REPORT

CENTRE FOR
INTERNATIONAL
ECONOMICS

Business costs of traffic congestion

Prepared for

Victorian Competition and Efficiency Commission

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1 Context

CAN THE BUSINESS COSTS OF TRAFFIC CONGESTION BE MEASURED? Is this a large cost, or is it small in the cities of Melbourne, Geelong, Ballarat and Bendigo? Is there information to answer these questions? What further work needs to be done to be able to answer these questions?

The Centre for International Economics (CIE) has been commissioned by the Victorian Competition and Efficiency Commission (VCEC) to answer these broad questions.

Background

VCEC is conducting an inquiry into the costs of options for managing transport congestion in Melbourne, Geelong, Ballarat and Bendigo. In April 2006, VCEC released a draft report examining the nature and incidence of transport congestion in these cities. VCEC has found estimates of the cost of congestion primarily based on the direct cost attributed to travel time delays.[1] Broader robust estimates for the indirect costs of congestion for businesses have not been identified. VCEC recognises the thrust of many submissions, including one made by the Committee for Melbourne that has claimed that the cost to business of congestion accounts for around 60 per cent of total congestion delay cost, suggesting that the indirect costs may be substantial. VCEC has encountered challenges in obtaining the data to verify such claims.

VCEC has identified research funded by the National Cooperative Highway Research Program (NCHRP) that sought to develop a framework for measuring the cost of congestion to business in cities in the United States of America (Weisbroad et al. 2001). The research led to a report, *Economic implications of congestion*, which provides a methodology for

[1] One of the points identified in the research that follows in the next chapter is that there is a wide range of views about what constitutes a direct or indirect cost to business from traffic congestion.

measuring both the direct and indirect congestion costs for business in key cities. The purpose of the study was to examine how urban traffic congestion affects producers of economic goods and services in terms of business costs, productivity and output, and how the sensitivity of various industries to congestion.

The NCHRP report develops a bottom-up methodology for determining the direct and indirect costs of congestion for businesses. Generally, changes in road congestion costs will result in two types of changes for business costs; a change in the:

- direct costs of production (including the cost of obtaining workers); and
- indirect costs relating to business' accessibility to specialised inputs.

The NCHRP models businesses' production responses in various urban zones to differences in relative costs of labour and materials. The report emphasises the need to disaggregate urban areas into various zones when analysing the full costs of congestion. The economic activity within these zones is further disaggregated by industry. The disaggregations identify the industries and zones most affected by congestion and the business costs of congestion. The authors of the NCHRP report explained their methodology for disaggregation in an appendix to the report. However, it should be noted that statisticians suggest that the more data is disaggregated the less reliable it becomes.

This study

This study aims to:

- Conduct a literature search on direct and indirect costs to business of road transport congestion to identify the broad types of impacts involved and the relative contribution of direct and indirect costs in the total economic costs of congestion.
- Examine the range of data used to provide the NCHRP estimates of the economic cost of congestion.
- Assess the extent to which local data sets correspond to those used to produce the NCHRP estimates for the economic costs of congestion and identify any gaps in the available Australian data.
- Form a preliminary view on what work would be needed to address any substantial information gaps to develop credible estimates of the economic cost of congestion along the lines of the NCHRP estimates.

The following chapters of this report step through these study goals in turn.

The study uses definitions about traffic congestion and business costs and others that are consistent with those used in the VCEC report.

2 *Views in the literature*

WHAT HAVE THE EXPERTS SAID about the business cost of traffic congestion?

General views

There is evidence that business views traffic congestion as causing a serious problem and believe that it causes a significant cost imposition. A survey from the United Kingdom found that traffic congestion was perceived as the most important factor likely to affect costs and service in the next three years (Fernie et al. 2000). Managers of trucking companies operating in California in the United States expressed a similar sentiment with 80 per cent of managers indicating that traffic congestion was a 'somewhat serious' or 'critically serious' problem (Golob and Regan 2001).

Consultation with business groups undertaken for this study has reinforced that business representatives view congestion in Victorian cities, especially Melbourne, as a costly problem.[2] Unfortunately, these organisations cannot point to research of their own or research that they are aware of that provides evidence of the specific costs to business.

Direct costs

There are different views about what constitutes a direct cost to business from traffic congestion.

Generalised cost of transport

A traditional approach is to identify the share of the generalised cost of transport congestion that is borne by business. The generalised cost of travel is an extension of the concept of cost to include items which

[2] Organisations consulted are listed in appendix A.

influence travel behaviour, but which are not always thought of in monetary terms. Key items are set out in conventional manuals for the economic analysis of roads and traffic and include:

- travel time — the additional time absorbed in delays caused by congestion; and
- vehicle operating costs — additional running costs (fixed and variable) such as depreciation, fuel, repairs and maintenance.[3]

As noted by Hensher and Puckett (2005) a weakness when focusing upon the generalised cost of transport is that it typically takes the analysis down the path of vehicle-trip based models that fail to incorporate the determinants for travel demand. The Bureau of Transport of Economics has expressed similar concerns about such models stating:

> Such a system assumes that each process is independent of the process below it. This assumption leads to the exclusion of the cost of travel from the list of determinants affecting the level of travel demand.[4]

Basically, the framework takes the need for travel as a given and does not look at how businesses may act to avoid travel.

