World Transport Policy & Practice

ISSN 1352-7614

Volume 10, Number 1, 2004

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Mission Statement

World Transport Policy & Practice is a quarterly journal which provides a high quality medium for original and creative work in world transport.

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Economic Value of Walkability*Todd Alexander Litman*

This paper describes ways to quantify the value of walking (the activity) and walkability (the quality of walking conditions, including safety, comfort and convenience). Walking and walkability provide a variety of benefits, including accessibility, consumer cost savings, public cost savings (reduced external costs), more efficient land use, community livability, improved fitness and public health, economic development, and support for equity objectives. Current transportation planning practices tend to undervalue walking. More comprehensive analysis techniques, described in this paper, are likely to increase public support for walking and other non-motorised modes of travel.

Keywords

Benefit-Cost analysis, economy, health, livability, pedestrians, transport, walking.

U.S. Air Transportation Since 9/11/2001: Disruption or Transformation?*James deBettencourt, Hank Dittmar and Anthony Perl*

This article examines air service changes at U.S. commercial service airports from October 1, 2001 through September 30, 2003, to determine whether the U.S. air transportation network is experiencing structural change, as opposed to the cyclical variation in activity that has been common in this transport mode. Almost all U.S. airports saw fewer flights in the year following the terrorist attacks of September 11, 2001. While many interpretations have attributed these airline schedule reductions to a discrete systemic shock that would eventually be eclipsed by a return to air travel's historic growth trend, several signs point to these changes representing the 'take-off' phase of a fundamental industry restructuring whose roots predate the 9/11 attacks. A second year of data on flight frequencies and capacity post 9/11 provides further evidence supporting this hypothesis. Our findings correspond with a recent economic analysis of airlines' financial performance attributing post 9-11 restructuring efforts to unsustainable structural factors, representing a 'more systemic industry crisis' that predated the 9-11 attacks (Nolan, *et. al.*, 2004, 239).

Keywords

9/11, airlines, airports, aviation, low-cost carriers, 'regional jets', restructuring, terrorism, travel.

Just how (Travel) Smart are Australian universities when it comes to implementing sustainable travel?*Carey Curtis and Carlindi Holling*

Australia, like the United States, the UK and Europe, has seen the development of policies for sustainable travel in the past decade. Although not a new approach, Travel Demand Management Plans are one tool seeking to manage commuter travel for transport

sustainability. Australian universities generate substantial commuter trips which result in a significant impact on transport infrastructure and on the community. Travel planning for universities needs also to be cognizant of the particular characteristics which set universities apart from other large employers.

The paper reviews international literature on TDM at universities in order to establish the extent to which TDM actions have been implemented. This provides a benchmark with which to compare action taken by Australian universities. The survey findings indicate that implementation of TDM in Australian universities is still in its infancy with only six of 25 surveyed universities developing TDM plans. The main focus of these plans is on improving public transport access. None seek to implement disincentives for access by car despite the heavily car dependent nature of those universities in suburban locations. Universities are reliant on individuals to champion the cause in the absence of federal legislation requiring such action. Such legislation may now be required in order to accelerate progress towards sustainable travel practices at Australian universities.

Keywords

Australia, TDM, Travel Demand Management, Universities travel.

Practical Lessons for Winning Support for Radical Transport Proposals*Marcus Enoch, Sarah Wixey and Stephen Ison*

This paper proposes that while many plans and solutions to the transport problems of the 21st Century have been mooted, very few have succeeded in significantly improving the situation within Europe. It is suggested that many schemes face problems at the project implementation stage due to adverse public and/or political reaction. This paper incorporates a series of vignettes, several of which are based on in-depth interviews with practitioners directly involved in the implementation of the schemes in question. It looks at several existing 'radical' transport schemes from around the world in an attempt to draw lessons as to how they overcame this, not least in terms of how the implementation of alternative strategies by European policy-makers could be shaped and adopted world-wide.

Keywords

transport policy, policy implementation, TDM, transport demand management, case studies.

In his paper "High Occupancy Vehicle (HOV) Lanes: Highway expansions in search of meaning", Preston Schiller wrote:

In the early years of the automobile, most vehicles were operated as high occupancy vehicles. In fact, the larger passenger capacity of many cars was designed to accommodate greater ridesharing. Economic necessity made carpooling a routine part of life for most families and individuals. Neighbours would share the ride to work, school, grocery shopping, and the movies. Wartime gasoline rationing encouraged ridesharing, as did explicit publicity campaigns. One World War II era advertisement of the U.S. Government portrays the grim message, "If you ride alone, you ride with Hitler!" *World Transport Policy & Practice*, Volume 4, Number 2, 1998, 32-39.

Recently, we discovered that "When You Ride Alone You Ride With Hitler!" by Weimer Pursell is on the internet at:

http://www.archives.gov/exhibit_hall/powers_of_persuasion/use_it_up/images_html/ride_with_hitler.html

It was printed in 1943 by the Government Printing Office for the Office of Price Administration.

We are grateful to the National Archives and Records Administration, College Park, MD, U.S.A. for permission to reproduce this image, NARA Still Picture Branch (NWDNS-188-PP-42).

There is an exhibition of U.S. Second World War posters at:

http://www.archives.gov/exhibit_hall/powers_of_persuasion/powers_of_persuasion_intro.html

Economic Value of Walkability

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Abstract

This paper describes ways to quantify the value of walking (the activity) and walkability (the quality of walking conditions, including safety, comfort and convenience). Walking and walkability provide a variety of benefits, including accessibility, consumer cost savings, public cost savings (reduced external costs), more efficient land use, community livability, improved fitness and public health, economic development, and support for equity objectives. Current transportation planning practices tend to undervalue walking. More comprehensive analysis techniques, described in this paper, are likely to increase public support for walking and other non-motorised modes of travel.

Keywords

Benefit-Cost analysis, economy, health, livability, pedestrians, transport, walking.

Introduction

What is more important, driving or walking? Conventional transport evaluation practices suggest that personal motor vehicle travel is far more important than walking, representing about fifteen times as many person-trips and fifty times as many person-miles as non-motorised travel.¹ From a conventional planning perspective, walking (the activity) is a minor mode of travel, and walkability (the quality of walking conditions, including safety, comfort and convenience) deserves only modest public support.

This high value placed on driving and low value placed on walking reflects how transport is measured.² Most travel surveys undercount non-motorised travel because they ignore short trips, non-work travel, travel by children, recreational travel and non-motorised links. For example, most travel surveys classify trips as 'auto' or 'transit' that are actually 'auto-walk', or 'walk-transit-walk'. The walking component is often ignored even if it takes place on

public rights-of-way and involves as much time as a motorised link. One study found that the actual number of non-motorised trips is six times greater than indicated by conventional surveys.³ If, instead of asking, 'What portion of trips *only* involve walking', we ask, 'What portion of trips involve *some* walking', most trips would be counted and walking would be recognised as a common and important mode.

Consider another perspective. Would you rather lose your ability to drive or your ability to walk? Being able to drive, although useful, is less essential than the ability to walk. With a little planning, a physically-able non-driver can engage in most common activities, but being unable to walk affects nearly every aspect of life, creating barriers to employment, recreation and social activities.

Transportation planners have standard ways to evaluate motor vehicle traffic conditions and the value of changes in these conditions. For example, computer models such as the *Highway Design and Maintenance Model* and *MicroBENCOST* calculate the monetised (measured in monetary units) value of vehicle operating cost savings, safety benefits and travel time savings from roadway improvements.⁴ This information helps justify roadway improvements. Walkability is not as easily quantified and so tends to be undervalued in planning decisions. This:

- Shifts resources from walking facilities to roads and parking;
- Favours automobile-oriented land use patterns (wide roads, generous parking, low density, single-use) over pedestrian-oriented development;
- Undervalues traffic management practices that support walking, such as traffic calming; and
- Undervalues pedestrian safety investments.⁵

This tendency to undervalue non-motorised travel can be particularly harmful because transportation

¹ The Bureau of Transportation Statistics 1995 *National Personal Transportation Survey* (<http://www.bts.gov/nhts>) indicates that 86% of total personal trips are by private automobile, 5.4% are by walking, and 1.8% are by public transit. Other travel surveys have similar results.

² VTPI. 'Measuring Transportation'. *Online TDM Encyclopedia*. Victoria Transport Policy Institute (<http://www.vtpi.org>), 2002.

³ Rietveld, P. 'Nonmotorized Modes in Transport Systems: A Multimodal Chain Perspective for The Netherlands'. *Transportation Research D*, Vol. 5, No. 1, January 2000, pp. 31-36.

⁴ *Highways Design and Maintenance (HDM) 4 Model*, World Bank (<http://hdm4.piar.org/main/home-e.htm>). *MicroBENCOST*, Texas Transportation Institute (<http://tti.tamu.edu>), 1997.

⁵ McCann, B. and DeLille, B. *Mean Streets 2000*. Surface Transportation Policy Project (<http://www.transact.org>), 2000.

decisions often involve mutually exclusive tradeoffs between different types of accessibility. Wide roads, high traffic speeds and large parking facilities create barriers to walking, so evaluation practices that undervalue walking tend to create automobile dependent communities.

To their credit, many transportation professionals support walking more than is justified by their own evaluation practices. They intuitively know that transport diversity in general, and walking in particular, are important to society and so favour walkability improvements. Although most travel surveys indicate that only about 5% of trips are by walking, many local transportation agencies devote 10-15% of their resources to non-motorised facilities and services. However, this occurs despite, rather than as a result of, conventional transportation survey data and evaluation methods.

This is a timely issue because there is growing interest in walking as a form of transport, and increased recognition of the benefits of transportation diversity.⁶ Better tools for evaluating walkability can help in countless transportation and land use planning decisions.⁷

This paper investigates the value of walking (the activity) and walkability (the quality of walking conditions, including factors such as the existence of walking facilities and the degree of walking safety, comfort and convenience). It identifies categories of economic benefits, describes how they can be measured, and the degree to which these are reflected in current transportation and land use planning. This paper can only provide a general review of these issues – more research is needed to create practical tools that can be used by transport planners to quantify the full benefits of walkability.

Most analysis in this paper applies to any form of non-motorised transportation, including cycling and skating and wheelchair use. For simplicity I use the term 'walking' and 'walkability', but readers may wish to substitute 'non-motorised travel' and 'non-motorised travel conditions' to be more inclusive.

Why walking is undervalued

There are several reasons why walking and walkability tend to be undervalued in conventional transport planning. Some of these are discussed below.

⁶ Litman, T. 'Evaluating Transportation Choice'. *Transportation Research Record 1756*, Transportation Research Board (<http://www.trb.org>), 2001, pp. 32-41, also available at VTPI (<http://www.vtpi.org>), 2001.

⁷ Sælensminde, K. *Walking and Cycling Track Networks in Norwegian Cities: Cost-Benefit Analysis Including Health Effects and External Costs of Road Traffic*. Institute of Transport Economics, Oslo (http://www.toi.no/toi_Data/Attachments/887/sum_567_02.pdf), 2002.

Difficult to Measure

Walking tends to be more difficult to measure than vehicle travel, and walkability tends to be more difficult to evaluate than motor vehicle traffic. As mentioned earlier, travel surveys often collect little information on total walking activity, and walking is given little attention in transportation models. As a result, most walking is invisible to transportation planners. However, travel surveys can collect more detailed information on non-motorised travel (for example, asking respondents to identify any walking trip on public right-of-way), and in recent years new techniques have been developed to better evaluate walkability.⁸

Low Cost

One of the reasons that walking tends to be overlooked is that it is so inexpensive. As a result there is not an organised walking industry as with automobile, transit and air transport, and there is little dedicated funding. Improved walkability can provide consumer cost savings, but such avoided costs are difficult to predict and are often given little consideration. Because it is used by lower-income people, walking tends to be stigmatised while motorised transport tends to be associated with success and progress.

'Will Take Care of Itself'

Decision-makers often seem to assume that walking can take care of itself. For example, it is possible to walk along most roads, either in the roadway or on dirt paths that develop along road shoulders, even if they lack sidewalks and paths. As a result, many new communities are built without sidewalks, and few communities devote significant resources to upgrading walkability in built-up areas. Such insensitivity to walking conditions is misplaced: areas with poor walkability tend to have significantly less walking and more driving than more walkable areas.

Categories of economic impacts

Economics refers to the allocation of valuable resources. This can include both market resources (money, labour and land) and nonmarket resources (safety, clean air, wildlife habitat and aesthetic features). *Economic impacts* refers to benefits and costs, that is, an increase or reduction in resource value. This section describes major categories of economic impacts associated with walking, the degree to which they are recognised in current transport evaluation, and how they can be evaluated.⁹

⁸ VTPI. 'Evaluating Nonmotorized Transport'. *Online TDM Encyclopedia*, VTPI (<http://www.vtpi.org>), 2002.

⁹ For a comparable analysis of public transit benefits, see Litman, T. *Evaluating Public Transit Benefits and Costs*. Victoria Transport Policy Institute (<http://www.vtpi.org>), 2002.

Accessibility

Description

Accessibility (or just *Access*) refers to the ability to reach desired goods, services and activities.¹⁰ Walking is an important form of access, both by itself and in conjunction with other modes (transit, driving, air travel, etc.). Walking provides basic mobility, that is, many people rely on walking to access activities with high social value, such as medical services, essential errands, education and employment.¹¹ It is particularly important for people who are transportation disadvantaged (people with disabilities, elders, children, and people with low incomes). Poor walking conditions can contribute to *social exclusion*, that is, the physical, economic and social isolation of vulnerable populations.¹² Pedestrian access to public transit is an important accessibility factor.¹³

Evaluation Methods

Several methods can be used to evaluate walkability, taking into account the quality of pedestrian conditions and the geographic distribution of destinations.^{8, 14} Accessibility can be evaluated using resident surveys, field surveys and Geographic Information Systems (GIS) to determine the portion of important destinations (medical services, shops, schools, jobs, government offices, etc.) that can be conveniently reached by walking or walk-transit-trips, particularly by disadvantaged populations. The value of marginal changes in walking conditions can be quantified using contingent valuation surveys to determine the value people place on improved pedestrian accessibility, and cost savings compared with other access options (such as driving).

Consumer Cost Savings

Description

Walkability affects consumer transport costs. Good walking conditions allow consumers to save on vehicle expenses. For example, one study found that households in automobile-dependent communities devote 50% more to transportation (more than \$8,500 annually) than households in communities with more accessible land use and more multi-modal transportation systems (less than \$5,500 annually).¹⁵

¹⁰ VTPI. 'Accessibility'. *Online TDM Encyclopedia*, VTPI (<http://www.vtpi.org>), 2002.

¹¹ VTPI. 'Basic Mobility and Access'. *Online TDM Encyclopedia*, VTPI (<http://www.vtpi.org>), 2002.

¹² Social Exclusion Unit, UK Government (<http://www.socialexclusionunit.gov.uk>).

¹³ Rood, R. *Local Index of Transit Availability*. Local Government Commission (<http://www.lgc.org>), 1999.

¹⁴ FDOT. *Quality/Level of Service Handbook*. Florida Department of Transportation (http://www11.myflorida.com/planning/systems/sm/los/los_sw2.htm), Feb. 2002.

¹⁵ McCann, B. *Driven to Spend: The Impact of Sprawl on Household Transportation Expenses*. Surface Transportation Policy Project (<http://www.transact.org>), 2000.

