Transportation Planning and Technology (2007) 30 (2-3):249-269.
doi: 10.1080/03081060701395501

Evaluating Flexible Transport Solutions

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(Received 14 October 2005; Revised 20 December 2006; In final form 10 April 2007)

ABSTRACT

Flexible transport services (FTS) have been of increasing interest in developing countries as a bridge between the use of personal car travel and fixed route transit services. This paper reports on findings from a recent study in Queensland Australia, which identified lessons from an international review and implications for Australia. Potential strategic directions, including a vision, mission, key result areas, strategies, and identified means of measuring performance are described. Evaluation criteria for assessing flexible transport proposals were developed, and approaches to identifying and assessing needs and demands outlined. The use of emerging technologies is also a key element of successful flexible transport services.

KEYWORDS: Flexible transport services; demand responsive transport; strategy; evaluation criteria; needs assessment

Introduction

Increasing road congestion costs and low levels of public transport patronage in developed countries, particularly in lower density urban and regional areas, have prompted a revised interest in flexible transport

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services (FTS). FTS has been found to provide the following benefits:

- potential to increase public transport patronage;
- integration between current fixed route and FTS to achieve more 'holistic' transport solutions;
- ability to serve areas with demand too high for door-to-door, but too low for fixed route services;
- making public transport more attractive to choice users, hence reducing car use and associated problems.

The potential application of telematics to develop new cost effective and efficient flexible transport operations has been the subject of past research. A high level of technology is thought to be a key element of a successful FTS.

The concept of flexible transport can be summarised as a flexible, integrated and customer centric adaptive transport option that sits somewhere between private car ownership and fixed route traditional transit (Waters, 2003). As shown in Figure 1, the degree of flexibility is dependent on vehicle operations and vehicle types, scheduling and advanced notice requirements.

There is a variety of FTS concepts, such as community and special needs transport, car sharing and car pooling schemes and demand responsive transport (DRT). The latter concept is the main focus of this paper.

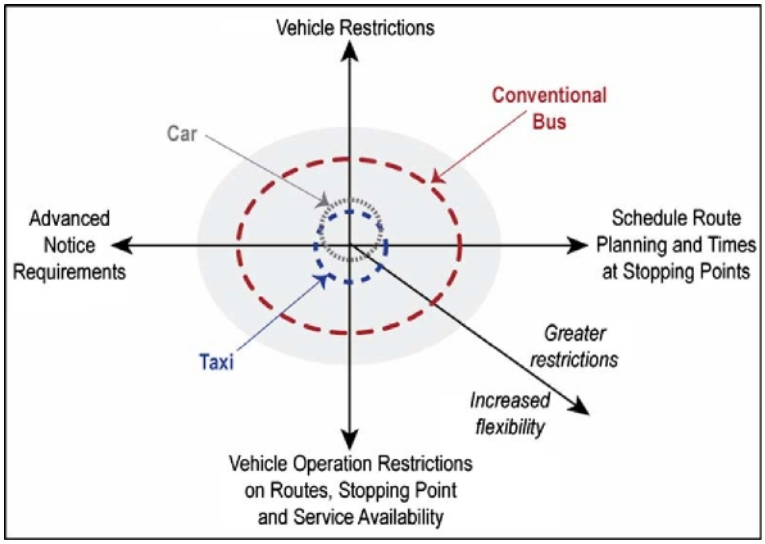

Figure 1. Degrees of FTS flexibility.

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Demand responsive transport (DRT) has been defined as a service that adapts to suit specific transport needs. True demand responsive services are fully flexible services such as taxis, and chauffeured limousines. Current forms of DRT can be destination specific (does not involve trip chains and usually targeted towards captive 'choice' user); substitute (implemented to replace conventional service); inter-change (intended to provide feeder links to conventional services); and network (provides additional services to current network).

International Experience

Integrating flexible services into the network of existing public services greatly contributes towards greater transport cohesion. However, operations were often found to be hampered by institutional, legal and economic barriers, which imposed limitations in some cases (Brake *et al.*, 2004).

Take-up of FTS has generally been poor. Where take-up has been successful, it has been attributed to strong branding, marketing, and a community orientated partnership (Brake *et al.*, 2004). There are many schemes where public consultation has proved to be critical to success, as people do not understand the nature of the flexible service. Often cultural barriers affected take-up. For example, in the UK there was found to be a cultural barrier against sharing taxis because of the proximity of strangers in small vehicles (Enoch *et al.*, 2004).

