons for schemes to fail. For instance, in Dublin a pilot shared taxi scheme was launched before Christmas 1999 to cater for a shortage of taxis. Unfortunately, while these were well used there were problems caused by uncertainty over who was supposed to pay, and due to some male passengers 'interfering' with female passengers. Therefore the pilot was not repeated and with the deregulation of the taxi market the taxi shortage problem is no longer so acute (Ahern, M., Dublin Transportation Office, Dublin, Ireland, 15 January 2003, (unpublished data)).

(4) LESSONS OF FAILURE

One method that can be used to determine how and why DRT schemes fail, is to use marketing theory. This approach is used rather than that used for implementing public policy (e.g. Hogwood and Gunn's theory on perfect conditions for policy success) (15), because a public transport service is more readily identifiable as a service product than a public policy. Palmer (16) suggests that schemes are influenced by the so-called marketing environment – the internal environment (Employees, Equipment, Finance, Functional responsibilities); the micro environment (Customers, Competitors, Other Stakeholders, Intermediaries, Suppliers); and the macro environment (Economic, Technological, Social, Cultural, Political and Legal Forces) and this framework is used to present the findings.

Table 1 shows how the vignettes described earlier are affected by the marketing environment.

TABLE 1 Failed DRT schemes and the organisation/scheme's marketing environment

	Internal	Micro	Macro
Translink, Shellharbour, NSW, Australia	Technical problems, lack of planning, poor marketing, disenchantment of bus operator		
Dial-a-Bus, Adelaide, SA, Australia	Poor planning, too ambitious a service planned, technology not up to it	Competition restrictions	Dispersed low density land use
Dial-a-Bus, Milton Keynes, Buckinghamshire, UK	Inflexible operator, fares too low, insufficient stakeholder commitment	Inter-authority rivalry	Dispersed low density patchy land use development and cul-de-sacs
Plus Bus, Truro, Cornwall, UK	Insufficient planning, area too large to serve, fares too low,	Hostile competition	
Corlink, Plymouth and south east Cornwall, UK	Lack of planning, too complex a market, technology problems,	Hostile competition, insufficient resources from Government, lack of coordination between councils	
Cango, Leigh Park, Havant, Hampshire, UK	Market niche too niche and irregular, reliability problems, overly complex service to market and understand	Restrictions due to competition rules, withdrawal of stakeholder support	
Shared Taxi schemes, Blackpool and Swindon, UK		Hostile local authorities, confusion over licensing regime	
Shared Station Taxis, Marylebone and Kings Cross, London, UK	Lack of concentrated demand		
Shared Station Taxis, Ipswich, Suffolk, UK	Uncertain rules of use		Cultural aversion to sharing taxis
Shared Taxi Scheme, Dublin, Ireland	Uncertain rules of use		Cultural aversion to sharing taxis
Regiotaxi KAN, Arnhem, NL		Inflexible funding arrangements	

From this it can be seen that almost all of the schemes failed due to a whole series of reasons, although one or two of the shared taxi operations were exceptions. Secondly, many of the problems were to do with the internal environment – i.e. to do with scheme planning and design.

Internal environment

Firstly, DRT systems involve considerably more variables than conventional public transport operations. This can be a strength, as DRT can be closely customised to the market it is serving. But it also means that anyone designing a new scheme needs a good understanding of the market to be served and issues like the fares that market can sustain. The design of a successful scheme cannot be plucked out of its market context and dropped in elsewhere. This was the fundamental problem of the Truro 'Plus Bus' and Kings Cross/Marylebone shared taxi projects.

There is a danger of DRT tempting service designers into offering unnecessarily flexible services that jeopardise operating economics. Too much can be expected of DRT. This is perhaps best illustrated by the belief in Milton Keynes that DRT would cure the hostile land use design of the town. Behind this is a wider and very important point. DRT, like any collective mode, operates most efficiently when demand is concentrated to provide a high utilisation of resources. Under certain circumstances, DRT systems can offer un-timetabled 'many-to-many' services over a large area, but such market situations are exceptional. In most cases, markets can only support more restricted variants of DRT. The Adelaide service fell into this trap with an un-timetabled 'many-to-many' service. So did the Truro service, by operating over too large an area and failing to concentrate demand. The same was true of the Kings Cross and Marylebone shared taxi services, which may well have succeeded had they not simply used the model developed for the exceptional situation of the Heathrow Express at Paddington. Almost the opposite problem is where the chosen targeted niche is too small. A classic example here is the Leigh Park Cango scheme in Hampshire, where it has been realised that targeting only health trips for example, is not a sufficiently large market to cover itself.

Strangely enough, the failed Shellharbour case provides a positive example of how a low-risk experiment with DRT can be undertaken. A number of successful cases in the *Intermode* research were of simple, low cost, low volume schemes that succeeded in concentrating demand in time and geography - often with semi-scheduled core routes. In such circumstances this produced something like 80% of the benefits for about 30% of the cost. Understanding the market and cost structure of a particular DRT application is vital to its overall cost-effectiveness and viability.