Evaluation Methods

Consumer savings from improved walkability can be evaluated based on potential transportation cost savings. For example, pedestrian improvements that allow more students to walk to school rather than be driven by parents, provides vehicle cost savings, and improved community walkability can reduce residents' vehicle ownership and operating costs.

Public Cost Savings (Reduced Transport Externalities)

Description

Motor vehicle use imposes various public costs for road and parking facilities, traffic congestion, crash risk, and environmental damages.¹⁶ Shifting travel from motorised to non-motorised modes reduces these external costs.¹⁷ Walking substitutes for relatively short vehicle trips, which tend to have high costs per vehicle-mile. In particular, energy consumption and pollution emissions are several times higher than average for short trips when engines are cold, and parking costs are high when measured per vehicle-mile, since these costs are divided into few miles. A short walking trip often substitutes for a longer motor vehicle trip. As a result, each percentage shift of vehicle trips to walking can reduce transport external costs by several percentage points, particularly under urban-peak conditions when emission and parking costs are high.

Evaluation Methods

A variety of methods are used to calculate the external cost savings that result when travel shifts from driving to non-motorised modes.¹⁸ Figure 1 illustrates one comparison of the estimated external costs of driving and walking. Shifting travel from driving to walking can help reduce various external costs, providing savings estimated to average approximately 25¢ per vehicle-mile reduced, and 50¢ per vehicle-mile reduced under urban-peak conditions.¹⁹

Land Use Efficiency

Description

Low-density development with large amounts of land paved for roads and parking imposes various

¹⁶ McCubbin D. and Delucchi, M. *Social Cost of the Health Effects of Motor-Vehicle Air Pollution*. UC Davis, ITS (<http://www.its.ucdavis.edu>), 1996. Also see *ExternE* (<http://externe.jrc.es>) and UNITE (<http://www.its.leeds.ac.uk/projects/unite>).

¹⁷ Litman, T. *Quantifying the Benefits of Non-Motorized Transport for Achieving TDM Objectives*. Victoria Transport Policy Institute (<http://www.vtpi.org>), 2000.

¹⁸ Murphy, J. and Delucchi, M. 'A Review of the Literature on the Social Cost of Motor Vehicle Use in the U.S.' *Journal of Transportation And Statistics*. Vol. 1, No. 1 (<http://www.bts.gov>), January 1998, pp. 15-42.

¹⁹ Litman, T. *Transportation Cost and Benefit Analysis*. VTPI (<http://www.vtpi.org>), 2002.

Figure 1. Estimated External Costs of Automobile Travel & Walking

economic, social and environmental costs.²⁰

Walkability improvements can help reduce these costs by reducing the amount of land required for transport facilities and encouraging more accessible, clustered land use patterns.²¹ This provides economic, social and environmental benefits.

Evaluation Methods

There are many factors to consider when evaluating the impacts of transportation decisions on land use patterns.²² Evaluating these impacts requires:

1. An understanding of how transportation in general, and walkability in particular, affect land use patterns.^{23, 24} Compared with driving, walking requires far less space for travel and parking, does not require building setbacks to mitigate traffic noise, and encourages more clustered development patterns. As a result, walkable communities can

devote less land to pavement and tend to result in higher development densities than is common with more automobile-oriented transport systems, reducing per capita land consumption.

2. An understanding of the economic impacts of different types of land use patterns, including the economic, social and environmental benefits from reduced impervious surface²⁵ and more clustered development patterns.²⁶

Community Livability

Description

Community Livability refers to the environmental and social quality of an area as perceived by residents, employees and visitors. This includes safety and health (traffic safety, personal security, public health), local environmental quality (cleanliness,

²⁰ Burchell, R. et al. *The Costs of Sprawl – Revisited*. TCRP Report 39, Transportation Research Board (<http://www.trb.org>), 1998.

²¹ Ewing, R., Pendall, R. and Chen, D. *Measuring Sprawl and Its Impacts*. Smart Growth America (<http://www.smartgrowthamerica.org>), 2002.

²² Litman, T. *Evaluating Transportation Land Use Impacts*. VTPI (<http://www.vtpi.org>), 2002.

²³ Carlson, D., Wormser, L. and Ulberg, C. *At Road's End; Transportation and Land Use Choices for Communities*. Island Press (Washington DC; <http://www.islandpress.org>), 1995.

²⁴ USEPA. *Our Built and Natural Environments: A Technical Review of the Interactions Between Land Use, Transportation and Environmental Quality*. US Environmental Protection Agency (<http://www.epa.gov/smartgrowth/pdf/built.pdf>), 2001.

²⁵ Arnold C. and Gibbons, J. 'Impervious Surface Coverage: The Emergence of a Key Environmental Indicator'. *American Planning Association Journal*, Vol. 62, No. 2, Spring 1996, pp. 243-258. Also see NEMO Project (<http://www.canr.uconn.edu/ces/nemo>).

²⁶ USEPA. *Indicators of the Environmental Impacts of Transportation*. Office of Policy and Planning, USEPA (Washington DC; <http://www.itre.ncsu.edu/cte>), 1999.

noise, dust, air quality, water quality), community cohesion (neighbourliness, respect, community identity), opportunities for recreation and entertainment, aesthetics, and the existence of unique cultural and environmental resources (e.g., historic structures, mature trees, traditional architectural styles).²⁷

Walkability has major impacts on community livability. Streets are a major portion of the public realm, that is, places where people interact with their community. More attractive, safe and walkable streets increase community livability.²⁸ Residents on streets with higher traffic volumes and speeds are less likely to know their neighbours, and show less concern for their local environment, than residents on streets with less vehicle traffic.²⁹

Evaluation Methods

Community livability provides a variety of direct and indirect benefits. It can affect property values and business activity in an area,³⁰ which can be measured with various techniques such as hedonic pricing and contingent valuation.^{31, 26} This may not reflect total livability benefits, since benefits to non-residents are not necessarily reflected in property values. The value of walkability varies, depending on several factors:

- Pedestrian-friendly, new urbanist community design tends to increase property values;³²
- In automobile dependent areas, sidewalks may have little effect on adjacent property values;
- Reduced vehicle traffic can increase adjacent property values, in part, because it improves walking safety and comfort;³³ and
- Proximity to public trails often increases residential and commercial property values.³⁴

²⁷ Steve Weissman and Judy Corbett. *Land Use Strategies for More Livable Places*. Local Government Commission (<http://www.lgc.org>), 1992. Also see *Center for Livable Communities* (<http://www.lgc.org/clc>).

²⁸ Forkenbrock D. and Weisbrod, G. *Guidebook for Assessing the Social and Economic Effects of Transportation Projects*. NCHRP Report 456, Transportation Research Board (<http://www.trb.org>), 2001.

²⁹ Appleyard, D. *Livable Streets*. University of California Press (Berkeley), 1981.

³⁰ LGC. *The Economic Benefits of Walkable Communities*. Local Government Commission (<http://www.lgc.org>), 2001.

³¹ Hanley N. and Spash, C.L. *Cost-Benefit Analysis and the Environment*. Edward Elgar (Aldershot), 1993.

³² Eppli, M. and Tu, C.C. *Valuing the New Urbanism: The Impact of New Urbanism on Prices of Single-Family Homes*. Urban Land Institute (<http://www.uli.org>), 2000.

³³ Bagby, G. 'Effects of Traffic Flow on Residential Property Values'. *Journal of the American Planning Association*, Vol. 46, No. 1, January 1980, pp. 88-94.

³⁴ NBPC. *The Economic and Social Benefits of Off-Road Bicycle and Pedestrian Facilities*. National Bicycle and Pedestrian Clearinghouse, No. 2 (<http://www.bikefed.org>), Sept. 1995.

Diseases associated with inadequate physical activity

• Heart disease	• Obesity	• Hypertension
• Osteoporosis	• Stroke	• Depression
• Diabetes	• Some types of cancer	

Source: Killingsworth R.E. and Lamming, J. 'Development and Public Health; Could Our Development Patterns be Affecting Our Personal Health?' *Urban Land* (<http://www.uli.org>), July 2001, pp. 12-17.

To the degree that improved walkability increases community cohesion, it may help reduce crime and other social problems in an area.²⁸ However, such relationships are difficult to measure and walkability is just one of many related factors that affects community cohesion.

Health

Description

Physical Activity refers to physical exercise.

Inadequate physical activity is a major contributor to health problems. Health experts recommend at least 30 minutes of moderate exercise a day, at least 5 days a week, in intervals of ten-minutes or more.³⁵

An increasing portion of the population, including many children, lack regular physical activity. Although there are many ways to be physically active, walking is one of the most practical ways to increase physical activity among a broad population. Walking tends to be particularly important for elderly, disabled and lower-income people who have few opportunities to participate in sports or formal exercise programs. Health experts believe that more balanced transportation systems can contribute to improved public health by accommodating and encouraging active transportation.³⁶

The health benefits of increased walking and improved walkability are potentially large.³⁷ Cardiovascular diseases are the leading causes of premature death and disability in developed countries, causing ten times as many lost years of productive life as road crashes.³⁸ Even modest reductions in these illnesses could provide significant health benefits.

Walking has a relatively high crash fatality rate

³⁵ Surgeon General. *Physical Activity and Health*. Center for Disease Control and Prevention (<http://www.cdc.gov/nccdphp/sgr/sgr.htm>), 1999.

³⁶ Jackson R.J. and Kochtitzky, C. *Creating A Healthy Environment: The Impact of the Built Environment on Public Health*. Sprawl Watch Clearinghouse (<http://www.sprawlwatch.org/health.pdf>), 2001.

³⁷ Litman, T. *If Health Matters: Integrating Public Health Objectives in Transportation Planning*. Victoria Transport Policy Institute (<http://www.vtpi.org>), 2002.

³⁸ Murray C. (Ed). *Global Burden of Disease and Injury*. Center for Population and Development Studies, Harvard University School of Public Health (<http://www.hsph.harvard.edu/organizations/bdu>), 1996.

per mile of travel, but this is offset by reduced risk to other road users and by the fact that pedestrians tend to travel less overall than motorists (for example, a walking trip to a local store often substitutes for a longer car trip to a more distant shopping centre). International research suggests that shifts to non-motorised transport increases road safety overall.³⁹ For example, the Netherlands has a high level of non-motorised transport, yet per capita traffic deaths and the cyclist death rate per million km ridden is much lower than in more automobile dependent countries.⁴⁰

Evaluation Methods

Public surveys can be used to determine the degree that people in an area rely on walking for exercise, and the degree to which improved walkability would increase physical activity by otherwise sedentary people. More research is needed to determine how changes in walkability affect physical activity and public health.

Economic Development

Description

Economic Development refers to progress toward a community's economic goals, including increases in economic productivity, employment, business activity and investment.⁴¹ Walkability can affect economic development in several ways.⁴²

Retail and employment centres are affected by the quality of their pedestrian environment, particularly in urban areas and resort communities. The popularity of retail malls, suburban office campuses, and pedestrian-oriented resort communities are indications of the high values that consumers place on pedestrian environmental quality. A shopping centre or office complex may become more economically competitive if walking conditions improve. Pedestrianised commercial districts ('main streets') can be important for urban revitalisation, although they must be carefully implemented to be effective.^{43, 44}

Walkability improvements can also support

regional economic development by shifting consumer expenditures from vehicles and fuel to other consumer goods that provide more regional employment and business activity (an indirect benefit from the transport cost savings described earlier). One study in Texas found that consumer expenditures shifted from automobiles to a typical bundle of consumer goods provide 71% more regional income and twice the employment activity.⁴⁵

Evaluation Methods

Walkability can affect economic development in several ways, each must be considered separately. Market surveys and property assessments can be used to identify how walkability factors affect commercial activity (such as retail sales), consumer satisfaction, competitiveness, employment, tax revenue, and property values in an affected area. Economic analysis techniques using input-output tables can be used to determine how changes in consumer expenditures affect regional employment and business activity.⁴⁶

Equity

Description

Equity refers to the distribution of resources and opportunities. Transport decisions can affect equity in various ways. There are several different equity issues, including *horizontal equity* (which assumes that people should generally be treated equally), and *vertical equity* (which assumes that society should provide extra support to disadvantaged people).⁴⁷

Walkability can help achieve several equity objectives, including a fair distribution of public resources for non-drivers, financial savings and improved opportunity for lower-income people, increased accessibility to people who are transportation disadvantaged, and providing basic mobility.

Evaluation Methods

Because there are different types of equity, a variety of factors should be considered when evaluating transportation equity impacts. Table 1 describes five equity indicators that can be used to evaluate the overall equity impacts of changes in walkability.

The most practical approach to evaluating equity impacts is to define equity objectives and performance

³⁹ VTPI. 'Safety Evaluation'. *Online TDM Encyclopedia*, VTPI (<http://www.vtpi.org>), 2002.

⁴⁰ Pucher J. and Dijkstra, L. 'Making Walking and Cycling Safer: Lessons from Europe'. *Transportation Quarterly*, Vol. 54, No. 3, Summer 2000, available at VTPI (<http://www.vtpi.org>).

⁴¹ VTPI. 'TDM and Economic Development'. *Online TDM Encyclopedia*, VTPI (<http://www.vtpi.org>), 2002.

⁴² LGC. *The Economic Benefits of Walkable Communities*. Local Government Comm. (<http://www.lgc.org>), 2001.

⁴³ Tyler, N. *Downtown Pedestrian Malls*, (<http://www.emich.edu/public/geo/557book/d210.pedmalls.html>) and *Pedestrians and Downtowns* (<http://www.emich.edu/public/geo/557book/c125.pedes.html>) 1999.

⁴⁴ Bohl, C.C. *Place Making: Developing Town Centers, Main Streets and Urban Villages*, Urban Land Institute (<http://www.uli.org>), 2002.

⁴⁵ Miller, J., Robison, H. and Lahr, M. *Estimating Important Transportation-Related Regional Economic Relationships in Bexar County, Texas*. VIA Transit (San Antonio; <http://www.viainfo.net>), 1999.

⁴⁶ Weisbrod, G. *Synthesis of Current Practice for Assessing Economic Development Impacts from Transportation Projects*. NCHRP Study 20-5 (<http://www.edrgruop.com/pages/summary-synthesis.html>), TRB, National Academy Press, ISBN 0-309-06873-8, 2000.

⁴⁷ VTPI. 'Equity Evaluation'. *Online TDM Encyclopedia*, VTPI (<http://www.vtpi.org>), 2002.

Table 1. Equity Summary

<i>Indicator</i>	<i>Description</i>
Treats everybody equally.	This reflects whether a policy treats each group or individual equally.
Individuals bear the costs they impose	This reflects the degree to which user charges reflect the full costs of a transportation activity.
Progressive with respect to income	This reflects whether a policy makes lower-income households better or worse off.
Benefits transportation disadvantaged	Whether a policy makes people who are transportation disadvantaged better off by increasing their options or providing financial savings.
Improves basic mobility and access	This reflects whether a policy favours more important transport (emergency response, commuting, basic shopping) over less important transport.

This table describes five indicators of transportation equity that can be used when evaluating walkability equity impacts.

Source: VTPI. 'Equity Evaluation'. Online TDM Encyclopedia, VTPI (www.vtpi.org), 2002.