Proposals are provisionally classified as commercially viable, acceptable or justifiable subsidy or financially unsustainable. However, few existing schemes are currently commercially profitable in the UK, Europe or the USA. Those that are profitable in the UK, such as the Black Taxibus (Enoch *et al.*, 2004) in Belfast, were developed due to specific critical needs and are not readily transferable.

During trials in Europe and the UK, the viability of FTS as a self-supporting system has not, as yet, been demonstrated. Hence, at present viability is being measured in terms of enhanced mobility, and a way to combat social exclusion.

Although the use of technology has been extensive, it has been found possible to run efficient services with short advance notice requirements with or without the use of technology. The use of cellular phones for communicating demand-response service requests is extensive. Currently ongoing research in the UK and Europe is looking at the next generation of FTS services which will offer a complete package of value added services through the collaboration of multiple service providers (Ambrossini *et al.*, 2002; Mageean & Nelson, 2003). It has been found important to balance commercial reality with the software that will provide the most efficient service for requirements.

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Table 1. Learnings from international experience

Attribute	Learnings
General	· Adoption of FTS services is not yet as widespread as one might expect • Initial slow growth can be sometimes attributed to lack of 'bus culture' in area of high car ownership • Demand responsive transport is already recognized as not merely meeting known demand but revealing unknown demands • Spatial methods of planning services not sufficient need to determine actual travel needs of each target groups within the community • Need to concentrate on supplying a 'service' as opposed to vehicles and schedules
Culture	· Western cultural issues such as fear of close proximity to strangers have had effect on growth of the service • Aggressive attitudes from either other transport operators or hostile authorities have severely impacted a systems potential for success
Fares	· Fare surcharges for deviations may be useful tool to encourage riders to board and disembark at fixed stops
Integration	· There are potential new markets for FTS to assist with modal shift since FTS offers scope for full integration with traditional services • Co-ordination with current conventional services and other services such as community transport networks is essential • Need for strong community ownership and local leadership plus ongoing consultation with community to ensure services are continuing to meet community needs
Governments	· More guidance is needed on the operation, setting up and potential of FTS • Trends that see the car as 'free', 'cheaper' should be reversed through marketing channels • Incentives such as the '4c fuel subsidy' if you buy at supermarkets, should not be encouraged, perhaps they could also offer discounts off public transport
Technology	· Technological issues include identifying the most appropriate scheduling system • Currently most flexible services are scheduled and dispatched without the use of advanced technology
Service designs	· Services offered must be clearly understood, as well financially and physically accessible, and relevant to user requirements • Services must be responsive to customer needs • Each flexible service design is unique • Fluid nature of some flexible services makes them difficult to describe clearly for registration and advertising purposes

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Table 1 *(Continued)*

Attribute	Learnings
	• If ridership rises significantly most operators take it as an indication that a fixed route service is required
Efficiency and flexibility	· The amount of time allocated for slack required in a semi fixed route varies and is difficult to ascertain and can be critical to the reliability of the service
Advance notice	· The shorter the advance notice required the better
Marketing	· Marketing transportation in sparsely populated rural areas is much effectively achieved through supportive community networks
	• Integrated involvement of local people is a major channel of communication for the spread of ideas and enthusiasm about the project
	• Marketing needs to be revised from traditional concept
	• Good marketing can have a direct and positive effect on the potential that an operation will succeed
Scheduling	· Scheduling can potentially be facilitated through the use of specific software
Costs	· Potential for reducing transport costs and improving or sustaining citizen mobility through the introduction of FTS is not yet fully established
	• The viability of FTS services as self-supporting systems has not has yet been demonstrated
Social objectives	· Flexible transport has been found to be an effective way to offer community transport and accessibility

Unlike Europe and the UK, the tendency in the US is to view each flexible service as unique, where there is little standard practice that can be passed onto operators to help design the services. Hence operator experience is relied upon to develop strategies to combat inefficiencies of DRT. The primary barrier in the US to successful FTS operations was found to be lack of funding. Table 1 summarises learnings from international experience.