Using the generalised cost of transport is a commonly applied framework for estimating the cost of congestion, particularly in Australia. BTE notes that most studies use a 'generalised' cost to road transport, noting that: 'more accurate approaches are unlikely to be worth the effort'.[5]

Direct business production costs

Another direct cost concept is to identify the costs of congestion that directly apply to the cost of production for business. That is, the costs that alter the ability of a business to make and deliver goods and/or services. Authors and analysts in this area generally take into account what happens to the business as well as what happens in vehicles.

A recent survey of businesses in Portland in the US highlighted a number of impacts of congestion (EDR 2005) on business production costs. These include:

- costs of additional drivers and trucks due to longer travel times;

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[3] See for example the Roads and Traffic Authority, 2004, *Economic Analysis Manual (Version 2),* RTA, Sydney and others like it in most states of Australia and BTCE, 1996 and 1996b.

[4] BTE, 1998, p. 15.

[5] BTE, 1999, p. 30.

- costly 'rescue drivers' to avoid missed deliveries due to unexpected delays;
- loss of productivity due to missed deliveries;
- shift changes to allow earlier production cut off;
- increased inventories; and
- reduced market accessibility and scale, including loss of market-scale and reduced access to specialised labour and materials.

The NCHRP report boils down a wide range of issues to three types of direct cost categories from traffic congestion for business:

- direct travel costs of all business-related travel, including vehicle operating expenses and the value of time for drivers (and passengers);
- logistics and scheduling costs, including effects on inventory costs such as stocking, perishability and just-in-time (JIT) processing; and
- reduction in market areas for workers, customers and incoming/outgoing deliveries (see section on 'Business adjustment costs' below).

As noted above the first category fits into a conventional perspective and is not disputed.

Many analysts propose the second category, logistic and scheduling costs. Stank and Goldsby (2000) note that JIT production techniques have led to demand for faster, more frequent and more reliable supply of inputs. Extra transport costs are preferred to carrying inventory (Sankaran et al. 2001). A paper by Shirley and Winston examined how highway infrastructure investment, which essentially decreases congestion costs, generate benefits by lowering firms' inventories (Shirley and Winston 2004a). Shirley and Winston also examine the cost of highway congestion on firms' inventories (Shirley and Winston 2004b). They estimate the highway cost of congestion on inventory and logistic costs is US$7 billion, with the costs of congestion to shippers accounting for nearly 25 per cent of total motorists and shippers congestion costs. Moreover, they noted that:

> Although truck traffic represents roughly 5 per cent of all vehicle traffic, shippers' share of the total cost of congestion is considerably greater than 5 per cent because freight shipments are exposed to more sources of delay than most auto trafffic because the cost of delay for some shipments may be extremely high.

Yet, the impact of congestion on logistics and scheduling costs is not well proven. A survey of distribution centres in the UK found that traffic

congestion had a minimal influence on warehouse operating costs (McKinnon 1998). Instead, the survey found the direct cost of outbound transport was of greater concern than the cost of congestion.

The impact of congestion on freight costs may be time dependent and avoidable in practice. Stakeholders consulted for this study said that freight related travel often occurs outside of peak travel times, although as the peak period is expanded the cost to business from congestion are likely to increase. Time shifting freight movements to avoid peak periods of congestion does not in itself eliminate the cost of congestion. Time shifting may reduce some transport costs but add other costs. Longer delivery times may, for example, impose costs in terms of higher inventory costs for both businesses and their customers.

Indirect costs

There are a number of differing views in the literature about what constitutes an indirect costs to business from traffic congestion. Major indirect cost ideas are discussed below.

Externalities

'Spill over' costs or externalities are often viewed as being indirect costs.[6] Externalities involve costs that are borne by road transport-related parties that are external to the people making decisions to use a road. Analysts often include the following costs in this category:[7]

- Accident costs — congestion generally slows down the traffic on roads which reduces fatalities which are normally a major cost, but congestion is also associated with more lower-level accidents. The frustration of start and stop traffic leads to 'bump and grind' driving and damage to property.
- Pollution costs — greenhouse gas emissions, other pollutants such as nitrous oxide, sulphur dioxide, particulate matter, noise and others.
- Reduced amenity — long queues of traffic can impact upon people and districts in many ways. Some people may find that it is harder to walk through an area, or it is less pleasing to do so.

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[6] It is notable that congestion itself is an externality. Congestion costs arise from the decisions of others.

[7] See BTCE, 1996; BTCE, 1998; BTE, 1999.

Typically, environmental and other externalities are taken into account in benefit-cost analysis of congestion. However, because of their nature, they do not generally pose a direct cost to business. In some cases they can pose indirect costs. Increased congestion may lead to higher pollution levels, for example, undermining the relative livability or attractiveness of an area and reduce business returns.