Table 2. Walkability Economic Impacts

<i>Name</i>	<i>Description</i>	<i>Measuring Techniques</i>
Accessibility	Degree that walking provides mobility options, particularly for people who are transportation disadvantaged.	Travel modelling, analysis of travel options.
Consumer cost savings	Degree to which walking provides consumer transportation cost savings.	Consumer expenditure surveys
Public cost savings (reduced external costs)	Degree that walking substitutes for vehicle travel and reduces negative impacts.	Determine to what degree walking reduces motor vehicle travel, and the economic savings that result.
Efficient land use	Degree that walking helps reduce the amount of land used for roadway and parking facilities, and helps create more accessible, clustered land use.	Identify the full economic, social and environmental benefits of more pedestrian-oriented land use.
Livability	Degree that walking improves the local environment.	Property values, business activities, consumer preference surveys.
Public fitness and health	Degree that walking provides physical exercise to people who are otherwise sedentary.	Travel and health surveys to determine the number of people who benefit from walking exercise.
Economic development	Degree to which walking makes commercial areas more attractive and shifts consumer expenditures to goods that provide more regional economic activity and employment.	Market surveys and property assessments. Input-output table analysis.
Equity	Degree that walkability helps achieve various equity objectives.	Various indicators of horizontal and vertical equity.

This table summarises various categories of impacts to consider when evaluating walking.

indicators, and then evaluate the degree to which a particular policy or project helps achieve them.⁴⁸ Equity benefits are difficult to monetise (there is no easy way to add equity benefits to other benefits such as vehicle cost savings or increased property values), but most communities seem to place a high value on achieving equity objectives.²⁸

Summary of economic impacts

Table 2 summarises the categories of economic benefits described above that should be considered when evaluating walking. In most situations, several impacts should be considered, with results added to determine total benefits. For example, a particular walkability improvement may improve accessibility, provide consumer cost savings, increase community

livability (and therefore local property values), improve public fitness and health, benefit the local economy (increasing employment, tax revenue and property values), and support strategic land use and equity objectives. The project's full value is the sum of these individual benefits.

Planning applications

The value of walkability can be incorporated into transport planning decisions in various ways, reflecting various perspectives and assumptions. Three approaches are described below.

Proportional Share

One approach that many people seem to consider fair and efficient is to allocate transport resources based on each mode's share of travel activity. For example, a mode which represents 2% of travel

⁴⁸ VTPI. 'Transport Planning'. Online TDM Encyclopedia, VTPI (<http://www.vtpi.org>), 2002.

should receive about 2% of resources, and a mode which represents 20% of travel should receive 20% of funds.

As discussed earlier in this paper, conventional travel surveys undercount walking. Although only about 5% of trips are made completely by walking, 16-33% of urban trips involve at least one walking link (Table 3). By this measure, a major share of transport resources should be devoted to walking.

Walking only represents a small portion (perhaps 1-2%) of total person-mileage. However, a short walking trip often substitutes for a longer automobile trip. For example, consumers may choose between walking to a nearby store or driving to a supermarket. Motorists tend to travel far more (about 3 times as much on average) as non-motorists. There is no obvious reason why society should subsidise automobile trips and motorists at a greater rate than walking trips and non-drivers.

Local governments devote a relatively large portion of infrastructure funds to walking facilities, perhaps 5-15% of transport agency budgets, and somewhat more if expenditures on recreational trails are also included.⁴⁹

However, other levels of government provide less support for walking. For example, the state of Oregon is considered a leader in non-motorised planning because it devotes 2% of state transport funds to walking and cycling facilities. Most states spend less than 1% of their transport budgets on walking facilities. Table 4 illustrates the estimated portion of transport expenditures devoted to walking, using upper-bound values (actual numbers are probably smaller). By this estimate, walking receives somewhat less than its proportion of trips as measured by conventional travel studies, and far less than indicated by more comprehensive counts.

This discrepancy between the portion of travel by walking and the portion of resources devoted to walking becomes far larger when other public resources devoted to transport are included, such as expenditures on parking facilities and traffic services, and the opportunity cost of public lands devoted to roadways.

There are many reasons to criticise the assumption that each mode should receive its proportional share of transport resources. It is backward looking, reflecting the transportation patterns resulting from past decisions, rather than forward looking, reflecting the transportation system society wants in the future. Some modes provide special social benefits, bear

⁴⁹ This estimate is based on reviews of typical transport agency budgets. I am unable to find specific published information since transportation financial statistics generally lack non-motorised mode expenditure data (e.g., http://www.bts.gov/publications/government_transportation_financial_statistics).

Table 3. Commute Trips By Mode

	<i>Car Only</i>	<i>Walking All or Part</i>	<i>Transit All or Part</i>
Winnipeg	73%	16%	15%
Vancouver	72%	20%	12%
Calgary	72%	21%	12%
Canada	69%	22%	10%
Toronto	61%	24%	20%
Ottawa	60%	33%	16%

Statistics Canada, General Social Survey on Time Use, 1992.

Table 4. Estimated U.S. roadway expenditures by level of government (2000, billions)

	<i>Total Roadway Expenditures</i>	<i>Estimated Portion Devoted To Walking</i>	<i>Walking Expenditures</i>
Federal	\$30.8	2.5%	\$0.8
State	\$66.4	1.0%	\$0.7
Local	\$31.3	10.0%	\$3.1
<i>Totals</i>	<i>\$128.5</i>	<i>3.5%</i>	<i>\$4.6</i>

This table shows the estimated portion of roadway expenditures devoted to walking. About 10% of the federal transportation budget is devoted to "Enhancements", of which about half is spent on Bike/Ped projects. Assuming half of this is devoted to walking, this represents 2.5%.

special costs, or reduce externalities. There are several reasons that walkability improvements might deserve *more* than a proportional share of resources:

- As described earlier, walking provides basic mobility and serves trips with high social value;
- Walking is particularly important for people who are transportation disadvantaged. Walkability improvements provide equity benefits, and bear special costs associated with serving people with disabilities;
- Some walking facility improvements can be included in other transport budgets (e.g., transit facilities, airports, parking facilities, ferry terminals, etc.) because they serve these modes; and
- Walking provides both transportation and recreation benefits. It therefore deserves funding from both transportation and recreation budgets. For example, it may be appropriate to devote 10% of a jurisdiction's transportation budget *and* 20% of its recreation budget to pedestrian facilities.

If we apply the principle that each mode should receive its proportional share of transportation resources, this suggests that walking should receive 10-20% of *total* transportation resources (not just municipal transport agency funds), five to ten times what is currently devoted to walking facilities and services, in addition to a significant share of recreational funding.

Table 5. Local Transportation Payments and Costs

	Mike	Frances
A. Annual local mileage	10000	3000
B. Household's general taxes used for road related services	\$300	\$300
C. Motorist user fees spent on local road (0.2¢ per mile)	\$24	\$0
D. Total road system contribution (B + C)	\$324	\$300
E. Tax payment per mile of travel (B/A)	3.2¢	10¢
F. Roadway costs (cars = 5¢/ml, walking = 0.2¢/ml)	\$500	\$48
Net (D – F)	Underpays \$176	Overpays \$252
Non-drivers pay almost as much as motorists for local transportation facilities and services, but impose lower costs. As a result, they tend to overpay their fair share.		

Cost Allocation

Transportation cost allocation evaluates to what degree each user group pays its share of transportation facilities and services through special user charges such as road tolls, fuel taxes and vehicle registration fees.⁵⁰ This reflects the principles of horizontal equity (consumers should pay for what they get and get what they pay for unless a subsidy is specifically justified), and economic efficiency (prices should equal marginal costs).⁵¹

Many people assume that because motorists pay road user fees dedicated to transport, non-motorised modes underpay their fair share of transport costs and so deserves little investment. This is not necessarily true. Although vehicle use fees fund major highways, local roads are funded through general taxes that residents pay regardless of how they travel. Motor vehicle use imposes many public costs besides direct highway expenditures. An average household pays several hundred dollars annually in general taxes for local transportation facilities and services, and pays hundreds of dollars in public subsidies for parking facilities. When these factors are taken into account, motorists underpay their share of public costs, while walking receives less than its fair share of resources.⁵² The example below illustrates this point.

Example

Two neighbours each pay \$300 annually in local taxes that fund transport facilities and services. Mike drives 10,000 miles annually on local roads, while Frances walks 3,000 miles. Table 5 compares their tax payments and transportation costs.

Although an *average* household pays its share of transport costs in taxes, taxpayers who drive less than average subsidise their neighbours who drive more than average. These subsidies can be significant,

totalling hundreds of dollars annually for somebody who relies primarily on non-motorised transport.⁵³ These cross subsidies are far greater when other external motor vehicle costs are also considered, such as public resources devoted to parking facilities, uncompensated crash damages, and environmental damages.¹⁹

This suggests that applying cost allocation principles, motorists should pay significantly more than they currently do in user fees, and more resources should be devoted to non-motorised transport facilities or nondrivers should receive tax discounts (such as in Austin, Texas, where households that do not own an automobile are exempt from a local transportation fee that is used to fund roads).⁵⁴

Benefit-Cost Analysis

A third approach to evaluating transportation policies and programs, and the approach that is considered best for maximising efficiency, is benefit-cost analysis.⁵⁵ This compares the incremental costs and benefits of a policy or project.

Benefit-cost analysis is applied to individual policies and projects, so it is difficult to make broad conclusions as to what effect its application would have on transport decision making. However, for reasons described below, it is likely that more rigorous application of benefit-cost analysis would tend to increase the resources devoted to walking.

- As described earlier, current transportation planning practices tend to undercount walking. Better counting of walking trips will tend to

⁵³ Ryan, B. and Stinson, T.F. *Road Finance Alternatives: An Analysis of Metro-Area Road Taxes*. Center for Transportation Studies, University of Minnesota (<http://www.cts.umn.edu>), 2002.

⁵⁴ *Austin Transportation User Fee* (<http://www.ci.austin.tx.us/development/ldc1.htm>)

⁵⁵ Litman, T. *What's It Worth? Life Cycle and Benefit/Cost Analysis for Evaluating Economic Value*. Presented at Internet Symposium on Benefit-Cost Analysis, Transportation Association of Canada (<http://www.tac-atc.ca>), available at VTPI (<http://www.vtpi.org>), 2001.

⁵⁰ FHWA. *1997 Federal Highway Cost Allocation Study*. USDOT (<http://www.fhwa.dot.gov>), 1997.

⁵¹ VTPI. 'Market Principles'. *Online TDM Encyclopedia*, VTPI (<http://www.vtpi.org>), 2002.

⁵² Litman, T. *Whose Roads?* VTPI (<http://www.vtpi.org>), 1998.

recognise more demand, and therefore greater potential benefits from walkability improvements.

- Few economic analyses account for the full range of benefits from improved walkability and increased walking described in this paper. More comprehensive analysis is likely to identify greater benefits and so justify greater investments.
- Only recently have non-motorised evaluation tools been developed, such as pedestrian level-of-service rating. Applying such tools can improve our ability to predict how a particular policy or project will affect non-motorised travel, which can justify greater investments in walkability.
- There is increasing recognition of the diminishing economic benefits from increased highway investments,⁵⁶ the significant social costs of automobile dependency, and the large potential social benefits of a more diverse transportation system.⁵⁷
- There is increasing recognition of the value of smart growth land use management to achieve social objectives.⁵⁸ These strategies place a high value on walkability.
- Current transportation funding is biased against non-motorised modes. Only a small portion of total transport funds may be used for non-motorised facilities, and financial match requirements are sometimes higher. More neutral investment policies would increase the amount of money available for walking.

More comprehensive benefit-cost analysis requires better techniques to measure and predict travel impacts of improved walkability, and to evaluate the full economic impacts that result, including indirect and nonmarket impacts that are not usually quantified in transport planning such as environmental, economic development and equity impacts.

Conclusions

Conventional transportation planning practices treat walking as a minor transport mode and recognise only modest benefits from improved walkability and increased walking. This results from evaluation practices that undercount non-motorised travel and undervalue walking benefits.

Other perspectives indicate that walking is a critical component of the transport system, and that improved walkability and increased walking can

provide significant benefits to society. Improved walkability increases accessibility, provides consumer and public cost savings, increases community livability, improves public health and supports strategic economic development, land use and equity objectives. A variety of methods can be used to evaluate these impacts.

Conventional planning practices may conclude that walking currently receives a fair and efficient share of transportation resources. However, this reflects an undercounting of walking trips, an undervaluation of walking benefits, and undervaluation of motor vehicle external costs. More comprehensive evaluation indicates that walking receives less than its appropriate share of transportation resources, and that walkability improvements can provide a high economic return on investment.

Greater appreciation of the full benefits of walking could change planning priorities. It would justify devoting more government funding to walking facilities and programs, shifting road space from traffic and parking lanes to sidewalks and paths, policies to create more walkable land use patterns, and greater efforts to manage motor vehicle traffic to improve walking safety and comfort. These shifts support and are supported by other transport and land use management reforms that improve transportation options, reduce automobile dependency and create more accessible land use.

Acknowledgement

Presented at the Transportation Research Board, 82nd Annual Meeting January 2003, Washington, DC, Paper 03-2731, where it won the TRB Committee on Pedestrians' *2003 Outstanding Paper Award*. Published in the *Transportation Research Record 1828*, Transportation Research Board (<http://www.trb.org>), 2003, pp. 3-11

⁵⁶ Boarnet, M.G. and Haughwout, A.F. *Do Highways Matter? Evidence and Policy Implications of Highways' Influence on Metropolitan Development*. Brookings Institute (<http://www.brookings.edu>), 2000.

⁵⁷ VTPI. 'Evaluating Transportation Options'. *Online TDM Encyclopedia*, VTPI (<http://www.vtpi.org>), 2002.

⁵⁸ VTPI. 'Smart Growth'. *Online TDM Encyclopedia*, VTPI (<http://www.vtpi.org>), 2002.

U.S. Air Transportation Since 9/11/2001: Disruption or Transformation?

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Abstract

This article examines air service changes at U.S. commercial service airports from October 1, 2001 through September 30, 2003, to determine whether the U.S. air transportation network is experiencing structural change, as opposed to the cyclical variation in activity that has been common in this transport mode. Almost all U.S. airports saw fewer flights in the year following the terrorist attacks of September 11, 2001. While many interpretations have attributed these airline schedule reductions to a discrete systemic shock that would eventually be eclipsed by a return to air travel's historic growth trend, several signs point to these changes representing the 'take-off' phase of a fundamental industry restructuring whose roots predate the 9/11 attacks. A second year of data on flight frequencies and capacity post 9/11 provides further evidence supporting this hypothesis. Our findings correspond with a recent economic analysis of airlines' financial performance attributing post 9-11 restructuring efforts to unsustainable structural factors, representing a 'more systemic industry crisis' that predated the 9-11 attacks (Nolan, *et. al.*, 2004, 239).

Keywords

9/11, airlines, airports, aviation, low-cost carriers, 'regional jets', restructuring, terrorism, travel.

Introduction

This article examines air service changes at U.S. commercial service airports from October 1, 2001 through September 30, 2003, to determine whether the U.S. air transportation network is experiencing structural change, as opposed to the cyclical variation in activity that has been common in this transport mode. Previously published analysis documented that almost all U.S. airports saw fewer flights in the year following the terrorist attacks of September 11, 2001, referred to subsequently as 9/11 (Reconnecting America, 2002). While many interpretations have attributed these airline schedule reductions to a discrete systemic shock, akin to the Gulf War of 1991 or the oil embargo of 1973, that would eventually be eclipsed by a return to air travel's historic growth trend, several signs

point to these changes representing the 'take-off' phase of a fundamental industry restructuring whose roots predate the 9/11 attacks. A second year of data on flight frequencies and capacity post 9/11 provides further evidence supporting this hypothesis.