Implications for Australia

Unique attributes in Australia which affect the acceptance of FTS include:

- low levels of residential densities and high levels of urban sprawl;
- greater traveling distances;
- greater vehicle ownership and strong car oriented culture;
- strong connection between status, success and car ownership;

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- minimal experience in the use of public transport;
- a reluctance to 'share' intimate space with strangers;
- relatively low fuel costs;
- strong safety initiatives that have reinforced options such as safety belts, and the lack of these safety features on public transport.

Australian research has shown that challenges such as a lack of motivation, innovation and reluctance of bus operators to consider alternative schemes and lack of adequate funding to service providers, pose additional challenges for the implementation of FTS services (Walker *et al.*, 2004).

Strategic Framework for FTS

There are a number of strategic issues and challenges facing transport and flexible transport in particular, including how to provide sustain-able passenger transport services, including:

- changing lifestyle and demographic patterns, including ageing population, and changing household size resulting in diverse and changing travel patterns;
- travel patterns (temporal and spatial) are becoming more diverse, with changing work, social and recreational travel behaviors, making it more difficult to economically and efficiently service these needs by conventional passenger transport services (timetabled, fixed route);
- growing proportion of population without access to a car and/or limited access to conventional passenger transport, such as the young, disabled, aged sectors of the community - resulting in increased demands on government supported services;
- use of conventional passenger transport has been declining in many developed countries, except in limited areas where high quality services have been provided, while the proportion of travel by car is increasing;
- costs of passenger transport are continuing to increase, and while cost efficiencies are being achieved, it is increasing difficult to further increase productivity. There is a need to provide cost-effective services matched to demands, such as flexible or demand-responsive transport;
- increasing demands on limited public funds;
- increasing demand for greater flexibility in sustainable transport services and reducing the reliance on the car to reduce environmental impacts and limit energy use.

While considerable improvements have been made with passenger transport, especially with new institutional arrangements and greatly

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Table 2. Strategic direction for flexible transport services

What is our Vision for the future?
Contribute to better transport for Queensland by connecting people, places and services by flexible *transport services to enhance economic, social and environmental well being.*
What is our core purpose or Mission
To develop, lead and manage flexible *transport services in Queensland which are safe, secure,* efficient *and inclusive.*
What are our key objectives or Key Result Areas and Strategies to achieve them?
Three primary roles
Transport leadership: *Develop, monitor and maintain a strategic plan for* flexible *transport services, establish priorities and ensure appropriate policies, regulations and operating practices.*
Strategy: Establish an active leadership role in flexible transport services, including developing and maintaining the strategic plan.
System Stewardship: Assess flexible *transport needs, plan and manage* flexible *transport projects and services and monitor, evaluate and report on* flexible *transport services.*
Strategy: Assess flexible transport needs, develop a list of priority flexible transport programs and projects and monitor, evaluate and report on flexible transport projects and services.
Service Delivery: *Manage the delivery and operation of* flexible *transport services.*
Strategy: Implement and manage flexible transport projects and services. *Supported by:*
Effective Relationships: *Develop and sustain effective relationships with stakeholders in* flexible *transport.*
Strategy: Develop and sustain effective relationships with key stakeholders in flexible transport.
Capability: *Develop the capability (people, systems, processes) to deliver effective* flexible *transport systems.*
Strategy: Develop improved and agreed planning, decision making and project evaluation processes for flexible transport.

increased investment in infrastructure and services, the demand for flexible transport continues to grow, particularly in lower density and low population areas.

The strategic direction for FTS includes the vision, mission, and key objectives or key result areas, and strategies, with identified means of measuring performance - a typical example is described in Table 2. Potential performance measures are outlined in Table 3.

Evaluation of FTS Projects and Proposals

Project evaluation processes are intended for use by anyone developing or appraising a project for government funding or conducting post-evaluations of projects after implementation. The evaluation process

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Table 3. Potential flexible transport performance measures

- Financial performance: cost/trip; subsidy/trip; revenue/cost ratio
- Patronage demand - by time of day, day of week
- Accessibility - connecting activity centers
- Mobility - services in relation to unmet needs
- Energy use - relative reduction
- Air quality - relative improvement
- Safety and security - relative crashes, injuries and personal security incidents
- Community and stakeholder opinion - survey of perceptions of performance

ensures a logical approach is taken, which promotes transparency, consistency, equity and clear objectives within the proposed project. Figure 2 summarizes the context of project evaluation.