This links into the core issue of realistic costing, which undoubtedly has been a critical factor behind the failure of many DRT schemes. This was true in Milton Keynes back in the 1970s and also played a central part in the Truro Plus Bus failure in 2004. There is also another financing issue, and that is that a strategy of long-term finance is an important issue. It is relatively easy to get trial project money, but the transition from a trial to a permanent scheme is often not adequately considered (see later).

However, there have been cases of DRT schemes which were well designed and realistically costed, and yet they still failed. One crucial issue is that of effective marketing. Bus companies predominantly operate in a culture that is distinguished by an almost total lack of marketing skills and awareness. Conveying the idea of DRT is a complex task, and requires considerable skill. This research found only one UK example where a private operator (Stagecoach) has been willing to invest effort in

marketing a new DRT service (Bunting, P., Stagecoach plc, Perth, Scotland, 6 August 2003, (unpublished data)). It is therefore not surprising that potential customers are often unaware of what DRT is and of its relevance to them. Many DRT services have also been developed in the context of a captive public transport market and so modern marketing practices are utterly alien to the operator.

One other point is that no matter how well designed a scheme is, it is all for nought if it is not delivered on time or at all. As noted above, many of the schemes had reliability problems due to problems with routeing software, communication, vehicle or staff problems – and ultimately it could be argued that this feature is perhaps the most crucial.

Micro environment

Such a situation links into the lack of operator commitment that clearly led to problems in a number of the failed DRT cases. This leads into the issue of effective partnerships in DRT development. For public policy-led DRT, a lack of enthusiasm and support by a contracted operator can be fatal. Ensuring the operator believes in DRT and will have something to gain from its success is crucial. But the reverse is also true, as was illustrated by the problem of commercially-led taxi sharing being very vulnerable to hostile local authorities (as in Swindon and Blackpool). DRT services usually require an effective partnership between several actors. The absence or hostility of one or more can be the core reason for failure.

DRT systems tend to require a more complex network than is needed to develop and operate conventional bus or taxi services. At the very least this involves operators, call centres and local authorities. It is also clear that good relations need to be established with the local community, rival transport operators (particularly minicab and taxi firms who may see a subsidised DRT service as a threat), and local trip generators e.g. employers, retail outlets etc that could encourage their staff and visitors to use the service, or even potentially sponsor or contribute towards the costs of providing the service. Obviously, where such a network does not exist, or where it falls apart as in the Leigh Park Cango scheme, then problems can arise.

There can be problems involving taxi and private hire operators as moving into DRT, and being expected to work in partnership with the local authority and others, is not their normal mode of operating.

It needs to be recognised that the development of an effective partnership may require the use of an organisation innovation in order to implement the service innovation of DRT. Old organisational structures and processes may not be able to effectively deliver DRT. This was well illustrated by the desire for a separate operating unit in the case of the Milton Keynes Dial a Bus. This was not fully developed, but even so, the new unit set up the service well and rapidly won user confidence. The fact that this new structure was compromised was probably the key factor behind the eventual failure of this system.

There are also issues to do with Government rules that are not designed to deal with DRT schemes. In the UK, this is manifested by the different operating regimes for buses, taxis and minicabs. Where funding is provided by Government grants, there can also be an issue of rules in place designed to protect existing public transport

services and this severely constrained the development of the Adelaide and Hampshire schemes. Insufficient resources is another problem. This affected the Milton Keynes and the Corlink schemes in particular, while in the Netherlands the financing system that allocates subsidy is such that it cannot deal with rapidly growing schemes – thus penalising Regiotaxi in Arnhem.

Macro environment

Finally, the impact of the macro environment needs to be taken account of. Unfortunately, this level is the one that is most beyond the control of the DRT operators, funders and regulators but can ultimately be the most critical. For example, in both the Ipswich and Dublin cases a major problem was the cultural aversion to sharing taxis – almost impossible to deal with – while the extreme land use patterns heavily influenced the performance of the Adelaide and Milton Keynes schemes.

(5) CONCLUSIONS

In conclusion, this study of failed DRT systems indicates a series of factors that are crucial in whether a DRT service succeeds or fails. It needs to be realistically costed and designed with a full understanding of the market it is 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 the latter area where the root of DRT failure is often to be found.

The examples of failure reinforced the conclusions of the *Intermode* study as a whole as to the planning and design needs of DRT services. There is a need for a very good understanding of the DRT market to be served. There appear to be three general market niches where DRT is appropriate. First, low tech, small scale simple DRT systems can be applied in areas where captive users are happy to use any form of public transport but are only willing (or able) to pay low fares. Second, there are niches (e.g. employer shuttles, airport shuttles) where commercial operators can target choice users with small scale simple to operate systems who appreciate luxury and are prepared to pay a premium for a service that is as far away from a bus or a minicab as possible. Finally, large scale, complex network DRT systems require high tech equipment if they are to operate efficiently. As a result they will be relatively expensive to operate. However, providing that savings can be made (usually by substituting even more expensive specialist transport) there is scope for these services to be cost effective - particularly if fares can be raised above those of a comparable bus service.

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