Service changes at United States airports from 2001 to 2003

Using schedule data from the *Official Airline Guide* (OAG) for the weeks of October 1, 2001, September 30, 2002, and September 29, 2003, we have assessed two dimensions of change in America's civil aviation system. First, the number of scheduled weekly flights at an airport was calculated to measure the convenience and national accessibility of large hubs, small and medium-sized hubs, and non-hub commercial service airports. Next, the weekly seat availability from these airports was determined in order to measure the scheduled capacity being supplied by airlines at a particular location. These data enabled both a ranking of service changes at individual airports and the development of trend lines for service to each airport size category. Another significant aspect of aviation restructuring is revealed by the share of flights and seats being supplied by the major airlines as compared to the share supplied by their regional affiliates. Results for each airport size category are examined below.

Large hub airports

This category includes the thirty large hub airports from which more than 55% of non-stop flights and more than 65% of available seats depart each week. Large hub airports lost an average of 10.3% of available non-stop seat miles and an average of 9.5% of non-stop flights from 2001 to 2002, with some large hubs on the East and West Coasts experiencing significantly greater reductions. From 2002 to 2003, large hub airports lost an additional 1.7% of flights, yielding a cumulative average loss of 11.1% at these airports. Table 1 ranks the ten large hub airports that lost the greatest number of flights.

Not all large hubs lost service following 9/11. Table 2 identifies the ten large hub airports with the

Table 1. Highest decrease in weekly flights at large hub airports, 2001–2003

Airport	Flight Reduction 2001-2002	Flight Reduction 2002-2003	Flight Reduction 2001-2003
1. IAD – Dulles	-20.0%	-11.2%	-29.0%
2. BOS – Logan	-23.3%	-7.1%	-28.7%
3. LAX – Los Angeles	-20.2%	-8.9%	-27.3%
4. PIT – Pittsburgh	-13.9%	-13.4%	-25.5%
5. SFO – San Francisco	-18.3%	-8.6%	-25.4%
6. STL – St. Louis	-14.4%	-8.9%	-22.0%
7. MIA – Miami	-18.7%	-2.6%	-20.8%
8. HNL – Honolulu	-8.5%	-13.2%	-20.8%
9. EWR – Newark	-20.0%	0.6%	-19.6%
10. JFK – New York	-12.0%	-8.7%	-19.6%

Table 2. Increase or lowest decrease in weekly flights at large hub airports, 2001–2003

Airport	Flight Change 2001-2002	Flight Change 2002-2003	Cumulative Flight Change 2001-2003
1. CVG – Cincinnati	8.3%	7.0%	15.9%
2. MDW – Chicago Midway	8.8%	1.7%	10.7%
3. SLC – Salt Lake City	0.0%	1.8%	1.8%
4. ATL – Atlanta	-8.0%	8.0%	-0.7%
5. DEN – Denver	-4.8%	1.2%	-3.6%
6. MSP – Minneapolis St. Paul	-4.7%	1.2%	-3.6%
7. FLL – Fort Lauderdale	-9.9%	6.4%	-4.2%
8. IAH – Houston	-7.8%	3.1%	-4.9%
9. LAS – Las Vegas	-4.4%	-2.0%	-6.3%
10. PHX – Phoenix	-1.4%	-5.2%	-6.5%

smallest service declines over the last two years. Three of these airports actually gained flight frequencies.

Examining the volume of seats available from large hub airports reveals that the total capacity offered by commercial aviation has declined across much of the United States. Between 2001 and 2003, there was an overall reduction of 14.9% in seat availability at large hub airports. Table 3 identifies the ten large hub airports that experienced the sharpest reduction in available seats.

Not every airport lost capacity, however. Table 4 identifies the ten large hubs that either gained capacity, or lost the least capacity from 2001 to 2003.

The evidence highlighted in Table 1 through Table 4 reveals a major change in airport operations. The drop in seat capacity after 9/11 has been greater than the decline in flight frequencies, as airlines have been replacing larger planes with smaller aircraft. For example, Cincinnati shows a nearly 16% increase in flight frequencies over two years, while

Table 3. Greatest decrease in available seats at large hub airports 2001–2003

Airport	Change in Seats 2001-2003
1. PIT – Pittsburgh	-35.3%
2. SFO – San Francisco	-33.5%
3. STL – St. Louis	-33.4%
4. BOS – Boston	-26.6%
5. LAX – Los Angeles	-26.4%
6. IAD – Washington Dulles	-24.9%
7. EWR – Newark	-22.8%
8. HNL – Honolulu	-21.7%
9. LGA – New York LaGuardia	-18.2%
10. ORD – Chicago O'Hare	-17.1%

simultaneously experiencing a *decrease* of almost 4% in total available seats. This indicates that more frequent service is being provided with smaller aircraft. Cincinnati illustrates what can happen when 'regional jets' are used to replace larger jet aircraft. The large hub category airport that posted the greatest capacity increase from 2001 to 2003, Chicago Midway, exemplifies the growth that is possible when one or more low-cost carriers rapidly expand their service in a major travel market.

Small and Medium hub airports

Small and medium hub airports include 101 of the nation's airfields. From 2001 to 2002, they experienced a 9.4% decline in available seat miles and a 9.6% drop in non-stop flights. This was followed by a virtually stagnant year, during which flight frequencies grew by 0.1%. Between 2001 and 2003, small and medium hub airports lost 9.6% of their flights. Table 5 identifies the ten small and medium hub airports losing the most frequency.

Some small and medium hub airports also experienced flight frequency gains during the last two years. The top ten gainers in the small and medium hub airport category are listed in Table 6.

Table 4. Increase or lowest decrease in available seats at large hub airports, 2001–2003

Airport	Change in Seats 2001-2003
1. MDW – Chicago Midway	8.9%
2. FLL – Fort Lauderdale	2.4%
3. CVG – Cincinnati	-3.9%
4. BWI – Baltimore-Washington	-6.7%
5. ATL – Atlanta	-6.7%
6. LAS – Las Vegas	-7.4%
7. TPA – Tampa	-7.7%
8. SLC – Salt Lake City	-8.0%
9. MSP – Minneapolis St. Paul	-8.0%
10. MCO – Orlando	-9.0%

Table 5. Decrease in weekly flights at small and medium hub airports, 2001–2003

Airport	Flight Reduction 2001-.02002	Flight Reduction 2002-.02003	Cumulative Flight Reduction
1. ACY – Atlantic City, NJ	-9.6%	-31.0%	-37.6%
2. ITO – Hilo, HI	-26.5%	-14.4%	-37.0%
3. KOA – Kona, HI	-12.7%	-22.9%	-32.7%
4. RDU – Raleigh/Durham, NC	-28.8%	-2.4%	-30.5%
5. MCI – Kansas City, MO	-21.7%	-10.9%	-30.2%
6. ISP – Long Island, NY	-23.2%	-7.0%	-28.5%
7. OGG – Kahului, HI	-13.6%	-16.3%	-27.7%
8. LIH – Kauai, HI	-11.3%	-18.2%	-27.5%
9. PVD – Providence, RI	-17.5%	-9.6%	-25.4%
10. TLH – Tallahassee, FL	-4.1%	-21.5%	-24.7%

Table 6. Increase in weekly flights at small and medium hub airports, 2001–2003

Airport	Flight Change 2001-2002	Flight Change 2002-2003	Cumulative Flight Change 2001-2003
1. SFB – Orlando Sanford, FL	21.7%	17.9%	43.4%
2. HSV – Huntsville, AL	6.9%	26.6%	35.3%
3. GCN – Grand Canyon, AZ	100.0%	-35.7%	28.6%
4. MHT – Manchester, NH	2.9%	19.2%	22.6%
5. FAI – Fairbanks, AK	4.3%	13.7%	18.5%
6. PNS – Pensacola, FL	3.5%	11.3%	15.2%
7. ICT – Wichita, KS	20.0%	-5.6%	13.3%
8. CAK – Akron/Canton, OH	-10.8%	27.0%	13.3%
9. SAT – San Antonio, TX	5.5%	2.4%	8.0%
10. SBN – South Bend, MI	7.0%	5.5%	6.2%

Table 7 profiles the ten small and medium hub airports that experienced the largest reduction in available seats between 2001 and 2003, a phenomenon which reflects both the overall reduction in flights and a trend toward aircraft downsizing by regional carriers flying into these facilities.

Eleven small and medium hub airports recorded gains in non-stop seat availability since 2001. These are listed in Table 8.

Overall, 90 out of 101 small and medium hub airports have seen a decline in their volume of available weekly seats since 2001.

Non-hub commercial service airports

On a percentage basis, some of the largest service reductions following 9/11 have been experienced by airports serving smaller communities, as revealed by changes at the 245 non-hub airfields that are included as a part of America's primary airport system. This category excludes the 317 smallest airports that are not part of the primary airspace system yet which do receive some scheduled service – often little more than a few flights a day. Among all 245 non-hub airports, 20% experienced some net growth in weekly flights since 2001, while 80% showed either no change or a decline in service frequencies. These smaller airports also experienced a dramatic reduction in the number of available seats, as they are not only being served by fewer flights, but also by smaller aircraft. Overall, 20% of these 245 non-hub commercial service airports recorded an increase in available weekly seats since 2001, but not necessarily the same 20% that showed gains in service frequency.

In addition to these impacts, a number of small cities experienced the total elimination of commercial air service during the past two years, while some gained service. In the non-hub primary airport category – the larger traffic category – nine communities lost service, one community (Provincetown, MA) replaced service suspended during runway construction, while two gained service compared to the 2001 schedule.

Service changes in the very small airports category, consisting of non-hub and non-primary airports have affected many more communities with mixed results. Forty airports in this group of 317 facilities lost all scheduled service for all or part of the period covered by this analysis.

Structural changes in the aviation network: 2001 – 2003

Our analysis of flight frequency and capacity data in the OAG demonstrates that no part of the United States air transport network has been unaffected by airlines' restructuring after 9/11. The overall drop in air travel, and the commercial crisis that this triggered at most major airlines appears to have

Table 7. Greatest decrease in available seats at small and medium hub airports 2001–2003

Airport	Reduction in Seats 2001-2003
1. ABE – Allentown, PA	-48.4%
2. ITO – Hilo, HI	-44.5%
3. GCN – Grand Canyon, AZ	-38.9%
4. EUG – Eugene, OR	-37.1%
5. KOA – Kona, HI	-34.7%
6. ROC – Rochester, NY	-32.9%
7. HPN – Westchester, NY	-32.7%
8. OGG – Kahului, HI	-31.6%
9. RDU – Raleigh/Durham, NC	-31.3%
10. MOB – Mobile, AB	-29.0%

Table 8. Increase in available seats at small and medium hub airports 2001–2003

Airport	Change in Seats 2001-2003
1. SFB – Orlando Sanford, FL	38.1%
2. XNA – Fayetteville North West, ,	17.7%
3. CAK – Akron/Canton, OH	16.4%
4. MHT – Manchester, NH	13.4%
5. FAI – Fairbanks, AK	9.7%
6. SMF – Sacramento, CA	3.7%
7. ACY – Atlantic City, NJ	3.7%
8. TLH – Tallahassee, FL	2.9%
9. HSY – Huntsville, AL	2.2%
10. OAK – Oakland, CA	0.8%
11. ORF – Norfolk, VA	0.4%

precipitated more than a temporary service retrenchment during difficult times. Yet not all carriers have done poorly during this period of restructuring.

The growth of the low-cost (or low-fare) carriers reveals how some airlines have succeeded in expanding their share in difficult economic times for the industry as a whole. The OAG's current definition of 'low-cost' carriers presently identifies 10 airlines, airline flight services or airline subsidiaries, including AirTran, America West, ATA, Frontier, JetBlue, Southwest, Spirit, SunCountry, Delta Express and the Delta Song 'airline-within-an-airline' operation. Operations that are not part of the low-cost segment are usually described as mainline network carriers, and are characterised by a hub and spoke route structure. Table 9 shows that since 2001, the network carriers' share of all flights has dropped from 79.48% to 74.77%. By 2003, this represented a decline of 4.71%. It appears that much of this reduction was offset by new

flights operated by low-cost carriers. In 2001, the low-cost carriers operated 15.56% of all flights. Low-cost carriers now operate 18.09% of total flights. This increase of just 2.53 share points represented a growth rate of more than 16% over the two-year period. Regional carriers have also increased their share of flights by 2.18 share points – a much higher 42% growth rate from a smaller base. This trend shows every indication of continuing, as the data depicted here does not reflect Delta's new Song subsidiary, nor United's Ted carrier, both of which should grow over the next year.

A similar pattern of change in the share of seats offered by network, low-cost, and regional carriers can be seen in Table 10. Network carriers' share of total seats has dropped from 78.46% to 73.01% between 2001 and 2003, a net loss of 5.45 points. Low-cost carriers picked up much of this reduction, increasing their 2001 seat share of 20.94% by 4.98 points to 25.92%. Regional carriers expanded their seat share from 0.61% in 2001 to 1.08% in 2003. This relatively small growth in regional carrier seat share, when compared to their flight share growth of 2.18%, reflects the capacity limits of the smaller aeroplanes that are flown predominantly by these regional carriers.

The use of 'regional jets' has increased substantially since 2001. These are basically newer design jets (e.g. Bombardier CRJ series), carrying fewer than 100 passengers, generally outfitted with a single class of service, and requiring smaller cabin crews. These regional jets are often operated by a network airline's regional partners to feed the larger narrow-body and wide-body jets offered on traditional 'mainline' routes. Table 11 reveals that in the two years following 9/11, regional jets have expanded from 14.3% of total flight frequencies to 26.6% of that total. This growth of 12.3 share points represents a two-year growth rate of 86%. During this period, the share of flights served by traditional narrow and wide body jets dropped from 57.5% to 51%. The share of flights served by turbo-props also dropped from 28.2% to 22.4%.

Regional jets appear to have taken on two different roles in the industry restructuring that followed 9/11. Downsizing mainline network carriers are using regional jets operated by their regional partners to replace some mainline services. And regional jets are also being used to upgrade some turbo-prop services.

Moving forward, regional jet makers will also begin introducing even larger regional jets, that start to compete directly against the smaller aircraft produced by Boeing and Airbus. If these next generation regional jets continue to be operated by regional carriers with more advantageous work rules, or by using lower tier wage scales at network carriers, regional jets could

Table 9. Proportion of flights by network, low-cost, and regional carriers: 2001–2003

Airline Category	2001	2003
Major/National Network	79.48%	74.77%
Major/National Low Cost	15.56%	18.09%
Regional and Other Carriers	4.96%	7.14%

Table 10. Proportion of seats by network, low-cost, and regional carriers: 2001–2003

Airline Category	2001	2003
Major/National Network	78.46%	73.01%
Major/National Low Cost	20.94%	25.92%
Regional and Other Carriers	0.61%	1.08%

Table 11. Proportion of flights by aircraft category

Aircraft Category	2001	2003
Narrow and Wide Body Jet	57.5%	51.0%
Regional Jet	14.3%	26.6%
Turbo Prop	28.2%	22.4%

continue to erode the share of flights being operated by traditional narrow-body and wide-body jet aircraft.

The shift to regional jets has far reaching business impacts for air carriers. It also brings about significant public policy implications since the energy intensity, emissions generation, and infrastructure utilisation of accommodating more frequent flights by smaller jet aircraft all tend to reduce the long run sustainability of aviation, as discussed below. The situation experienced by Cincinnati's 'hub' airport exemplifies what a significant shift from mainline jets to regional jets can produce. Cincinnati's post 9/11 reconfiguration outcome is often raised as an example of the value of regional jets. Cincinnati was cited earlier in this analysis as the large hub airport with the highest gain – about 15.9% – in weekly flights between comparable periods in 2001 and 2003. Cincinnati was also a leader in seats retained, the third best of all large hubs, losing only 3.9% of total seats between 2001 and 2003.