Projects are initially filtered to eliminate any that will not pass a detailed assessment, and then evaluated using a multi-criteria analysis process (incorporating benefit-cost analysis) against goals and objectives; priority strategies; and specific performance measures. Potential evaluation criteria to assess FTS projects are shown in Table 4.

When evaluating FTS, several impacts have to be considered, including:

- changes due to trips being diverted from other modes;
- changes in mobility and accessibility;
- the so called 'option value';
- impacts on land values and spatial design;
- impact on community (economically and socially).

It is important that these impacts are assessed as for their long-term and/or short term implications in terms of monetary and qualitative gains and/or losses. Additionally, qualitative impacts of the new system to the local community need to be assessed.

Achieving Objectives

In the past, the primary motivation for the implementation of FTS has been combating social exclusion. However, other objectives have included:

- increasing public transport patronage;
- replacing existing uneconomic bus services with something more flexible and more economic services;
- reducing car use;
- supplementing existing transport by adding additional capacity;
- reducing emissions;

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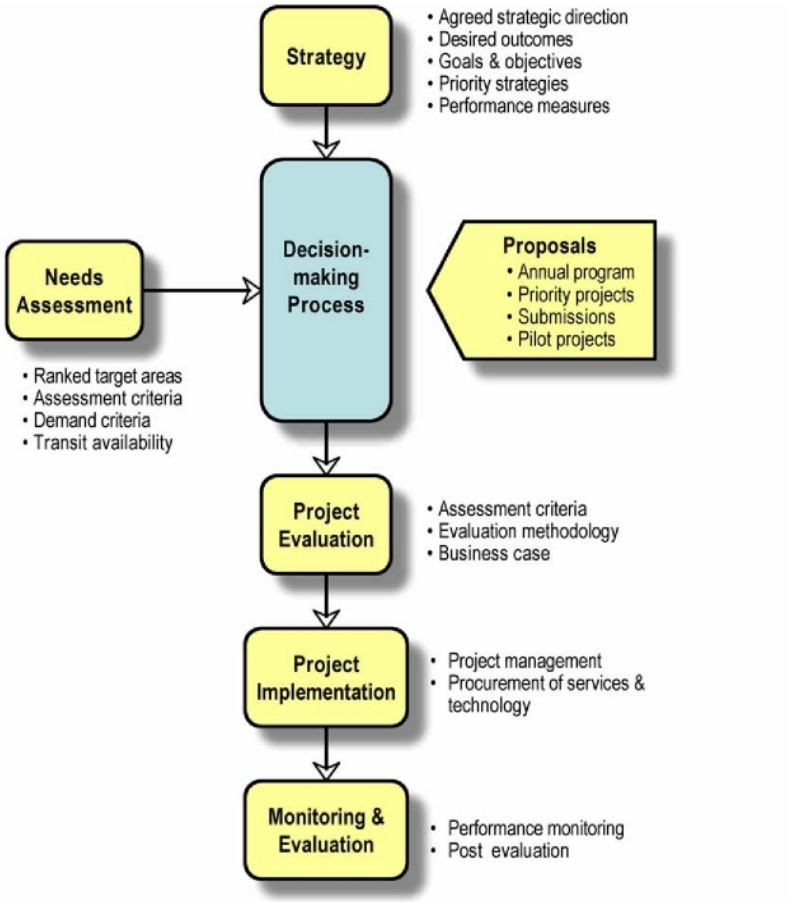

Figure 2. Context of FTS evaluation.

- reducing business costs through lower levels of road congestion;
- public transport profitability;
- improving resource efficiency;
- trial transitions between no service and conventional fixed-route service.

Assessing Transport Needs and Demands

Deprivation, like poverty is relative. Needs can be felt, expressed or normative (i.e. validated by a professional) and comparative (i.e. arising from comparing one's needs and how those needs are met, with others) (Evans, 1987; Kent & Barnes, 1999). Hence, different people and different groups can differ in their needs, and subsequently

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Table 4. Evaluation criteria to assess flexible transport projects