The Bureau of Transport Economics notes that congestion increases carbon dioxide emissions and other pollutants (BTE 2000; BTCE 1996). Reflecting carriage of freight and heavy vehicle movements these costs are likely to be higher than for business transport on average. BTRE has recently released a publication estimating the contribution to greenhouse gas emissions from freight (BTRE 2006).

Typically the value of externalities in economic evaluations is viewed as being a small proportion of the overall road transport costs.[8]

Business adjustment costs

Increased congestion can require various adaptations for businesses. Although adaptations are made, they are not costless. Contributions to the literature on the business costs of congestion point to several components of these costs, including (Weisbrod et al. 2001):

- market access costs — congestion interrupts the advantages that businesses obtain in urban centres from the 'agglomeration' of buyers and suppliers of goods and services (Ciccone and Hall 1996). The commercial response to excess congestion in the centre of a city for some businesses is to relocate to the periphery. Those businesses reduce their costs, but they also break down networks of businesses that provided benefits to all of the participants in the network.
- wage rate increases — some contributions to the literature suggest that employers pay higher wages to compensate for higher commuting times. This effect is viewed as being strongest for skilled white collar jobs in large urban areas.
- Overall productivity costs — a combination of the above factors can reduce the scale and efficiency of businesses.

Businesses will respond to congestion by adjusting their operations to minimise production costs. Businesses might adjust to congestion by moving away, or through adjusting their inventory management. In more

[8] See Mayeres, 2000; Peirson and Vickerman, 1998; Peirson and Vickerman, 1998b.

severe cases, businesses might be unable to adjust and would go out of business.

In addition, businesses might adjust their capital-labour ratio to reflect the availability of specialised labour in their local region. The NCHRP report captures the possibility of these substitution effects by incorporating substitution elasticities for both industry and occupations. Essentially these elasticities indicate the extent (or otherwise) that businesses would be willing pay a premium for specialised goods, services or labour. The lower the elasticity the more likely business will draw on resources from a wide geographic area and be prepared to incur the associated travel costs.

Economy wide adjustment costs

Economic systems are interconnected. It should therefore not be surprising to see that there are many contributions to the literature about the business costs of congestion that highlight broader flow-on cost implications as the economic system at large adjusts.

The Sydney Morning Herald recently circulated a study measuring the economic implications of projected increase in congestion costs in Sydney and the rest of New South Wales (CIE 2006). The analysis utilised a multi-regional computable general equilibrium (CGE) model. It showed that in addition to the direct costs of congestion in Sydney (measured in terms of an increase in the generalised cost of transport) there would be significant losses in other regions and to the state at large. These arose because congestion reduced productivity in Sydney, reduced its competitiveness and the competitiveness of regions around it. Basically, some capital, labour and households are forecast to move to other regions where returns were higher. The avoidable cost of congestion was estimated to have a value today of around $10 billion. This was estimated looking at the commercial costs of congestion alone. The costs to households in terms of lost time for leisure or work was not included.

Other analysts have examined the economic costs of traffic congestion in other countries and cities using regional computable general equilibrium (CGE) models. Their findings reveal similar broad economic relationships without the need to invest in specific additional transport activity data collections (Kim et al. 2004; Juri and Kockelman 2006).

Studies examining the economy wide costs of congestion indicate that they are substantial. The analysis conducted for the Sydney Morning Herald, for

example, found that the economy wide costs amounted to an additional cost impost of between 50 per cent and 60 per cent of the direct costs.[9]

Relative contribution of direct and indirect costs

There are wide discrepancies in the literature over the relative contribution of direct and indirect costs. Bozuwa and Hoen estimates for the indirect costs of congestion suggest that they might be 8–11 per cent of the direct costs of congestion (Bozuwa and Hoen 1995). McKinnon quotes a paper by the Hague Consulting Group for the International Road Transport Union indicating that, for freight traffic, the indirect costs of congestion are 2.2 times the cost of additional time lost from congestion (McKinnon 2004).

BTE (1999) examined a wide range of papers examining the cost of road investment. Papers cited by the BTE include indirect benefits of up to 105 per cent from road investment. Implicitly, this suggests congestion costs are quite high as the road investment is alleviating so many indirect costs. However, other papers cited by BTE indicate much lower levels of indirect benefits from road investment. For example, an analysis of the Melbourne Ring Road by FDF Management had savings in indirect costs of 14 per cent. BTE (1999) suggests that the indirect effect of road investment (which is essentially the converse of increasing congestion) is relatively minor.

Several papers indicate that direct and indirect costs will depend on the nature of the business. Runhaar and van der Heijden (2003) indicates the relative importance of 'indirect' costs vis-a-vis direct transport costs varies from firm to firm:

> To shippers of high-value goods with a short commercial life cycle, interest costs of freight in transit and the risk of obsolete products may be significant. Such shippers therefore tend not to economise on direct transport costs, but instead use fast and reliable modes of transport (such as airfreight). To manufacturers of low-value products, direct transport costs are often more important. This may result in the use of relatively cheap but slow modes of transport.