Table 12 provides additional information on the ten airports with the highest frequency of regional jet service in the OAG's 2003 schedule listing. This table includes eight large hubs and two medium hubs.

This table shows that Cincinnati now has more than 73% of its departing flights provided by regional jets; Chicago O'Hare relies upon regional jets for more than 40% of its departures. Both Cleveland and Memphis see regional jets on more than half of all departures. Most airports have seen high double digit increases in the share of flights operated by regional jets since 2001. The ten airports profiled in Table 12

Table 12. Ten hubs with the highest regional jet frequency in 2003

Airport	Hub Type	Regional Jet Departure Share 2003	Regional Jet Departures 2003	Regional Jet Departure Share 2001	Regional Jet Departures 2001
ORD – Chicago O'Hare	Large	40.94%	3209	25.95%	2229
CVG – Cincinnati	Large	73.08%	3089	62.13%	2266
DFW – Dallas/Ft. Worth	Large	36.14%	2402	9.73%	698
ATL – Atlanta	Large	27.48%	2221	11.50%	936
IAH – Houston	Large	39.93%	1459	17.95%	690
CLE – Cleveland	Medium	56.03%	1203	45.91%	1054
EWB – Newark	Large	38.56%	1144	18.94%	699
MEM – Memphis	Medium	51.13%	1065	31.21%	714
DTW – Detroit	Large	24.98%	1052	12.81%	588
LGA – New York La Guardia	Large	30.58%	1017	21.85%	818

Table 13. Average seats per departure, departure efficiency and operations ratios for airports with highest regional jet use

Airport	Hub Type	Seats Per Departure 2003	Seats Per Departure 2001	2003/2001 Efficiency Ratio	2003/2001 Operations Multiplier
ORD – Chicago O'Hare	Large	99.9450185	110.0893	0.907854	1.101499
CVG – Cincinnati	Large	73.7229714	88.95503	0.828767	1.206612
DFW – Dallas/Ft. Worth	Large	97.8883707	106.0061	0.923422	1.082929
ATL – Atlanta	Large	119.528152	127.2453	0.939352	1.064563
IAH – Houston	Large	97.4326765	104.6207	0.931294	1.073774
CLE – Cleveland	Medium	69.1476479	79.80183	0.866492	1.154079
EWB – Newark	Large	104.068082	108.4209	0.959853	1.041826
MEM – Memphis	Medium	76.2011522	86.20323	0.883971	1.131259
DTW – Detroit	Large	101.960342	106.29	0.959265	1.042465
LGA – New York/La Guardia	Large	98.5039086	107.0403	0.92025	1.086661

saw regional jet service increase by 67% in two years, representing a combined total of 10,692 regional jet departures in the 2001 schedule and 17,861 regional jet departures for the comparable 2003 schedule.

This increased reliance on regional jets doesn't come without potential problems. Rather than being upgrades for turbo-prop service, regional jets are often introduced as replacements for larger aircraft that are then retired by the network carriers. Regional jets generally carry fewer passengers than the larger jets they have replaced on the network. This means that more flights will normally be required to provide the same count of departure seats – generating more noise and atmospheric pollution, and consuming more fuel, than if these same travellers were accommodated on fewer, larger aircraft. Regional jets speed and operating characteristics also result in greater fuel consumption than turboprops they replace for shorter stage lengths. And, because the passengers travelling

aboard regional jets are more likely to connect with other scheduled flights at one or more hubs across a network, regional jets are also more likely to be on the ground longer at hub airports requiring expanded terminal and concourse facilities.

Should regional jet use continue to increase, and if major carriers further substitute regional jets for service supported by the traditional narrow-body and wide-body aircraft, more flight operations would be required to provide the same level of service. This could result in more airport congestion, more demands upon the air traffic control system, more fuel consumption, and greater greenhouse gas emissions than the pre-9/11 system configuration would have generated for an equivalent passenger volume. All the hubs listed in Table 12 have shown decreases in average seats per departure from 2001 to 2003. This change is summarised in Table 13.

The efficiency ratio presented in Table 13 is simply

the ratio of the average seats per departure in 2003 to the average seats per departure in 2001. For Chicago O'Hare, on average a 2003 departure is only providing 90.7% of the seats that an average departure provided in 2001. Providing an equivalent number of departing seats – assuming the current mix of narrow-body, wide-body, regional-jet and non-jet aircraft – would require a bit more than a 10% increase in total weekly departures.

The airports in Cincinnati, Cleveland, and Memphis have even higher service multipliers, in part because they have experienced an even greater reliance on and growth in the use of regional jets. As departure efficiency declines relative to previous levels that may have been used to develop existing airport facilities planning and financial analyses, greater financial burdens may be placed on both operations and passengers in order to support airport facilities and services.

Conclusions

After two years of considerable change, it appears that the U.S. domestic aviation industry has moved a considerable distance from its pre-9/11 business model in which all major carriers save Southwest Airlines competed over national route networks that were configured in a hub and spoke pattern and operated mostly by jets seating over 100 passengers and turboprops seating under 50 passengers. The industry's response to both reduced travel demand, and a particular decline in demand for the 'full service' air transportation that network carriers traditionally provided to business travellers has significantly reshaped the structure, and the impacts of air transportation in the U.S.A. Industrial transformation has seen low-cost carriers take a growing share of seats and flights in major travel markets while traditional network carriers have cut back capacity in these same markets. Further, network carriers have embraced regional jets, either operated directly on a lower wage scale or provided through their regional carrier affiliates, as part of an operating cost reduction strategy. While these regional jets may offer carriers new opportunities in a depressed travel market by enabling the continuation of a higher frequency level in the face of fewer passengers, they are also likely to challenge other organisations in the air transportation system, notably airports and air navigation service providers to redevelop their infrastructure in order to support a changing supply of air transportation. And they will generate greater energy use and emissions than a network in which reduced demand was met by cutting back the frequency of larger aircraft movements.

Such realignment is already presenting financial challenges to many airports, where capital budgets

and infrastructure redevelopment programs were launched based on the pre-9/11 business model. Both low-cost and regional carriers are unlikely to generate either the aeronautical or 'land side' revenues that airports were counting on to finance their current and future infrastructure expenditures. Changing business models and the resulting fleet mix adjustments are almost certain to have an impact on both local and global emissions generated by civil aviation, with regional jets consuming more fuel and producing more emissions per passenger than if traffic were to be consolidated on larger aircraft. And as low-cost carriers tend to eschew the hub and spoke model of traditional network carriers, new needs and opportunities for inter-modal linkages will arise in the communities that are left behind in terms of the new aviation system's frequency and capacity. The transformation that is now under way can be expected to play itself out over several years. At the end of this restructuring, American civil aviation will look quite different than it did before 9/11, and to operate in ways that will create new needs for transportation planning to address the environmental, financial and mobility gaps resulting from changes that are now under way.

Acknowledgement

The authors would like to acknowledge helpful comments on earlier drafts of this manuscript that were received from Scott Bernstein, Sarah Campbell and Richard Gilbert. Financial support for this research was received from MacArthur Foundation, the Surdna Foundation, the Turner Foundation and the University of Calgary's Office of Research Services.

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Just how (Travel) Smart are Australian universities when it comes to implementing sustainable travel?

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Abstract

Australia, like the United States, the UK and Europe, has seen the development of policies for sustainable travel in the past decade. Although not a new approach, Travel Demand Management Plans are one tool seeking to manage commuter travel for transport sustainability. Australian universities generate substantial commuter trips which result in a significant impact on transport infrastructure and on the community. Travel planning for universities needs also to be cognizant of the particular characteristics which set universities apart from other large employers.

The paper reviews international literature on TDM at universities in order to establish the extent to which TDM actions have been implemented. This provides a benchmark with which to compare action taken by Australian universities. The survey findings indicate that implementation of TDM in Australian universities is still in its infancy with only six of 25 surveyed universities developing TDM plans. The main focus of these plans is on improving public transport access. None seek to implement disincentives for access by car despite the heavily car dependent nature of those universities in suburban locations. Universities are reliant on individuals to champion the cause in the absence of federal legislation requiring such action. Such legislation may now be required in order to accelerate progress towards sustainable travel practices at Australian universities.

Keywords

Australia, TDM, Travel Demand Management, Universities travel.

Introduction

There has been little progress with sustainable travel practices at most Australian universities despite over a decade of national and state policy statements urging the need for sustainable travel in Australia (Department of the Environment and Heritage, 1992; Department of Transport, Ministry for Planning, Main Roads Western Australia *et al.*, 1996; Western Australian Planning Commission, 1997; Queensland Transport, 1998; National Transport

Secretariat, 2003). Passenger transport is responsible for over half of Australia's road transport emissions, and the emissions from this sector are increasing more rapidly than total greenhouse emissions (Bureau of Transport and Regional Economics, 2002). The need to reduce the contribution motor vehicles make to greenhouse emissions is recognised both federally and internationally (Kemp, 2003; Whitelegg, 2003). The 2004 Australian Road Summit noted that road transport faced enormous pressures and that strategies emphasising travel behaviour change and TDM are now high on the agenda of transport agencies (Smart Urban Transport, 2004).

Travel demand management is one approach aimed at achieving more sustainable travel patterns by influencing a reduction in the number of car trips. TDM Plans or Green Commuter Plans are most applicable for institutions generating a high volume of vehicular trips. Regulatory and incentive levers are used to achieve a redistribution of trips from low occupancy car travel to the more sustainable travel modes of walking, cycling, public transport and high occupancy vehicles.

Action to manage travel demand is more common throughout the United States, United Kingdom and Europe where government policy (and legislation in some cases) encourages business uptake of commuter plans (DfT, 2002; Rye, 2002; Rose and Ampt, 2001; Coleman 2000; Environmental Resources Awareness Group & Conservation Council of Western Australia, 1999). In Australia, to date, there has been an absence of federal government legislation encouraging travel planning in the workplace. State governments have addressed the issue, and most are devoting some resources (albeit limited) to TDM planning. Commuter plans have been trialled through the Australian Conservation Council's Smogbusters program. However, the catalyst for developing a commuter plan has usually been the desire by individual businesses to address greenhouse gas emissions, on-site parking issues and to a lesser extent, congestion on the surrounding road network (Estill Associates & Department for Planning and Infrastructure, 2003; Mason, 2000).

Australian universities are significant travel generators. Campuses usually have a student and staff population in the thousands, and attract a large number of daily visitor trips in addition to staff and student travel. Curtin University of Technology in Perth, Western Australia estimated 32,400 car trips were made daily during the 2001 teaching semester (BSD Consultants cited in Curtin University Access and Parking Committee, 2003). Like Curtin University, tertiary institutions located on suburban sites are experiencing growing parking demands. Surrounding road networks suffer high traffic volumes during peak hours that delay public transport services and discourage walking and cycling.

Travel planning for universities needs also to be cognizant of the particular characteristics which set universities apart from other large employers. Extended hours of operation generate travel demand during times of low frequency transit service outside of peak transit periods. Within university departments, teaching schedules of faculty staff can vary significantly presenting particular constraints to developing shared transport programs. Students are often time poor, their travel is constrained by cost and influenced by work and other commitments outside of university study. The diversity of ages, life styles, cultures and occupations contributes to complex travel patterns at universities and presents a particular challenge to implement special forms of TDM programs.

This paper reviews international literature in order to establish the extent of TDM action by leading universities across the world. This provides a benchmark with which to compare the extent of action taken by Australian universities as a whole. The paper then reports on the findings of a survey which examines whether Australian universities have recognised the need to manage travel, and if so, to what extent they have taken action to manage the transport demands of staff and students.

The need for Commuter Travel Management for large employers

Large employers generate a significant proportion of employee trips to and from the workplace during the morning and evening periods. There is also some inter-peak travel for business trips, private trips by employees and visitor business trips (Environmental Resources Awareness Group & Conservation Council of Western Australia, 1999; DfT, 2002). Much of this travel is undertaken by motor vehicles with a high proportion of trips as driver only (Environmental Resources Awareness Group & Conservation Council of Western Australia, 1999). The predominance of car travel for commuting is exacerbated by business decentralisation to suburban and light industrial areas

(Banister, 2002), i.e. locations that are often poorly serviced by public transport and have limited infrastructure for walking and cycling.

Employees lacking adequate transport alternatives will commute by car, a practice that contributes to congestion during peak hours, and creates a significant demand for on-site parking. Within Australia the mode share for travel to work by car was 64% in 2001, having grown from 55% in 1991 (Australian Bureau of Statistics, 1994; Australian Bureau of Statistics, 2001). High levels of car use add to global greenhouse emissions and diminish local air quality. Congestion during peak periods reduces the efficiency of road transport networks and undermines the amenity of local areas (Newman & Kenworthy, 1999).

Developing and implementing a TDM plan has the potential for considerable economic, environmental and social benefits. A 'TravelSmart' initiative in South Perth, Western Australia, aimed at encouraging households to reduce their car trips, demonstrated a private user benefit of AUD\$2.54 million for the 35,000 people participating (Ker & James, 1999). This is equivalent to a saving of approximately AUD\$76 per person per annum. There are also cost savings coming from reduced investment in, and maintenance of road and car parking infrastructure. Furthermore less car parking contributes an opportunity for more productive use of land. Other benefits include improved health of staff, as well a marketing edge of a sustainable, accessible environment. Institutions with travel plans contribute to a wider community benefit via increased public transport patronage and associated revenue gain, reduction in road building and maintenance through a reduced rate of traffic growth and reduced air pollution.

TDM Plans are a tool for employers to manage the travel choices of their employees and to some extent, of business visitors (Environmental Resources Awareness Group & Conservation Council of Western Australia, 1999; Enoch & Potter, 2003; Rye, 2002). The aim is a reduction in the number of car trips to the workplace, with an increase in employee travel by other modes. Plans can be developed either by the employer or by a consultant in conjunction with the employer, or by an employer/employee partnership and respond specifically to the site and employee travel characteristics. The key is in providing an integrated package of measures that support the aim of the plan (Environmental Resources Awareness Group & Conservation Council of Western Australia, 1999; Rye, 2002). The approach to influencing employee travel behaviour is three pronged: information and education; incentives; and regulation or disincentives. This framework is applied across the actions of the plan. The actions should address public transport discounts, walking, cycling and flexible work practices, onsite car

parking availability and cost, company car provision and usage, and car pool schemes.

University TDM: International best practice

A literature review of international best practice at universities shows that there is a wealth of solutions that can be implemented to achieve sustainable travel practices. Some universities stand out as leaders in TDM: University of British Columbia, University of Washington and Oxford Brookes University (Australian Greenhouse Office, 2003). Often such progress is made through individuals acting as champions, but the task has been made easier where government policy underpins TDM practice. Our review found that developing a TDM Plan involves three key steps: understanding the issues facing sustainable travel at the university; finding the champions for the TDM Plan; and taking action to achieve desired outcomes. Our review is framed around these three steps.

Understanding the issues

Understanding how a TDM plan relates to the broader sustainability issues within the university will assist in setting the context for the planning process. Universities may have policies and practices that present additional barriers to be addressed in travel planning. These may include incentives for car use via salary packaging, priority and seniority allocation of car parking, reimbursement of car travel expenses, and lack of reimbursements for travel by other modes. The student union/guild may subsidise student parking permits. The absence of information and support and facilities for more sustainable transport modes is another barrier.