Evaluation criteria	Comment
Economic: efficient passenger transport	
Start-up costs	Estimate of all costs which can be attributed to system start-up. This includes system design, planning, marketing, bookings set-up and software/ hardware requirements.
Financial performance	Flexible transport often driven by social inclusion objectives and not set-up on a purely commercial basis. Annual operating cost; revenue; subsidy per passenger and per trip; revenue/cost ratio Assessing financial performance: categories project under three main financial performance levels (FPL): • FPL1 - requires little or no subsidy when network wide financial impacts are included. Typically applied to small niche markets (e.g. employer and airport shuttles). • FPL2 - requires approximately the same level of subsidy ($/trip) as current passenger transport services in the area. Typically applies to low-technology, small scale; low cost base with demand which is evenly distributed throughout the day. • FPL3 - requires higher level of subsidy than FPL2. Justified if there are significant benefits in terms of achieving stated transport objectives (e.g. target area of operation); or if demonstration/trial project is being assessed. Social inclusion driven projects tend to fall under this category. In UK this is typically twice the level of subsidy needed for FPL2 projects.
Potential to attract patronage	The estimation of likely service patronage becomes critically important when evaluating a new service given the reliance on that estimate throughout the evaluation process. May need to undertake purpose specific survey if area residents have not been surveyed recently on tripmaking behavior. Could use trip rate take-up from similar systems elsewhere as a guide but care is needed in that case.

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Table 4 *(Continued)*

Evaluation criteria	Comment
	Need to estimate level of new trips generated by the system and level of trips diverted from other modes. To what extent are trips being diverted from conventional public transport, car driver and car passenger? What is the current mode share in the study area and for the main origin-destination pairs being considered? • Has the service the potential to improve patronage on the existing bus system through better connections with existing services? • Is proposed demand at right level for flexible transport? • Is it spread over the day? • What market is being targeted? • What trip purposes are being targeted? • What is the potential to reduce car travel? • How robust and 'believable' are demand forecasts? • Potential to complement existing passenger transport network? (e.g. feeder services)
Quality of project management of risk	Qualitative assessment of how risks in each category have been addressed Risk level (low, medium high). This needs to be broken down by:
• procurement	· procurement risk
• technical	· technical risk (is new untried software being used?)
• financial	· financial risk (confidence on patronage estimates, public/private sharing)
• community acceptance	· community acceptance (what is the marketing plan? Have community been allowed sufficient 'ownership' of the system?)
Quality of project management for:	Judgmental result which will influence the assigned level of risk attributed to each risk element above.
• marketing and operations	What is the quality of the plans submitted and what is the track record of proposed operators?
• monitoring performance	What are the proposed performance indicators covering technical, financial and service provision aspects?

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Table 4 *(Continued)*

Evaluation criteria	Comment
Social: equitable access to passenger transport	
Potential to fulfill 'unmet demand' for targeted markets	Has there been an attempt to quantify unmet transport needs in the affected area? What is the potential for the system to satisfy some of the unmet transport needs? See separate report on Needs Assessment (QT 2005d) for guidance on how to measure unmet demand. Equity in evaluation usually refers to the notion of insuring fairness in the distribution of benefits and in the avoidance of uncompensated losses. Equity can be horizontal - treating similar groups equally; or vertical - treating different groups equally. Equity can be represented by the concept of mobility or transport related accessibility. This involves providing a basic level of mobility to all members of a community regardless of income, car availability or age. PT induced mobility increases, which are closely tied to access to employment, education and other essential activities, can be a major component of total project benefits. Four main types of mobility benefits, have been identified in the literature, namely: • economic (access to jobs and education and services); • personal (career benefits, access to social events, financial benefits through access to a wider range of services); • equity (inadequate mobility compounding social and economic inequities); and • increased travel options in case of emergencies or altered conditions. • Forecast usage by targeted market (eg: low income; unemployed; elderly; pensioners; mobility impaired). • The assessment of unmet transport needs of a given geographic area needs to have three main components, namely: defining the current level of service provided by the transport systems serving the area; identifying and quantifying the extent to which the residents of the area are disadvantaged from a transport perspective; and identifying and quantifying the extent to which the mode share of PT for the trip markets better suited to it, falls short of expected threshold values.