[9] Traditionally, economy wide analysis dwelt upon National or state impacts and was of limited value when seeking to assess impacts that related to a particular place or area. It is notable that recent model development has led to models that enable detailed analysis of economy wide interactions in particular regions. Thus some of the recent work cited above involves models about impacts within cities as well as surrounding regions.

A report by AECOM (2001) found that the value of indirect benefits arising from industrial reorganisation varied depending on the economies of scale in production (see table 2.1). Part of the report analysed a 25 per cent reduction in the cost per product-mile of transport. The report found that if economies of scale were small (a = 0.95),[10] the reorganisation (indirect) benefits are estimated at 12 per cent of total benefits. The paper reveals that for those businesses with greater scale-economies the ratio of direct to total benefits increases following a reduction in transport costs. The paper's authors note: 'The results are, in a way, disappointing', suggesting that they had hoped to find greater indirect benefits from reducing transport costs.

2.1 **Benefits of a 25 per cent reduction in transport costs**

Manufacturing scale-economies index (a)	*Direct benefits*	*Indirect benefits*
	%	%
0.95	88.1	11.9
0.90	89.0	11.0
0.85	89.7	10.3
0.80	90.5	9.5
0.75	91.2	8.8
0.70	91.6	8.4
0.65	92.2	7.8
0.60	92.6	7.4
0.55	93.0	7.0
0.50	93.3	6.7

Source: AECOM (2001).

The paper draws heavily on the work of Mohring and Williamson (1969), who were the first to examine 'reorganisation' benefits arising from adjustments in logistics arrangements. The paper is cited by several recent authors and used as a basis for examining the relationship between direct and indirect costs of transport (for example, Small (1999) and Lakshmanan and Anderson (2002)). However, Small also notes 'benefits are fully captured in the demand curve for transportation, and hence are transfers rather than new benefits'.

Mohring and Williamson's paper has also been open to other criticisms. For example, Jansson and Wall (2002) suggest that reorganisation benefits might be about five times higher than those calculated by Mohring and Williamson (which would suggest indirect benefits might be as high as 60 per cent). Jansson's and Wall's analysis examines independent single-plant

[10] The scale-economies index in this paper (a) represents the proportional increase in direct costs if production is increased. If production increases by K, then costs will increase by $K^{1/a}$. For example, if there were no economies of scale (and the index equalled 1) then a doubling of output would mean a doubling of direct costs.

profit-maximising firms rather than using the cost minimisation method used by Mohring and Williamson (and AECOM). The framework employed by Jansson and Wall might prove useful for measuring the relative contribution of direct and indirect costs. However, the authors indicate the topic needs further exploration to be of practical use in benefit-cost analyses.

Based on the views and evidence discussed in the literature a conservative estimate for the relative magnitude of the indirect costs of congestion to business would place it at around 8–12 per cent of the total transport costs. The relative magnitude of costs faced by a particular business would vary depending on the nature of the business. However, there still remains significant uncertainty about the relative contribution of direct and indirect costs and there is reason to suspect that indirect costs might be higher. Such claims require further theoretical and applied research.

It is notable that variation in the results reflects problems in trying to separate direct and indirect costs in a partial equilibrium or benefit–cost analysis framework.

Potential benefits

Congestion may actually produce potential benefits for business. For example, businesses along a popular shopping strip might benefit from an increase in passing trade due to congestion. Identifying whether particular businesses, or even whole industries, benefit from congestion is an important consideration when measuring the net costs of congestion to businesses.[11]

Key points

Key points apparent in the literature about the business costs of road traffic congestion are summarised below.

- Studies show that businesses are conscious of costs that they face from congestion.

[11] Benefits from congestion are often considered to arise due to economies of agglomeration. Typically, there is a trade-off between congestion costs and agglomeration benefits. The trade-off is likely to differ across different industries. That is, one business' congestion cost might be another business' agglomeration benefit. Chapter 5 discusses methods for identifying businesses that benefit from congestion and measuring that benefit.

- Direct costs of congestion to business arise through an increase in the generalised cost of transport. That is, businesses absorb costs through the cost of increased value of travel time and vehicle operating costs. These costs are closely linked to use of transport systems.
- There are also direct costs to business through increases in the cost of producing goods and services. These are costs that businesses see in their normal business accounts and are directly related to congestion, but they may appear in terms of non-transport items.
- Indirect costs include some spillovers and externalities that are generally not paid by business. More importantly, costs arise as other factors in the interconnected system adjust. Mechanisms proposed in the literature include increases in wages in high congestion areas.
- There is little consistent and comparable evidence about the relative size of the direct and indirect costs of congestion for business. Some analysts view that the direct generalised costs are the major costs. Others view that the indirect costs are significant. Some view that the indirect costs are more significant than the direct costs.

3 *Data needs for direct and indirect assessment*

A SUBSTANTIAL AND DIVERSE RANGE OF DATA are required to estimate the cost of congestion to business. Severe congestion is often localised and many generalised regional traffic indicators fail to capture local peculiarities. Many other frameworks fail to take into account that the 'relationship between traffic levels and congestion delay is not linear' (Weisbrod et al. 2001). The NCHRP report has constructed a framework that provides for the assessment of many of the direct and indirect costs of congestion. This chapter reviews the framework used in the NCHRP report.