Finding Champions

Gathering support for travel planning requires that staff, students and stakeholders are involved in the plan's development. Where staff, faculty and students have not been included in planning phases, little participative support and even obstruction to implementation has occurred (University of Western Australia, 2003; Curtin University Access and Parking Committee, 2003). Endorsement of the TDM plan will be necessary by senior staff within the university. High level decision-makers in appropriate departments should be targeted to ensure their support for the plan. Universities should also aim to find a champion for the plan, a person who is willing to participate in the plan actions and promote the TDM plan at orientation days, induction days and relevant functions.

Involving stakeholders is an important component of travel plans. Establishing good relationships with local authorities, public transport service providers, neighbouring businesses and government will be necessary to successfully achieve off-site infrastructure

improvements (DfT, 2002). Universities with the greatest successes from travel planning established Transport Committees for the regular participation of stakeholders. The Committee focuses on 'problem diagnosis, policy development and introduction of implementation measures' (Oxford Brookes University, 1999), ensuring stakeholder resources and time are used effectively.

Taking Action

The third step in planning for sustainable travel involves: auditing the university site and surrounds; surveying staff and students; devising the travel plan; and monitoring and evaluating the outcomes. Conducting an audit of the existing transport infrastructure suggests that pedestrian infrastructure is assessed to a distance of 2km, cycling infrastructure to a distance of 5km, whilst public transport (and multi-modal with bicycles) is assessed for the metropolitan or regional area, and that all modes should be accessible for people with a disability. An access audit should consider the performance criteria described in Table 1.

The audit of pedestrian routes also requires assessment of route safety. A 'SAFE Assessment' (Table 2) considers Safety, Amenity, Friendliness and Efficiency and should include both day and night time analysis. After-dark SAFE assessments should include campus bus stops, shuttle bus waiting areas, bike and walking paths, bicycle parking areas and car parks. It is recommended women and people with a disability conduct SAFE audits. This will ensure the campus meets the safety needs of the gender more vulnerable to opportunistic crime.

In addition to the 'users audit', undertaking a survey of staff and student travel patterns is fundamental to understanding how the existing transport infrastructure is utilised and facilitates identification of users' real needs (rather than those perceived by administrators or auditors or consultant experts). A survey also presents the opportunity to identify attitudes towards potential initiatives of the TDM Plan. Attitudinal information and infrastructure changes indicated by staff and students can be utilised to justify proposed actions in the plan. The overarching purpose of the questionnaire is to guide the actions of the plan and generate baseline data against which change can be measured.

To reduce the impacts of the university on its locality TDM Plans need to address the variety and level of service of transport modes available to the university and adjoining areas, and in conjunction with disincentives for motor vehicle use, offer incentives for travel by more sustainable modes. For pedestrians, safe and convenient infrastructure must be available and its provision can be linked to the university's bike plan for

Table 1. Infrastructure criteria to be assessed for each transport mode.

Access Audit Performance Criteria

Pedestrians	<ul style="list-style-type: none"> • Number and location of dedicated pedestrian routes • Number and location of pedestrian crossings on roads on and off site (immediately adjacent to site) • Pedestrian crossings located at high demand access points ie: between student housing and campus • Pedestrian crossings are raised ie: pedestrian plateaus and signed for drivers • Pedestrian routes are safe, visible, well lit, high amenity, connective, with rest points (seating and water fountains) at intervals • All routes are accessible for people with disabilities • Emergency telephones for medical or police emergency • Number and location of information points (map of campus with pedestrian paths, dedicated and share use, rest points, paths of steep gradient, emergency telephones)
Bike	<ul style="list-style-type: none"> • Number of parking racks • Type of parking racks ie: toaster, U rail, lockers or lidded parking • Location of parking – visible for security, close to each building or building cluster • Number of shower and change rooms • Number of lockers (for clothes) available for cyclists • Number of cycle routes on & off site including shared paths & on road cycle lanes, & slow speed areas • Campus cycle routes connecting to wider cycle network • Lighting, visibility and amenity of cycle routes • Parts or repair shop on campus (with space for DIY) • Incentives to cycle (mileage allowance, depreciation, staff loans to buy bikes, free clinics on bike riding, bike repair clinics, bike user groups, cycle buddv, safety information) • Number and location of information points (showing map of campus, bike routes and parking)
Bus	<ul style="list-style-type: none"> • Number of bus routes servicing site • Frequency of services • Coverage of services, radial and cross-town routes • Connectivity of services (eg: with train stations, other major land uses in area) • Location of bus stops to university buildings (pedestrian catchment) • Shelter, lighting, safety and comfort of bus stop • Safety, amenity and connectivity of route from bus stop to site • Incentives to travel by bus ie: discounts, 10th trip free • After-dark shuttle bus within campus and to nearby destinations (ie: student housing, train station, residences within 3km of campus) • Number and location of service information points on site • Services are accessible for people with disabilities
Train/tram	<ul style="list-style-type: none"> • Location of station or stop relative to site • Frequency of service • Connectivity with other services if necessary ie: bus services, shuttle bus • Provision for bikes on train/tram • Safety and comfort of station • Safety, amenity and connectivity of route from station/stop to site • Incentives to travel by train/tram (eg: no charge for bike, bulk purchase discounts, 10th ride free) • Number and location of information points on site (ie: information on public transport services, pedestrian and cycle maps, car pooling) • Services are accessible for people with disabilities
Car	<ul style="list-style-type: none"> • What is the number of parking bays on and off campus? • What is the cost of parking on and off campus (are daily fees higher than the cost of an all-day transit pass)? • What parking controls exist on and off site? (ie: time monitored or user restricted) • What is the utilisation of parking capacity on and off site? • Are there incentives for car travel by staff and students (free parking, mileage allowance, car loans, leases, company cars, etc)? • Parking and access is accessible for people with disabilities
Traffic Calming	<ul style="list-style-type: none"> • What is the designated road speed for campus roads? • Is this speed limit enforced? • Are there signed pedestrian and cyclist crossings? • Are pedestrians a designated priority at the crossings and across campus? • Are internal roads designed to slow traffic near pedestrian areas (10km shared zones)?
Car Pool	<ul style="list-style-type: none"> • Number of dedicated parking bays for car pooling • Cost of parking (lower fees than cost for Single Occupant Vehicle) • Location of parking bays (closer to buildings than SOV parking) • Incentives to car pool (cheaper parking, more convenient parking, guaranteed ride home, occasional SOV parking for slightly reduced rate)

Source: Australian Greenhouse Office, 2003 (Adapted from: Manners 2001; Curtis & Coleman 1996; Coleman 2000).

Table 2. SAFE Assessment criteria for university campuses

Safe, Attractive, Friendly, Efficient		Score		
Assessment Criteria		Good	Medium	Bad
		1	0.5	0
Safe	<ul style="list-style-type: none"> • 'eyes on the street', frontages/windows to increase personal safety... buildings fronting streets provide good day and night surveillance; • good footpath design... footpaths are preferable on both sides of the street, clearly defined dual use paths for pedestrian and cyclists, paths of sufficient width and construction, lowered and tactile kerb paving and street crossings; • pedestrian street crossings/traffic safety... streets should be detailed to allow ease of at-grade pedestrian crossing and normal target traffic speeds; and • cars parked on-street... parked cars act as a buffer between moving traffic and pedestrians on the footpath. 			
Attractive	<ul style="list-style-type: none"> • vibrant destinations... alfresco eating areas, views and opportunity for 'people watching'; • sheltered footpaths... shade trees or verandas; and • good pedestrian amenity, level of interest and event... places to sit along the way, active land uses, attractive building frontages, no graffiti or vandalism. 			
Friendly	<ul style="list-style-type: none"> • inviting streets... walking for leisure, to work places and daily needs shopping; • no isolated points... poorly lit bushy areas that are perceived as dangerous areas; • no isolated walking environments... such as unsurveilled footpaths and separated pedestrian walking ways; and • legibility/site responsive streets... streets that lead directly to destinations and which respect local landmarks. 			
Efficient	<ul style="list-style-type: none"> • good street design... traffic lights at busy intersection, median strip, tight corner radii and on-street parking to slow traffic, appropriate landscaping; and • availability of transit... access to a station or bus stop. 			

'SAFE' Total

For each street add the above scores

Source: Department for Planning and Infrastructure, Western Australia

efficient use of resources. Incentives to support and encourage walking to university include a night shuttle bus which will transport staff and students to their doorstep within a certain distance of the university (for example up to 1.5km), and take passengers to other key destinations including student housing and nearby commercial areas. On-campus security for pedestrians is imperative and should include emergency phones monitored by closed circuit television and security officers available to provide an escort through the campus at night.

Transport networks to the university must provide a safe and convenient environment for the novice cyclist. This requires that heavily trafficked roads have shared cycle/pedestrian paths available adjacent to the carriageway or bike lanes. For on-road cyclists, busy intersections require advanced stop lines ahead of motor vehicle traffic. Ensuring cyclists move through

an intersection and into bike lanes ahead of motor vehicles reduces the potential for conflict between cyclists and cars and improves efficiency of all traffic movement at intersections (Poinsatte & Toor, 1999; Main Roads Western Australia, 2002). On campus, cyclists require parking in a visible location outside faculty buildings (for passive surveillance of bicycles) and lockable compounds for storage of more valuable bicycles.

End-of-trip facilities (ETFs) are essential for both pedestrians and cyclists, and are best located within faculty and administrative buildings for improved personal safety (University of Western Australia, 2003). Ideally ETFs will include full height lockers which can store clothes and cycling equipment. Some North American universities (for example University of British Columbia) run a bike shop through the student union, providing space to carry out minor bike

repairs and also offer tool hire and an on-site mechanic for a reasonable fee (Poinsatte & Toor, 1999). All cyclists invariably encounter mechanical faults that can be alleviated by an on-campus commercial outlet stocking bicycle repair kits and parts, and staffed by personnel knowledgeable in bike repair. Such a shop becomes the point for all information on cycling groups, buddy schemes, safety and education programs. The university can further support cyclists by bulk purchasing insurance and passing on the discount when selling insurance to individual staff and students (DfT, 2002).

Universities should work closely with service providers to ensure public transport provides good penetration into the university campus, as this will improve accessibility and provide a high profile for this mode. Public transport service providers will largely dictate service improvements to the university unless the university provides full or partial service funding. Greater leverage may be achieved with a Universal Pass (U Pass) scheme or integrated ticketing by providing an assured capital stream to the public transport service provider. U Pass schemes are common in the U.S.A. where the schemes are structured around compulsory student membership which then provides free or subsidised public transport, access to all other initiatives in the TDM Scheme and discounts at sponsoring businesses. The compulsory purchase of the U pass guarantees the university and participating service providers' predictable annual revenue regardless of the frequency with which U Pass cards are used. Such a scheme provides the university with persuasive power during negotiations for public transport improvements. Universities can also get some leverage by charging higher parking fees.

Coupled with incentives to use public transport and non-motorised modes, regulation of single occupant vehicles (SOVs) must also form part of the TDM Plan, although consideration must be given to the potential for SOVs to compete with public transport. Permits offer a mechanism to limit parking availability to SOVs. Parking charges must also be applied. In the UK Oxford Brookes University (1999) distributes parking permits based on three categories of 'need':

- operational needs – if staff must regularly travel off campus for work related duties;
- special needs – if staff or students have a physical disability or carer responsibilities;
- distance of residence from the university.

When applying for parking permits, staff and students should be required to provide information about the availability of public transport services (DfT, 2002). This process may reveal to the applicant there is little need for car travel to the university.

Permits can be made more readily available to car

pool vehicles. Carpool parking should be located most conveniently in the university and the cost of daily car pool parking lower than for SOVs. Car pool participants must have access to a guaranteed ride home if the pool vehicle is not available and participants should also have access to a limited number of single use parking permits enabling them to occasionally drive their own vehicle. University vehicles should be available to staff during the day for work-related travel whilst a shuttle bus to the nearest commercial district can provide transport for staff and students errands. The key to car pool programs is to remove the barriers that discourage people from car pooling (Poinsatte & Toor, 1999).

The final step in a TDM Plan is monitoring and evaluation. Monitoring involves periodically collecting and reviewing information whilst evaluation focuses upon determining how well the plan's objectives are being achieved (Morrison & Pearce, 2000). Monitoring requires that staff and students are resurveyed to ascertain their travel patterns and attitudes to transport initiatives (University of British Columbia & Translink, 2002; DfT, 2002; University of Western Australia, 2003; Roads and Traffic Authority, 2002). Infrastructure audits can be addressed in the questionnaire through specific questions regarding 'missing links' in the transport network. Audits of parking supply and parking controls should be undertaken annually in conjunction with local residents and/or businesses to ensure any new or de facto off-site parking locations are not undermining restrictions on campus or impacting negatively on the locality. To determine the extent of the plan's success evaluation will compare the results established from the monitoring against the plan's objectives. Where results show limited success this can assist to provide the justification for future stronger actions.

The extent of TDM action by Australian universities

Given the array of solutions that some universities have implemented towards more sustainable travel practices, our research sought to explore the extent of action across Australian universities as a whole. To determine how universities were addressing their transport impact, a postal survey was undertaken to ascertain the current state of travel planning in Australian universities. The questionnaire focussed on three key aspects:

- first, assessing the existing transport infrastructure available at each university's main campus;
- second, how universities managed staff and student use of that infrastructure; and
- finally, what methods (if any) were utilised to influence modal choice of people accessing the university site.

Figure 1. Off-campus parking controls at Australian universities

The survey sought information about travel to the main university campus, which was defined as the campus with the largest total student and staff population. The survey focussed only on main campuses for a number of reasons. Firstly, developing and implementing a TDM plan has an associated cost and greatest cost effectiveness will be achieved where a large number of participants are assured. In this regard, it was expected larger campuses were more likely to have undertaken some travel planning. Secondly, university campuses with a large staff and student population are more likely to have experienced pressure on available transport infrastructure. This pressure may have prompted some interventionist action to address network problems.

Questionnaires were issued to 40 Australian universities achieving an initial 40% response rate. Universities that did not respond to the first questionnaire were sent a second survey. Twenty five usable questionnaires were returned, giving a response rate of 63%. The majority of responding universities indicated the main campus is situated in a suburban area (14 universities) with a further five campuses each located in the city or rural/regional areas. One university defined its geographical location as that of the city fringe.

Transport Infrastructure and Management – existing access arrangements

Geographical location appears to strongly influence the amount of car parking available. Three of the five city campus universities provided no parking whatsoever. Of the campuses with less than 500 bays of car parking, 75% were situated in a city. Campuses

providing more than 4,000 parking bays were predominantly located in suburban areas (75%).

The majority of universities provided car parking for students (84%) and all provided parking for staff. Of the four campuses that did not provide student car parking, three were located in the city and one on the city fringe. It is not surprising that city campuses provide the least amount of car parking and imposed some restrictions on student use of the parking as they are spatially constrained with limited opportunity for expansion of car parking. Existing infrastructure must be used more efficiently, achieved partly by limiting availability to certain sectors of the university population.