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Table 4 *(Continued)*

Evaluation criteria	Comment
	• What is the level of transport disadvantage in the target area? (measured in terms of car ownership, income and other socio-economic characteristics). • Transport disadvantaged are those residents who are physically disabled; aged; without access to a car; poor or unemployed. In terms of social justice, accessibility to destinations may be restricted to trips that are undertaken to fulfill the essential functions of employment, education, health and shopping. • Evidence of 'unmet travel needs': purpose specific local surveys or socio-economic indicators as proxies (e.g. are local trip rates by purpose, lower than average regional rates).
Potential to improve accessibility to activities and services	It may be possible to quantify the extent to which the new service improves access to education and shopping using predicted level of patronage for each origin-destination pair. What is the level of new tripmaking generated by the scheme? For trips being diverted from other modes what is the average gain in travel time and travel cost (estimated values may have significant uncertainty attached to them). It is possible to place a dollar value on travel time savings using standard values of time used in road project evaluations. Accessibility may be defined in terms of: characteristics and location of residents (e.g. address, access to a car, physically disabilities, etc.); opportunities available for the basic human needs such as employment, education, health and shopping; and the transport system used to link individuals with the opportunities available within a specified area. Use hourly opportunity to travel as an indicator of accessibility rather than traditional distance to bus stop and service frequency. • Access to social networks (e.g. elderly people) may have a positive impact on community health. The proposed service may provide access to those who are not able to use existing services at all. The service my have significant benefits to specific groups by reducing their sense of isolation

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Table 4 *(Continued)*

Evaluation criteria	Comment
	• Accessibility may be defined in terms of: characteristics and location of residents (e.g. address, access to a car, physically disabilities, etc.); opportunities available for the basic human needs such as employment, education, health and shopping; and the transport system used to link individuals with the opportunities available within a specified area. • Use hourly opportunity to travel as an indicator of accessibility rather than traditional distance to bus stop and service frequency. • Access to social networks (e.g. elderly people). • Potential health benefits
Potential to increase social cohesion and community pride	Qualitative judgment made based on market research results. What is the level of support offered by residents when asked in perception surveys?
Safety: safe and secure passenger transport	
• Potential to reduce crashes and injuries	Safety may be of low impact due to small exposure. Security difficult to predict accurately since it relies on subjective judgment regarding perceived impacts on personal security. However, this type of impact could be a significant benefit of FTS.
• Potential to increase confidence in passenger transport personal security	Vehicle kms saved on existing trips and additional vehicle-kms traveled on the new system can be converted to road crash estimates based on standard rates per million vehicle-km traveled used by DMR for accident saving calculations.
Environment: reduced energy use and improved air quality	
• Potential to reduce fuel consumption	FTS is unlikely to produce high levels of benefit in this regard. However, it is important to capture gains in a quantifiable fashion. However, any estimates may have high degree of uncertainty given the errors in estimation diverted trips and hence changes in vehicle-kms traveled. Using estimates of total vehicle kms using the new system is only part of the answer. Estimates of vehicle kms saved by car trips and conventional public transport are also needed. Converting to fuel consumption can be done using average consumption (liters/km) for peak and off-peak conditions. GHG and most other pollutants can be estimated from fuel consumption estimates using standard rates used in road project evaluation manuals.

Table 4 *(Continued)*

Evaluation criteria	Comment
• Potential to reduce green-house gas emissions • Potential to reduce other emissions	

their transport needs. Groups of concern for transportation needs, need not be groups categorized as disadvantaged as per the index of deprivation or socially disadvantaged (Walters, 2000).

Equity regarding mobility implies that it is just as important to provide access to life-enhancing facilities as to life-sustaining facilities. In fact, lack of access to enhancing services may lead to depression and subsequent social problems which may ultimately cost the community in other ways (TDM Dictionary, 2004).

The gaps in transport supply should be defined as either spatial, temporal or economic (Instant Advocate, 2004). A spatial gap means that there is no existing service to fulfil the current need (this includes the complete lack of special wheelchair access buses on some life-sustaining routes). A temporal gap means that the service is not frequent enough or does not run at specific hours when it is critically needed (an example of this is the lack of specialist disabled transport during peak school hours). The economic gap (or affordability gap) is when residents that need to access life-sustaining facilities cannot because they cannot afford to use existing services (i.e. unemployed not attending job interviews or vital training).

At a simplification of the individual level it has been summarised that constraints to accessibility are affected by a combination of (a) circumstances of the population and the individual, (b) the location and type of facilities to which the individual requires access, and (c) the availability and options for transport opportunities to access these facilities (Stanley & Farrington, 1981).

Hence, to analyze and quantify transport related needs, the following data is prerequisite:

. definition of the study area (boundaries of the area being covered by proposed FTS);
. socio-economic characteristics of study area;
. quantify current levels of public transport service available, including frequencies and route types;
. extent and degree of unmet demand;
. transport disadvantage and groups of concern.