A framework

The NCHRP framework is data-intensive due to the need to disaggregate traffic data into Traffic Activity Zones (TAZs) and further disaggregating the flow traffic across TAZs by industry sectors.

As part of the analysis the NCHRP researchers developed a software application. They refer to the application as a Congestion Decision Support System (CDSS). The required inputs for the CDSS are indicated in box 3.1. These inputs provide a streamlined checklist of the data requirements for estimating the cost of congestion to business using the NCHRP framework.

The comprehensive level of data needed for the NCHRP framework is designed to identify how congestion is affecting particular industries and particular locations in a city. It seeks to identify the cost of congestion to business at a highly disaggregated level. Extensive data sets are, therefore, critical to the NCHRP approach.

3.1 **Minimum data requirements for CDSS tool**

Business operations

- truck and service-related trips by origin-destination zone by industry;
- base case average daily travel times (minutes) by origin-destination zone;
- improvement case average daily travel times by origin-destination zone;
- distance by origin-destination zone;
- unit costs of vehicle operations, safety and driver time;
- additional reliability costs incorporating an average level of delay;
- value of commodities carried; and
- elasticity of substitution by industry.

Commuting

- population by residential zone for each occupation;
- employment by residential zone for each occupation;
- base case average daily travel times (minutes) by origin-destination zone;
- improvement case average daily travel times by origin-destination zone;
- distance by origin-destination zone;
- average daily wage by industry;
- elasticity of substitution by occupation; and
- average modal share for drive-alone, transit, carpool and other modes.

General system parameters

- number of zones; and
- number of districts.

Source: Weisbrod et al. (2001).

Data sets used by the NCHRP in the CDSS

The NCHRP report identifies several major sources for data sets used in the study. For commuting trips most of the data comes from US census journey-to-work data set. For truck trips, that data comes from Metropolitan Planning Organisation models (MPO). The data sets and, where applicable, who provides the data, are:

- MPO commuting trip data, which is often based on US Census journey-to-work data set. These data sets typically disaggregate trips based on the number of industries and origin-destination zones;
- MPO truck and business data, although this is often limited as it does not contain information on industry (so these are estimated based on

employment data). Furthermore, the data sets generally do not include information on truck travel to and from areas that are external to the metropolitan region;

- commodity flow survey (CFS) provides information on data freight flows by commodity, including external origin-destination patterns as well. However, the report's authors used 'special tabulations' to disaggregate this information for the subregional level; and
- MPO travel time and variability data were used to obtain information on inter-zonal travel distances and travel times.

Other data requirements with unspecified sources:

- professional and service activity, which captures travel involving cars, small delivery vans and other light commercial vehicles (and are not captured in the CFS data); and
- inventory and logistics costs associated with transport-related costs. These costs tend to arise from travel time variability rather than average congestion costs. They reflect costs associated with perishability of products and a business' capacity to use just-in-time production techniques. The cost of travel time variation is in addition to predictable costs of road traffic congestion.

Key points

The key points derived from this chapter are as follows.

- The NCHRP report adopts a data intensive approach to modelling the cost of congestion.
- Traffic analysis zones (TAZs) and industry and occupational breakdowns are key components of the framework.

4 The availability of data in Australian data sets

THE RANGE OF AVAILABLE DATA sets that correspond to those used in the NCHRP study and could be applied to a Victorian context are identified in this chapter. The analysis looks at the availability of data for the Victorian cities of Melbourne, Geelong, Ballarat and Bendigo. It also identifies how current Australian data sets could be extended to capture information used in the NCHRP framework.

Range of currently available Australian data sets

There is a range of agencies that provide data sets that either resemble or could be used to develop a framework for Victorian metropolitan cities similarly to that used by the NCHRP report. The main sources of information are:

- Victorian Department of Infrastructure's (DOI) Melbourne Integrated Transport Model;
- VicRoads;
- ABS;
- AustRoads;
- BTRE; and
- Census of Land Use and Employment (CLUE).

DOI's Melbourne Integrated Transport Model

The Melbourne Integrated Transport Model (MITM) is used to simulate transport systems congestion in Melbourne. MITM is based on a 4-step transport modelling process, which incorporates some of the aspects of the NCHRP framework and has the scope to include many more. The four main components are trip production and attraction (which are exogenous or determined by the modeller, not the model), trip distribution, mode split and trip assignment.

Currently, MITM does not have the capacity to estimate the cost of congestion to business directly. The CIE has been advised that DOI are looking to develop the model to identify travel purposes, which would include business-related travel and freight movement. DOI are also planning to create a freight movement model, which would capture freight movements within Melbourne. The model's extension could be useful for measuring the direct costs to business of freight movement. Although, it is unclear whether an industry breakdown would be possible.