The literature review of best practice indicated that restricting parking availability also requires that areas not designated for car parking should not be used for demand overflow. However six of the responding universities allowed overflow parking within areas on campus, with much of this occurring at the university union or student college (50%) or university ovals (33%). Streets and parkland within the campus site also absorbed some parking demand. Overflow parking often occurs in inappropriate locations that inconvenience pedestrians and cyclists, and an absence of formal thoroughfares between such car parks and buildings can create dangerous conditions during peak periods. Overflow parking also implies that car drivers can have unfettered access to the university, conveying preferential treatment for car travel. If universities are to reduce motor vehicle trips to the campus, areas utilised for overflow car parking must be restricted. The grounds management and

environmental costs of use of such areas should be regarded as a monetary subsidy favouring car use.

Off-campus parking usually also operates to meet excess parking demand. 76% of responding universities have nearby areas of off-campus parking. Almost half (47%) of the off-campus parking sites offered unrestricted parking (by time or by cost). 11% of universities indicated off-campus parking is inconsistently regulated with a mix of parking controls in some locations and an absence of restrictions in other areas. For those universities with off-campus car parking subject to some form of controls, metered street parking and time restricted parking spaces were most common (see Figure 1). Ensuring appropriate controls are applied to off-campus parking requires dialogue between the university, local government and local land users. A good TDM Plan will involve all relevant stakeholders to ensure that parking sites adjacent to the university campus are subject to regulations supporting the aims of the travel management plan.

The pricing structure applied to on-campus parking for staff and students can be seen in Figure 2. While the majority of universities (76%) employ pricing controls for campus car parking, a quarter continue to provide free car parking despite its role in promoting car use. 52% of universities indicated they utilise both annual and daily charges. Annual car parking charges alone, applied by 26% of universities, can actually act as an incentive to parking on campus. Once the initial purchase has been made there exists a financial incentive to use the pass and appropriate its full value. Daily parking charges, particularly when set at an hourly rather than daily rate, encourage the use of parking occasionally for a limited period and are possibly the most effective disincentive to parking on-campus (DfT, 2002). However, only 5% of universities utilised daily charges.

The application of parking controls also varied between parking allocated for staff and students. In comparison with students, more universities required staff to purchase annual parking permits (8% and 24% respectively). 12% of universities required students to pay daily charges, while only 4% applied daily charges to staff parking. The difficulty with any such variation in parking controls is that it could be argued that one sector of the university population receives preferential treatment. Unless a justifiable basis can be established for variations in parking controls, the same charging regime should be applied to all staff and students.

In addition to parking provision for access by car, most Australian university campuses are served by a range of public transport and non-motorised infrastructure. Almost all of the universities provided outdoor bicycle racks (96%) with half also providing indoor parking or lidded bicycle racks. On reflection the survey should have assessed adequacy of supply and suitability of locations.

Almost one quarter of the universities lacked high frequency public transport services (those with a frequency of 15 minutes or less). Public transport services running at least every 15 minutes offer flexibility comparable to the car (DfT, 2002; Estill Associates & Department for Planning and Infrastructure, 2003). For universities attempting to reduce car trips to campus, frequent public transport services are a basic necessity to attract ridership. For those universities with public transport services (75%), bus access predominated, indicative of the high level of road infrastructure available in Australia. In contrast access by train was limited. Three universities had no railway station at all in the locality; five did not have a train station within comfortable walking distance of the university (1km). Eleven universities

Figure 3. Catalyst for initiating a TDM Plan at Australian universities

had a station within 6 km of campus; to take advantage of this would require good integration with other transport modes such as cycle and bus.

Achieving frequency improvements and services dedicated to meeting the transport demand at the campus may require promotion and support or funding directly from the university. Half of the university campuses had one or more buses directly servicing the campus, with almost a third of these universities partly or fully funding the service. Some universities indicated a dedicated bus was a night shuttle bus, a service that transports staff and students around campus, to student housing and car park areas after dark. Such a service although necessary, is not adequate to meet the wider transport needs of a university seeking more sustainable travel patterns. They should not be seen as a substitute against safer cycling and walking facilities. Reductions in car trips to campuses will only occur if this and regular and frequent public transport services are available to and from the residential areas of university staff and students.

Achieving reductions in car trips also requires that staff and students are aware of alternative travel modes, and how to use these modes. Surprisingly, a third of the universities do not promote travel by non-car modes. Given that 88% of the universities had one or more public transport services within proximity to the campus and 96% provided facilities for bicycle parking, failure to at least promote these modes is an important oversight. Providing on-campus information (e.g., web-based maps and guides) about the available non-car transport infrastructure as well as about car parking availability is possibly the least expensive step in travel planning.

TDM planning at universities

Not surprisingly given the slowness to embrace

commuter planning in Australia, only six of the twenty-five universities had TDM Plans. Half of the plans had been initiated very recently (2003). Three plans were initiated in consecutive years between 1997 and 2000. The primary reason for initiating a TDM Plan was to reduce SOV trips (2 out of 6 universities) with a variety of catalysts for the remaining plans (see Figure 3).

None of the plans directly tackled the need to reduce single occupant car journeys in the described actions, instead the plans showed a preference for focusing on improvements to public transport and cycling infrastructure. All of the plans lacked specific actions to manage the availability, convenience and cost of car parking at the universities, with the exception of two plans that were still in the development phase. International best practice indicates that by managing parking with restrictions and pricing disincentives, greater reductions in SOV trips are achieved (DfT, 2002). Clearly, in Australia this needs to be supported by improvements for other modes at the same time.

Improvements to infrastructure for sustainable travel modes were noted as part of the actions for all TDM Plans. One university plan also included actions to provide a maintenance course for cyclists. All the plans described actions to provide information and promote sustainable transport modes. The overriding finding from the six plans is that infrastructure improvements for walking, cycling and public transport are necessary at all universities, and the six universities recognise the need for ensuring staff and students are better informed about sustainable transport. It is clear that these universities have chosen these actions as priorities before tackling the disincentive approaches relating to car access.

Decision making

In developing the TDM Plans, some described the need to create a framework for policy and procedure that would work to deliver it effectively. All universities saw management of the TDM Plans as being undertaken by the universities alone. Only one university involved the state transport department in the decision making process for the plan. Without adequately involving stakeholders outside of the university, it is unlikely a TDM Plan will achieve any significant and long-term changes to the modal distribution of travel patterns. Off-campus infrastructure must be available for sustainable transport modes, and must provide an environment that is conducive to various combinations of walking, cycling or public transport. For this to occur, car traffic needs to be managed and increased priority given to pedestrians, cyclists and public transport services. Such changes will require the university to collaborate with stakeholders (including state and local government) with short and long-term benefits available from involving these parties at the outset.

Action outcomes of existing TDM plans

Of the three university travel plans initiated prior to 2003, results indicate achievements in infrastructure improvements and travel behaviour change. Two of the three universities have gained more frequent public transport services resulting in a higher proportion of trips to the university by this mode. One university also reported an increase in the proportion of carpool trips. Improvements in ticketing and information associated with the transport services were also reported. Other achievements reported include the creation of a dedicated transport office, and changes to the university vehicle fleet aimed at reducing greenhouse gas emissions.

Overall there is limited detail as to the individual plan successes at the universities and this may be related to the paucity of rigorous evaluation and monitoring. No university described a systematic process of monitoring and evaluation as part of the TDM planning process. One university currently developing a TDM Plan indicated monitoring would occur by undertaking transport surveys at relevant times to assess the degree of modal change. However, two universities with existing TDM plans do not undertake any monitoring, one indicated they would 'review' the plans achievements, but provided no further detail as to what the review process entailed.

Evaluation enables measurement of a plan's progress towards set targets. It brings rigour to plan design and can help decision-makers maintain a plan that is responsive to changes in travel demand and travel patterns (Bridgeman & Davis, 2000). Results of the evaluation can be utilised for promoting the success

of the plan, securing new infrastructure or further financial support. Where benchmarks have not been met, the survey results can be utilised to justify further action to achieve change (Roads and Traffic Authority, 2002). Evaluation and monitoring are therefore an essential part of travel plans and efforts should be extended to developing a program in the early phases of TDM planning.

Conclusion

In Australia, the last decade has seen the development of policies for sustainable travel emanating from federal and state governments. This is mirrored in the United States, where further weight is given through legislation and funding, and in the United Kingdom and in Europe. However, while there is evidence of real action and implementation of sustainable travel practices elsewhere, Australian universities as a whole are in their infancy in TDM. Only a quarter of surveyed universities are taking action to manage travel demand. Of these universities, half have only recently embarked on developing TDM plans indicating a slowness to embrace commuter planning.

Australian universities are significant trip generators, and many are located in suburban areas with poor access by non-car modes. Consequently, universities contribute a significant and negative impact, through congestion on the local road network and ever growing demands for on-site and off-site car parking. Current access to these universities is heavily car dependent. Yet of the few TDM plans that have been developed little action is taken to create a disincentive to car travel by addressing parking provision and charges. Instead these TDM plans focus on improving access by public transport. None see the need to take action on both fronts. Until it is recognised that the potential public transport market is the existing car commuters who are encouraged to drive to university by car by cheap, ample car parking, the likelihood of success in changing travel patterns is limited.

The review of best practice indicated a wealth of solutions, but more importantly the need for a comprehensive approach. This approach required three steps. First understanding the issue, which involves the university assessing its current practices and policies to see if they pose barriers to travel behaviour change. Second the need to find champions for the approach. This means gaining support not only from persons targeted for behaviour change, but also by partnering with local government and public transport providers and advocates and researchers within and outside the universities. The final step, taking action, focuses on devising the TDM plan, implementing its actions and evaluating the outcomes. When considered

in the context of Australian universities, two key findings need attention. Universities with TDM plans were seeking to improve public transport access, but their success will be hindered by the lack of awareness of the need for dialogue with public transport service providers and adjoining local government. It is also imperative to ensure that high priority, safety and convenience for walking and cycling is maintained or provided up to 5km from campus to reduce the number of short car trips and to not overload public transport. Furthermore, if TDM planning is to be seen as a long term solution, the need for clear monitoring and evaluation is important, yet universities with TDM plans have failed to take this into account.

An opportunity exists now for Australian universities as a whole to become leaders in sustainable travel management, and for leading universities to lead not only other universities and similar large organisations, but the whole community by way of example. However, the incentive for them to do so needs to be clearly articulated. This may require directive or legislation at a Federal level or funding for demonstration projects. Without this universities will continue to rely on individual champions to act as the catalyst, and the evidence to date shows this to be a slow process. Universities are charged with educating and researching; they should also be practicing and demonstrating cutting edge leadership in TDM.

Acknowledgement

The authors would like to acknowledge the research funding from the Australian Greenhouse Office which provided for a review of international best practice in travel demand management and the subsequent development of a website providing a 'Universities TravelSmart Resource Kit' (<http://www.travelsmart.gov.au/universities/index.html>). The questionnaire survey of Australian universities was conducted by the authors and was not commissioned by the AGO.

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Practical Lessons for Winning Support for Radical Transport Proposals

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Abstract

This paper proposes that while many plans and solutions to the transport problems of the 21st Century have been mooted, very few have succeeded in significantly improving the situation within Europe. It is suggested that many schemes face problems at the project implementation stage due to adverse public and/or political reaction. This paper incorporates a series of vignettes, several of which are based on in-depth interviews with practitioners directly involved in the implementation of the schemes in question. It looks at several existing 'radical' transport schemes from around the world in an attempt to draw lessons as to how they overcame this, not least in terms of how the implementation of alternative strategies by European policy-makers could be shaped and adopted world-wide.

Keywords

case studies, policy implementation, TDM, transport demand management, transport policy.

Introduction

It is widely acknowledged across the developed world that transport systems within many of its member states are stretched to breaking point. Since the 1950s, nearly all developed countries have witnessed a 'mobility explosion'. For instance, between 1991 and 2001, car and taxi traffic levels in billion vehicle kilometres increased by 12% in the United States, 44% in Japan, 8% in Germany, and 14% in Great Britain, while usage almost doubled in Portugal (85%) and more than doubled in Spain (107%), while usage appears to have fallen in Ireland and Sweden (DfT, 2003).

This has resulted from an increase in road capacity, income and population. Both income and population growth are viewed as the major drivers behind increasing vehicle ownership and use (Marshall *et al.*, 1997; Marshall and Banister, 2000).

Between 1970 and 2001, vehicle ownership in the EU-15 almost tripled from 62.48 million to 184.70 million. Thus, by 2001 there were 488 cars per 1000 EU-15 inhabitants (Eurostat, 2003). A report by the OECD

predicted that this would increase by a further 50% between 1995 and 2020, resulting in vehicle ownership levels of more than 600 per 1000 people in many EU-15 countries (OECD, 1995a).

While many plans and solutions have been debated, none has yet succeeded in significantly improving the transport situation within Europe. For instance, in the UK, road user charging has been consistently touted by academics and transport planners as the ideal policy mechanism for traffic reduction since the 1960s, but was only implemented for the first time on a sizable scale in February 2003. Moreover, the long term future of the central London scheme is still by no means guaranteed, with the Conservative Mayoral candidate Stephen Norris having declared his intention to abolish the scheme if elected (Wolmar, 2004). It is suggested within this paper that many of the problems experienced when trying to introduce 'radical' transport schemes are due to public and/or political opposition at the project implementation stage. A number of additional barriers – most notably resource, institutional and policy barriers, social, cultural, legal, and physical barriers – have also precluded such actions (Banister, 2002).

The most difficult barriers to overcome are the social and cultural barriers, which can also be described as public and/or political opposition. This perception is supported by Gunn (1978) in a seminal paper on 'perfect implementation' which has particular relevance in the transport sector (Ison and Rye, 2002). Gunn states that 'the circumstances external to the implementing agency should not impose crippling constraints'. In other words, for implementation to occur, one needs to ensure that the policy is acceptable to all parties that have the power to veto it (Ison and Rye, 2002). Assuming rational behaviour, the policy-making actors will devise strategies for the implementation process, which will result in maximising their own benefits: as such there will be both winners and losers and/or successful and unsuccessful implementation. There are examples of urban areas that have managed to implement radical

car restraint policies without the associated negative consequences often experienced.

The aim of the paper is to examine a selection of existing schemes from across the world and briefly describe some of the common difficulties faced by those responsible for implementing transport projects. In order to achieve this objective a series of vignettes were constructed based on in-depth interviews with key stakeholders, which is all important when attempting to understand the reasons for scheme implementation. The paper explains how transport practitioners have overcome adverse public reaction in practice. For example, the paper outlines how the 'Ring of Steel' in London was introduced, how Electronic Road Pricing was 'sold' to the public in Singapore, and how motorists pay to enter Manhattan and San Francisco via bridge and tunnel charges. Eight strategies are identified for future policy implementation. Four of the strategies focus on 'sweetening the pill' of potentially unpopular measures while three aim to convince the motorist that the new policy is in fact a reasonable response to the traffic problem. The final strategy suggests that transport policy goals need to be met through the sympathetic introduction of other ostensibly unrelated policies – or 'joined-up' policy-making. Finally the paper offers some lessons for European policy-makers, revealing how 'alternative' implementation strategies could be shaped and adopted within Europe.

It is important to state at the outset that the case studies are at a high level of generalisation. In each case one key issue/aspect has been identified. This is not to say that the implementation of any such initiative can be distilled down to simply one factor but the aim has been to offer an insight which may provide an important catalyst for change in urban areas worldwide.

What is meant by 'Implementation'?