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Table 5. Specific needs of the elderly

Key points

1. Mobility needs of the elderly are complex
2. Flexible transport services need to be targeted directly for the elderly
3. Many elderly have restricted income or pension allowances
4. Many elderly have already become accustomed to restricted mobility long before driving cessation
5. Elderly often feel uncomfortable about walking any distance to bus stops or other transport options
6. Elderly still require reliability but are far more flexible in time restrictions
7. May need to investigate cultivating and improving current private services (i.e. clubs) to also provide specialty access
8. Those that have perhaps made life and housing decisions based on mobility may suffer disproportionately when they finally lose their license more than those who have grown with supporting a car-free lifestyle

Key indices

Criteria for assessing the level of transport advantage in the elderly include:

- Extent of availability of a support network of family and friends
- Driver or non-driver
- Confidence as a car driver (at night, during congested periods)
- Extent of fitness (always mobile, some days need walking aid, some days immobile, nearly always immobile)
- of fitness (always mobile, some days need walking aid, some days immobile, nearly always immobile)
- Regular previous user of public transport/little use/no use
- Socio-economic grouping
- Choice of life-style (i.e. always previously reliant on car, lives remotely, etc.)

Critical supply aspects for FTS service may be:

- Minimization of walking to pick up and drop off points (both due to safety fears and health issues), and these must be clearly distinguishable and non-confusing (door-to-door appears to be preferred)
- Booking requirements must be simple, and information must be clear and easy to understand
- Comfort, cleanliness and confidence in the driver are priorities
- Target services at elderly prior to complete cessation of driving. This accustoms people to using public transport prior to losing their independence
- Elderly may feel insecure traveling alone on public options

Groups of concern define specific groups which have particular transport needs within the community. For example, youth, disabled, elderly, unemployed and those without access to a car. Although it is recognized that none of these groups are homogeneous, the specific targeting of some of their generic needs, simplifies the overall potential need assessment. Tables 5-10 highlight specific needs of the elderly, youth, family; lower socio-economic groups and those unemployed.

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Table 6. Specific needs of youth

Key points
1. Youth needs vary to elderly
2. Youth may be more acceptable of walking longer distances to bus stops and interchanges
3. Youth readily embrace new technology and alternatives
4. Youth may require vehicles that have facilities for bicycles, skateboards and other sporting equipment
5. Youth tend to see independence in transport as the initial road to adulthood and success
6. Most youth do not have their own vehicle and hence are totally reliant on public transport, family and friends
7. Educating youth to use public transport options as much as possible will increase the chances that they are more open to using such services in adulthood
8. The option to travel with family is decreasing as the number of dual working families' increases; this will increase the need for public transport options for youth
Key indices
Criteria for assessing the level of transport advantage in the youth include:
• From single parents or two full time working adults family background
• Socio-economic grouping
• In education/employed/unemployed living at home/away from home
Critical supply aspects for FTS service may be:
• Use of technology an advantage
• Needs to be flexible and respond to the demands of youth

Before they cease driving, elderly drivers are already adjusting their travel patterns to account for personal limitations, such as failing night vision, or slowing reactions (limiting driving to within daylight hours and quiet periods). By the time elderly begin to rely on public transport, their transport needs may be substantially reduced to encompass mainly only lifeline services.

For youth, transport can pave the road to independence and represents a symbol of success and adulthood. It enables youth to begin to make choices about where they want to travel, what activities they want to participate in, and employment opportunities. Storey and Brannen (2000) have shown that the needs of youth may have been neglected due to the fact that older people are perhaps better able and more experienced in recognising their needs in terms of equipment and services.

Research has found that unemployed young people with driving licenses return to work twice as quickly as those without (Stafford *et al.*, 1999).