There is also a concern that MITM does not take sufficient account of systemic change. Variables used in MITM, such as where people start and finish trips, how many trips they take and where businesses are located, are determined by the creator of the model. They are currently exogenous to the model when in reality they are shaped by things that happen inside the system (that is, they should be endogenous). Where a business is located, for example, is very likely to reflect access to transport and may change with more or less congestion.

MITM does not allow for key informational feedbacks. It does not include (or produce) some of the information used in the NCHRP framework. For example, it does not include the effects of higher wages and substitutability of labour. Periodic re-calibration to observed transport patterns could be used to adjust the model so that this is less of a problem, but it would remain a concern in dynamic applications of the model seeking to anticipate what happens in the medium to longer term.

The MITM has been extended to analyse road networks in regional cities in Victoria and the network over the state at large.

A key point about the MITM is that the results are a forecast or a prediction of transport outputs. Empirical observations are used in the model, but the results are simulations or simplifications of the real world.

VicRoads

VicRoads collects a substantial amount of information on road use in Melbourne and to a lesser extent Ballarat and Geelong. VicRoads also has plans to extend the collection of traffic information to Bendigo in the near future. While VicRoads collects information on travel times and the general level of congestion on roads, access to the information on business-related travel may be blocked or restricted. This is partly due to the expense of collecting such detailed information and partly because such information might be confidential (for example, if there are a limited number of freight operators).

It is understood that previously, VicRoads did not consider identifying such information as important because businesses (and freight) in particular had a greater capacity to change the time freight was being carried to avoid congestion. Business-related travel tended not to take place during peaks hours and truck movements tended to occur later at night. However, as the peak-period lengthens, VicRoads have placed a greater emphasis on collecting such business-related travel information.

VicRoads helps DOI to calibrate its MITM model. The MITM is likely to prove even more useful in the future as new information is collected on the business-related travel and freight movements.

Australian Bureau of Statistics (ABS)

The ABS has two publications that are directly useful for measuring the cost of congestion. The first is the *Survey of Motor Vehicle Use*, which has information on business car use and truck use for each of the states. The second publication, *Freight movements, Australia* has origin-destination information on kilometres travelled for freight at the statistical sub-division. However, many of the entries have high standard errors and are therefore, likely to be unsuitable for obtaining accurate estimates for the cost of congestion.

Additionally, the ABS has demographic information at a highly detailed level through the Census. This is able to capture population information by residential zone and includes information on employment and journey-to-work details. The ABS also has information on average wages by industry and by statistical area.

While the ABS has information on households, it lacks detailed information on businesses. Confidentiality requirements and the level of disaggregation might prevent the ABS from being a useful source for collecting data on businesses.

Austroads

Austroads has undertaken considerable research to find the direct costs associated with road transport use. Information includes the value of travel time and the estimates for vehicle operating costs (see tables 4.1 and 4.2). Consultation indicates that the Austroads values are commonly used for assessing the cost of congestion in Victoria.

4.1 **Estimated urban values of travel time – occupant and freight payloads**

Vehicle type	*Occupancy rate*	*Value per occupant*	*Freight – value per vehicle-hour*	*Vehicle operating cost*
	person/vehicle	$	$	cents/km
Cars				
Private	1.6	9.23	na	na
Business	1.4	29.52	na	na
Rigid trucks				
Light truck (2 axle, 4 tyres)	1.3	19.32	1.00	4.5
Medium truck (2 axle, 6 tyres)	1.3	19.69	2.72	9.8
Heavy (3 axle)	1.0	20.22	9.31	10.5
Articulated trucks				
4 axle	1.0	20.94	20.05	14.3
5 axle	1.0	20.94	25.57	16.6
6 axle	1.0	20.94	27.57	17.1

Source: Austroads (2004).

Austroads has also undertaken research across industry on the types of goods affected by road transport costs (Austroads, 2003). Indications of the various transport costs associated with various industries are presented in chart 4.3.