The term 'implementation' can be defined in many ways. For the purposes of this paper, 'implementation' can be viewed as: 'policies, actions or decisions relevant to the target population that can be put into effect at 'street level', and 'implementers' as those responsible for doing that. As the definition implies, the policy process does not end once agreement has been reached on a proposal. The agreement still has to be implemented before the policy has any real existence. Bardach (1977) has described the implementation process as a game (see also Mendrinou, 1996, 13–16). According to Lane (1995), there are a number of aspects of the implementation process other than the accomplishment of the policy objectives. These include:

- the strategies and tactics employed by various parties to the implementation game;
- the mechanism of delay as a decision parameter;
- the variety of motives among the participating actors; and
- the need for coalition building and fixing the game.

As implementation theory suggests, one of the most favourable conditions for successful implementation is where policy-makers and implementers develop a co-operative relationship (Richardson, 1996, 290). Indeed, Cram (1997, 84) suggests 'if policies are formulated in the absence of active and enthusiastic participation by those whose co-operation is essential at the implementation stage, then implementation failure is more likely'. Pressman and Wildawsky (1984) suggest that correct implementation usually involves several semi-independent organisations or agencies, each of which can, to a large extent, block or change the direction of implementation. When a situation arises where implementation failure becomes so evident that a process of 're-steering' (Lundquist, 1972, 33) has to take place, policy-makers must take action to encourage or force implementers to behave in ways more likely to achieve the set policy objectives (Richardson, 1996).

The Alternative Strategies

The following vignettes form practical examples of how existing examples of radical transport schemes might be classified according to a simple strategic implementation framework.

Compensating losers

The introduction of road user charging in Singapore in 1975 has long been seen as a 'one off' event, which was only possible because of unique circumstances not least in that the citizens are essentially law abiding, and that there are no alternative cities for businesses to relocate to. While this certainly played a large part in the introduction of the original low-tech Area Licensing Scheme which used paper windshield stickers enforced through visual inspection by traffic inspectors within a single cordon, it was somewhat less important when an Electronic Road Pricing system was adopted in 1998.

Instead, what is less well publicised is that the Singapore Government made a policy decision to ensure that the majority of people benefited as a result of the change. This was achieved by granting rebates to certain road user groups. For example, taxis were given road tax rebates for the first three years after implementation, while businesses were given four years of rebates. In addition, a S\$60 a month levy imposed on owners of non-residential parking spaces was replaced by a nominal S\$1 per space per month licence fee in the same year. In other words, the Government effectively 'bribed' the public to ensure that the scheme had a chance of working in the first year, and gambled on the scheme being accepted by the

time the rebates were withdrawn.

Such an approach was suitable as the main objective of the scheme was – and is – to manage traffic levels rather than raise revenue. The costs of the ‘subsidies’ were written off as a necessary implementation cost.

Bribing the motorist not to drive

Certainly the most overt way of ‘incentivising’ drivers out of their cars is by paying to them not to use their cars for certain trips – i.e. effectively bribing motorists to use an alternative mode. One application of this principle – the parking cash out – is becoming increasingly common in the UK. Annual schemes operate at Southampton General Hospital (Bailey, 2002) and at Orange’s new Bristol office (Baker, 2003), while a monthly pass system operates at the Vodafone offices in Newbury, Berkshire (Hopkins, 2003).

Still more radical, the pharmaceutical giant Pfizer began operating a parking cash out scheme that rewards non-car commuters on a daily basis among staff at its research and production facilities. The scheme was launched at Sandwich, in Kent in June 2001 and at Walton Oaks near Reigate, Surrey in December 2001 (Elliot and Chadwick, 2002). This works by using staff personalised security pass ‘proximity card’ technology with an employee’s card credited with enough points to ‘pay’ for one month’s parking. The card opens the parking barriers and records how many points are used. If not used for parking, staff then cash in these parking points at the end of each month, which are paid through the payroll. Staff at the Sandwich site receive £2 per day for leaving their car at home, while at Walton Oaks the incentive is £5 a day – a reflection of the far tighter parking standards set by the local planning authority at the Reigate site. Overall, it is estimated that the value of cash outs given to staff will amount to approximately £0.5m a year, and currently around one-third of staff travel to work by modes other than the private car.

It is not only parking spaces that motorists are paid to give up – in some cases they are paid to give up their cars. For example, during Green Transport Week in June 1999, public transport operator ‘First Glasgow’ introduced the ‘Swap a banger for a bus’ scheme, which led to more than 500 residents from Glasgow swapping their car for an annual bus pass worth £560 (BIA, 1999). In the U.S.A. too, a car cash out project is being tested by the State of Washington and public transport operator King County Metro in Seattle, through funding from the Federal Highway Administration value pricing programme (VPP, 2001).

Highlighting the benefits

By contrast in Oslo, road tolls were introduced in the city to raise money in order to pay for new transport infrastructure, and not to reduce traffic

congestion. This meant that the ‘rebate route’ might exempt too many people for the required amount of money to be raised. Indeed, the charges introduced were relatively low and were spread across the ‘population’ as far as possible so that they could maintain traffic levels and maximise revenue.

In the Norwegian case therefore, the important objective was to convince the public that the money they were being asked to pay was being used to directly benefit them as motorists. Accordingly, much effort was spent on a well targeted and publicised information campaign, which was aided by the charge being implemented only 14 days after the Oslo Tunnel (i.e. *Festningstunnelen*) was opened to traffic.

Offering more choice to the road user

The key reason for drivers accepting the High Occupancy Toll (HOT) lane facility on Interstate 15 to the north of San Diego, is that drivers are offered a genuine and informed choice. Motorists can use the general purpose lanes for free with the likelihood of being delayed, or else they can pay but enjoy a hassle free and predictable journey time.

The HOT facility originally opened in 1988 as a High Occupancy Vehicle lane to buses, vanpools and two-person carpools (Shreffler *et al.*, 2001). In 1991, it was suggested that the lanes could be opened to single occupancy vehicles (SOV) as only 50% of the two lanes’ capacity was being utilised while adjacent general-purpose lanes were experiencing severe congestion during peak periods. It was not until December 1996 that the HOT lane became a reality.

As drivers approach the HOT lane, variable message signs advise them of the toll to use the facility. The level of this toll depends on how much spare capacity is available in the general purpose lanes, and varies from US\$0.50 to US\$4 in normal circumstances, with drivers paying more to use HOT lane when the general purpose lanes are congested. Around US\$430,000 of the annual US\$1.6m toll revenue covers operating costs, and US\$60,000 is received by the California Highway Patrol in order to enforce the operation of the lanes. State law requires the remaining money to be spent on developing the express lanes and improving the public transport service along the corridor, specifically, the express bus service known as the Inland Breeze, which began operating in November 1997. While initially there were concerns that these would become ‘Lexus Lanes’ – i.e. only used by the rich – this has not been borne out in practice.

The lesser of two evils

Related to this, is the idea that the public is provided with two choices, one of which is even more politically unpalatable – yet just as logical or reasonable – as the favoured one. A recent example of this approach occurred in the City of Durham before

the introduction of the congestion charge near the Cathedral in October 2002 (Ieromonachou *et al.*, 2003).

In summary, the problem was that traffic was causing problems for the World Heritage Site of the city's cathedral and castle, as well as for pedestrian shoppers in the city centre. Accordingly, a transport study demonstrated that action needed to be taken – a position appreciated by almost everyone – either car drivers were to be charged for driving in the congestion area or else banned altogether. Given the alternative, it became the less controversial route for the council to adopt the access charge.

It might have been worse...

A similar tactic was used to herald the introduction of London's Congestion Charge in February 2003. Hostile newspaper reporting prior to the introduction of the charge and predictions of traffic chaos by the London Mayor (Webster, 2003), combined with a lessening in traffic due to a half term school holiday, meant that for the first week the charge performed far better than expected. Consequently, after the first week of congestion charging the scheme was seen as a policy success. Further research is obviously required, however, before labels such as 'success' or 'failure' can be assigned to this scheme.

Adapting tried, tested and accepted methods

Despite the recent media frenzy surrounding the launch of the London Congestion Charging Scheme in February 2003, two cities in the USA (San Francisco and New York City) have been charging vehicles to enter or exit downtown areas for many years. The two cities were able to introduce such a measure with virtually no adverse political problems. Drivers are required to pay tolls to cross eight 'Caltrans' bridges in the Bay Area of California, including the four bridges to enter San Francisco (Caltrans, 2000). Similarly in New York City, drivers crossing into Manhattan must pay to use seven of the city's bridges and two tunnels (MTA, 2003). This apparent public acceptance indicates that drivers are happy to pay to use a facility such as a bridge or a tunnel, whereas the idea of paying to enter the downtown area of a city would be extremely controversial. Fundamentally though, it could be argued that there is no real difference in that both are paying to use a designated section of road. The lesson here would therefore seem to be that 'traditional' charges that have been in place and accepted for many years might do an equally effective job as something seen as new, radical and threatening, but with rather less opposition. In addition, paying for a new 'service' is less galling than paying for something that previously cost nothing.

The Trojan Horse

Perhaps the classic case of a transport policy being introduced by a 'trigger mechanism' – i.e. on the back

of a totally unrelated policy – is that of the so-called 'Ring of Steel' imposed on the City of London in 1993. This policy was instigated almost overnight in response to a terrorist bomb attack in Bishopsgate, and involved restricting access to the central core of the city. In addition to the closure of 17 minor streets and the conversion of 13 roads to one way, traffic signals were altered at 23 junctions and public transport and pedestrians were given greater priority (Cairns *et al.*, 1998). Overall, as a result of what was a security policy – in the eyes of the public at least – traffic entering the restricted area fell by a quarter from 160,000 vehicles a day, and pollution levels were 15% lower. There was however, a slight increase in traffic levels on the zone boundary.

Interestingly, the bomb exploded only a month before a traffic scheme known as "The Key to the Future" was due to be implemented that was also designed to restrict traffic for environmental reasons, and so significant elements of this proposal were incorporated into the security operation.

The Manchester bomb that exploded on Corporation Street in the City Centre on 15 June 1996 caused severe damage to the buildings and infrastructure of the city's retail and commercial district and enabled the city stakeholders (e.g. local politicians, residents and retail organisations) to think boldly about transport issues. The bomb resulted in the closure of four central streets and yet the city continued to function normally. As such, the closures were made permanent as far as general traffic was concerned with a small number of streets being pedestrianised, whereas in other streets, access was limited to buses, taxis and servicing vehicles, or in some cases, the direction of traffic was altered thereby changing the routes of some of the city's bus services (GMTU, 2001).

Overall therefore, it may be worth transport planners becoming more involved with the Emergency Planning sections at local councils. A note of warning is that care must be taken in choosing the 'right sort' of emergency. For example, the fuel shortages caused by a blockade of refineries by hauliers and farmers during September 2000 – arguably an unforeseeable emergency – were blamed on the Government and not the protesters, due to the high level of tax on fuel, presumably because it is under the Government's control. It is questionable whether this was the right sort of 'emergency'. War or problems in the Middle East on the other hand, have allowed Governments to ration petrol (or at least prepare to ration petrol). In the UK petrol rationing was implemented between 23 September 1939 and 26 May 1950 due to the Second World War, and again in 1956 because of the Suez Crisis. In addition, it was almost adopted during the oil shocks of 1973 and 1979 (Harman, 2002).

Table 1: Radical transport schemes should be...

WISE	So the public perceive there is a problem and the policy seems a reasonable way of solving it
COMPENSATORY	So the public see they benefit from the scheme, are compensated in some way for any disbenefits, or are provided with a viable and acceptable alternative means of travel
SUPPORTED	So the public feel that other organisations or individuals are convinced the scheme is the right way to go
CONSULTED	So the public feel they have been properly consulted as to their opinions, and these have at least been listened to and ideally acted upon
INDISPENSABLE	So the public feel there is no alternative (or that it is the least worst alternative)
COMPARABLE	So the public perceive that the scheme is not so different to existing schemes or if they have had experience of similar schemes
STIMULATED	So the public believe that the scheme is implemented as a response to some kind of crisis that is beyond the Government's control – e.g. an act of terrorism or a national emergency – or obviously for the public good – e.g. drink driving, security

Finally, deteriorating air quality due to high traffic levels and unfavourable weather conditions have led to Paris and several Italian cities adopting 'alternate plate' days, whereby only traffic with an odd or even numbered registration plate is allowed into the city, and even to total traffic bans. Such action has been driven by concerns over poor health. Similar conditions could perhaps be created by taking advantage of particularly bad weather or some other 'Acts of God', or more predictably by maintenance problems closing roads, bridges (e.g. Hammersmith Bridge, see Rees and Williams, 1998) or car parks (for example, Lancashire County Council was forced to close an employee multistory car park due to structural problems in early 2003).

'Conventional' Implementation of Good Practice

The vignettes highlight a number of important lessons that can be learnt from the successes and failures of radical demand management schemes to date. As demonstrated by the Cambridge experience of road pricing (Ison, 1998), these are not necessarily always about the technology issues but can often be about how schemes are designed, the effective inclusion of user concerns and political sensitivity. For example, there has to be a climate for change, i.e. congestion should be perceived as a major problem before the public are likely to accept a change in policy direction. In other words, the proposed policy or scheme *needs to be supported* by politicians of all political persuasions and the general public need to *understand the problem* before they are likely to accept or even support it.

Those responsible for developing the policy or scheme can only gain public acceptability if the *aims and objectives are clearly defined, complementary to other sectoral policies and widely inclusive* at all stages of the decision making process – from as early on in the process as possible (Wixey & Ruiz, 2003).

Achieving at least some of the benefits promised as quickly as possible, yet at the same time *not trying to*

achieve too much in the early stages are also vital lessons that can be learnt from some of the 'successful' schemes highlighted above. In other words, it could be argued that piecemeal implementation may create better results than implementation by stealth. One of the criticisms often levelled at transport schemes is that they do not *offer a realistic alternative* to travellers who wish to switch from the car. Fortunately, this was a lesson that the London Congestion Charging scheme took on board, and an increase in the number of buses and bus routes provided meant that there was a realistic alternative in place before the congestion charge was introduced.

One of the most important lessons to be learnt is that the implementation process needs to be both *transparent and flexible*. The process must be able to adapt to changing circumstances, public attitudes, objectives and technology changes and that it can react to 'unexpected' events.

Additional levers

These 'conventional' lessons are certainly important. But what the vignettes also demonstrate is that in many cases of successful implementation there were additional factors that helped transform uncertain outcomes into positive results. These are summarised in Table 1.

Clearly, the strategies suggested above are already implemented to varying degrees in most transport projects, but have possibly not been set out quite so bluntly in the past. It is also obvious that the appropriateness of some or all of these strategies is strongly dependent on the particular circumstances of a proposed scheme.

Conclusion

This paper has shown that there is no single model of policy implementation that will guarantee a successful policy outcome. It is clear that in many of the more radical schemes adopted around the world, additional strategies have been employed, either

deliberately or almost accidentally. The evidence also suggests that there is scope for combining suitable strategies in order to increase acceptability still further. This paper has provided an alternative way of looking at the implementation process.

It is the implementation of a project – and in particular in convincing the public and/or local, national and European politicians – rather than the planning or even the financing of a project that determines whether it should go ahead or not. As this paper suggests, it must be recognised that modelling the process of executing public policies – i.e. the implementation process – is different from evaluating the extent to which objectives have been accomplished – the implementation assessment. In essence, not all policies that are ‘successfully’ implemented actually meet their original objectives.

Acknowledgements

The authors would like to acknowledge the contribution of the interviewees and colleagues Dr Tom Rye and Dr Josie Kelly for their comments.

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A ferry departs Coilleag a'Phrionnsa, Eriskay, destination Aird Mhor, Barra, Outer Hebrides, Scotland, April 2003.

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