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Table 7. Specific needs of the family

Key points
1. Single car owners where the car is needed to take someone to work can be left as isolated as those with no car 2. Family needs are the most difficult to group as there needs are perhaps the least homogeneous of all the groups 3. Options such as 'family rides free' on weekly commuter 'fixed service' tickets could be an incentive for commuters to use transport options rather than buy an extra car
Key indices Criteria for assessing the level of transport advantage in the family include: • Lower-middle incomes one car families/no car families • Single parent families • Migrants or newly immigrated families • High car dependent areas • Disabled or disadvantaged dependents Critical supply aspects for FTS service may be: • Demand highest at non peak times • Often requires facilities for prams and young children, and perhaps groceries (drivers may be expected to help with boarding etc.) • May have access and knowledge of technology use

The Use of Emerging Technologies

A high level of technology is assumed to be a key element of a successful FTS (Pratelli, 2002; Koffman, 2004). In conjunction with this, recent research studies are also being undertaken in advanced mathematical simulation methods to optimize the amount of 'slack' time required to accommodate demand-responsive service requests within the scheduled operating times (Fu, 2002). It is also recognized that technology and in specific database techniques can be an essential tool in gathering and analyzing target community information. During implementation, technology enables targeting information specifically on media which are directly attractive or usable by specific groups of concern. It is also expected that developments with respect to internet and SMS based pre-trip planning, GPS, and smart card technology, can only help in the development and emergence of FTS.

The methodology for quantifying unmet needs and requirements would be rendered more powerful with the use of current technology, such as GIS and software solutions, such as MapInfo to map and analyse current transport options, as well as optimising flexible and fixed access facilities. Decision making tools, such as fuzzy logic analyses, could also be used to explore various flexible options, as well

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doi: 10.1080/03081060701395501

Table 8. Specific needs of disabled

Key points
1. Disabled transport needs to be sensitive to the specific needs of the disabled, this includes considering the needs of those partially or only temporarily disadvantaged 2. Considerations are not made for peak usage overloads or other 'human' factors 3. Drivers and other key staff need to understand disability issues and be trained in how to deal with them 4. Information regarding transport options should be clear and available to all, including those which may have disabilities such as the visually or mentally impaired 5. Needs of disabled youth and disabled elderly vary considerably 6. Disabled need to feel confident that they can use transport facilities comfortably, safely and independently
Key indices Criteria for assessing the level of transport advantage in the disabled include: • Extent of availability of a support network of family and friends • Extent and type of disability • Socio-economic grouping • Capacity needs to allow for overloading at peak times • In employment/training/education/unemployed Critical supply aspects for FTS service may be: • Peak time and normal service requirements apply with additional infrastructure requirements • Dependent on disability, pick up and drop off points may be required to be door to door • Booking requirements and information hubs should take into consideration extent and types of varying disabilities

as to minimise subjectivity in the quantification of perceived mobility and accessibility needs.

Conclusions

A systematic approach to the evaluation of flexible transport solutions has been put forward to enable such solutions to be prioritized and their net benefit compared with alternative transport strategies.

Standard solutions and targets based on typical needs of certain groups of concern may be used to enable the design of optimum flexible solutions. In addition, developing confidence and education on the use of public transport can be an important part of the flexible solution. Providing accessibility is only one component of the complex problem of getting individuals to recognize and act on their needs for support.

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Table 9. Specific needs of lower socio-economic groups

Key points
Although current service may be adequate, needs may not be being met due to affordability
Key indices Criteria for assessing the level of transport advantage for those with lower socio economic disadvantages include: • Many facilities located at different locations and requiring different transport modes - this means many different trips, and more accumulative costs • Presence of younger children (i.e. 8-16 years) who may require multiple trips to access resources Critical supply aspects for FTS service may be: • Needs to cater for peak capacity demands (e.g. start/finish work, school, sport activities) • Often alternative solutions such as car sharing should to be evaluated. These solutions can be more flexible to a families needs, perhaps giving lower income families opportunities to 'get away' on the weekend or other times

Car transport has been marketed for years as a means of independence, security and status. Such attitudes and biases, which may also exist in the minds of policy makers and operational planners, need to be overcome by offering a product which is significantly different from conventional transit.

Table 10. Specific needs of the unemployed

Key points
1. Reliability, affordability, speed and flexibility is paramount 2. Destinations may be located away from standard stop points
Key indices Criteria for assessing the level of transport advantage for those unemployed include: • Economic disadvantage could be temporary • High demand for training and activities to increase opportunities • Those living away independently, or with working parents may require higher level of transportation options • Potentially facing discrimination from employers if reliant on public transport options - may need to direct information to business as well as individual in need Critical supply aspects for FTS service may be: • Alternative FTS solutions such as temporary car/moped sharing should be considered. These have been proven to be very successful within this group • Options should be targeted at business communities as well as at individual level

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