4.2 **Vehicle operating costs — cars**

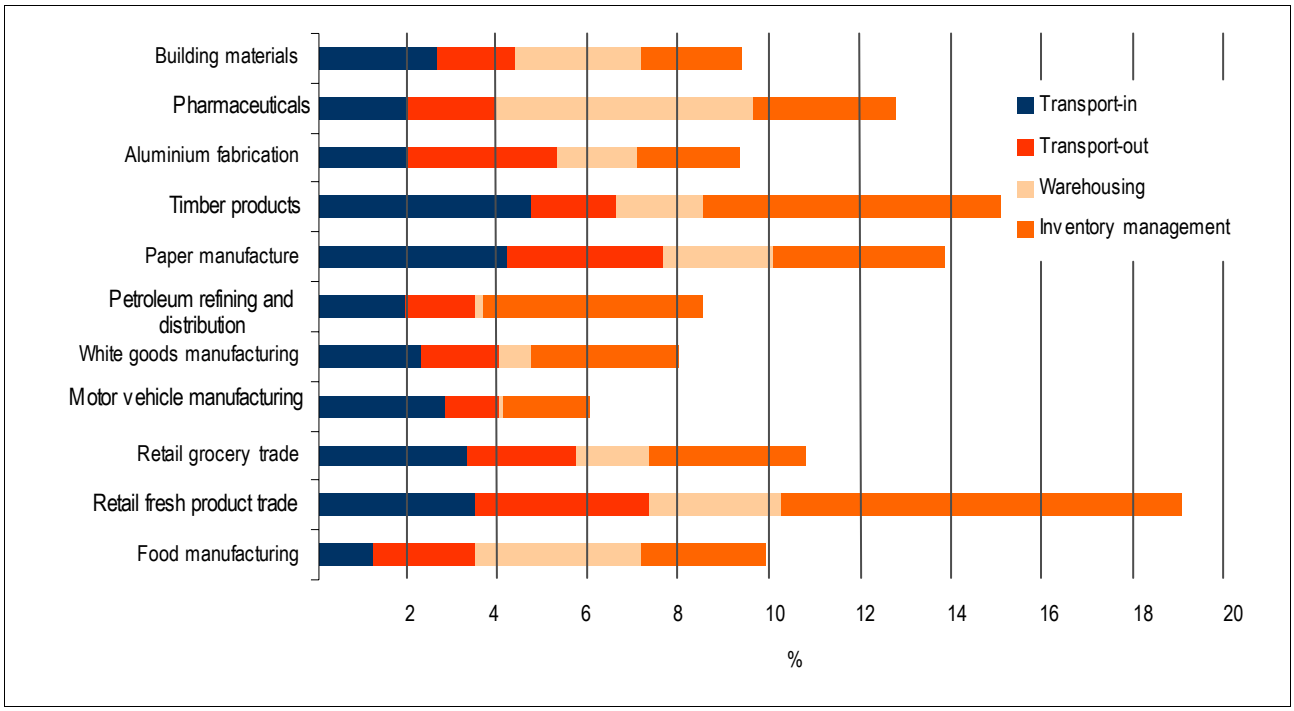
	Small	*Medium*	*Large*	*Average*
Cents per kilometre	4.6	4.9	5.3	4.9

Source: Austroads (2004).

BTRE

BTRE has put a growing emphasis on examining the issues of both inter-capital and intra-capital freight. Its recent publication, *Freight measurement and modelling* (BTRE, 2006) represents the first genuine attempt to develop a consistent time series of freight statistics in Australia. The publication contains useful information on urban freight tonnes-kilometres for Melbourne (and other capital cities) as well as some indications for freight costs.

4.3 **Logistics cost profiles for Australian industry**



Data source: Austroads (2003).

BTRE also has publications on appropriate methods for estimating benefits and costs associated with transport (BTE, 1999). BTRE has information on appropriate methodologies for evaluating congestion costs in cities. It also discusses comparisons of different types of transport models (BTE, 1998). It is not useful for providing the localised data required for the NCHRP framework.

City of Melbourne's Census of Land Use and Employment

The Census of Land Use and Employment (CLUE) collects information on the employment by industry within the City of Melbourne. This data is based on a comprehensive, biannual survey of businesses within the City of Melbourne's council area beginning with a limited survey in 1982.[12]

CLUE now includes data regarding:

- industry structure and type (ANZSIC code, number of establishments or business locations);
- floorspace type and use (offices, vacancy rates, retail, accommodation, industrial, entertainment etc);
- employment type and status (full-time, part-time, casual, contractor, male and female);

[12] http://www.melbourne.vic.gov.au/info.cfm?top=91&pg=2089

- building information (Number of floors, gross floor area, lettable area, etc);
- venue and capacity measures (café seats, education seats, child care spaces, rooms, off street car parking spaces, residential dwellings, student dwellings, student beds, theatre / stadium seats, conference & meeting seats, gaming machines etc); and
- spatial distribution (maps, CLUE blocks, regions, suburbs).

Consultation indicates CLUE could be extended to include information on business-related travel within the city limits of Melbourne, however the information would not extend to the greater Melbourne area or other regional metropolitan cities.

Summary of available data

Table 4.4 summarises the CIE's understanding of information available under the items required for the NCHRP framework. Details about the nature of the data and the ability to use it in conjunction with other data sets have not been checked.

4.4 Checklist of data requirements

Data requirements	*Available*	*Source*
Business operations		
Truck and service-related trips by origin-destination zone by industry	Limited	VicRoads, ABS
Base case average daily travel times (minutes) by origin-destination zone	Limited	VicRoads
Improvement case average daily travel times by origin-destination zone	Yes	VicRoads
Distance by origin-destination zone	Yes	VicRoads, DOI
Unit costs of vehicle operations, safety and driver time	Partly	Austroads, BTRE
Value of commodities carried	Yes	Austroads
Elasticity of substitution by industry	Yes	Various
Commuting		
Population by residential zone for each occupation	Yes	ABS
Employment by residential zone for each occupation	Limited	VicRoads, ABS, CLUE (partial)
Base case average daily travel times by origin-destination zones	Yes	DOI, VicRoads
Improvement case average daily travel times by origin-destination zone	Yes	VicRoads
Distance by origin-destination zone	Yes	VicRoads, DOI
Average daily wage by industry	Yes	ABS
Elasticity of substitution by occupation	Partial	Various
Average modal share for drive-alone, transit, carpool and other modes	Yes	ABS
General information		
Zones (and districts)	Yes	DOI, ABS, VicRoads

Source: Various.

What are the gaps in Victoria's existing data?

An overall assessment regarding the availability of data to apply the NCHRP framework to a Victorian context is summarised in table 4.5. Ticks reflect an assessment that data is available for an item. Crosses indicate a view that the data is not available. 'Partial' indicates that some aspects of the data are available.

Table 4.5 indicates that while data for many of the items are available, there are also gaps and areas of partial coverage.

The analysis indicates that there is more data available for Melbourne than the other cities examined. Given data constraints it would probably not be feasible to pursue application of the framework to the other cities at this time.

4.5 **Availability of relevant data for metropolitan areas**

Data type	*Melbourne*	*Geelong*	*Ballarat*	*Bendigo*
By industry	Partial	✗	✗	✗
Truck and service-related trips by origin-destination zone by industry	Partial	Partial	Partial	Partial
Base case average daily travel times (minutes) by origin-destination zone	✓	✓	✓	✓
Improvement case average daily travel times by origin-destination zone	✓	✓	✓	✓
Distance by origin-destination zone	✓	✓	✓	✓
Unit costs of vehicle operations, safety and driver time	Partial	Partial	Partial	Partial
Value of commodities carried	Partial	Partial	Partial	Partial
Elasticity of substitution by industry	Partial	✗	✗	✗
By occupation	Partial	✗	✗	✗
Population by residential zone for each occupation	✓	✓	✓	✓
Employment by residential zone for each occupation	✓	✓	✓	✓
Base case average daily travel times by origin-destination zones	✓	✓	✓	✗
Improvement case average daily travel times by origin-destination zone	✓	✓	✓	✓
Distance by origin-destination zone	✓	✓	✓	✓
Average daily wage by industry	✓	✓	✓	✓
Elasticity of substitution by occupation	Partial	✗	✗	✗
Average modal share for drive-alone, transit, carpool and other modes	✓	✓	✓	✓

Source: CIE.

Looking at Melbourne it is apparent that there are no crosses against the information requirement categories, but there are many where the data is viewed as being 'partial'. The areas that are viewed as having partial availability relate mainly to freight and elasticities of substitution by occupation.

Reliance on partial indicators may not block the development of a NCHRP framework. The indicators that are available could provide guidance and with additional assumptions could be adjusted to build a tool for analysis that met the requirements of the NCHRP framework. This may, however, erode the empirical base of the framework and reduce confidence in the findings.

The lack of data specifically identifying freight and business-related travel has been identified as an issue by several Australian transport organisations for some time. Organisations such as VicRoads, DOI and BTRE are moving toward collecting, collating and analysing travel data relating to these areas of travel. It is therefore likely that the data sets will improve over time, raising confidence in those data frameworks. To be useful for the NCHRP analysis this information would need to distinguish types of journeys by type of industry at a high level of detail and specifically link that to areas in which business is being done.

The main caveat about the assessment of the data is that data compatibility has not been assessed in detail. That is, it has not been feasible to check if there are sufficient common identifiers in the different data sets to enable the data about transport, industry and specific locations to be brought together.

Investigations so far indicate that, at best, only partial linkages between the key data sources are practicable at this time in Melbourne. This largely reflects the information obtained in the CLUE data set for Melbourne. Similar data is not available for the other Victorian cities. To put this into practical terms, data may provide information about the income of people in households in an area, but it generally does not provide information about how far people in that region travel to obtain that income. Looking at the issue from businesses' perspective, there is little data about wages paid in a region by different types of industry, and even less about how far (in distance or time) employees travel to obtain that income. This type of information is important when assessing the response to changes in traffic congestion (through elasticities) in the NCHRP framework.

Data compatibility is typically a major challenge for data collation from various sources and it is likely that this would also be the case for collating the data in table 4.5.

Key points

Lack of available data for some aspects of the NCHRP framework hampers the ability of applying the framework to other metropolitan areas. The authors of the NCHRP report acknowledge this limitation. Even within the US context the authors note that there is a lack of available information on key elements such as inter-zonal truck movements.

The data availability situation regarding the potential application of the NCHRP framework in Victoria is mixed.

- Much of the necessary data to implement the NCHRP framework for Melbourne is available.
- Data deficiencies are apparent. Specifically,
  - there is only partial data regarding industry disaggregations for business-related travel and costs, and freight movement;
  - there is only partial data regarding origin-destination travel patterns for business-related travel and freight movement; and
  - collating data is likely to be problematic because sufficient common identifiers probably do not exist.
- The main challenge is in linking the data. Origin-destination pairs in transport models need to be linked to economic parameters such as industry sector and location as well as to employment information and wages paid. This would involve considerable structural adjustment in the databases and the construction of an overall framework (which is largely the purpose of the CDSS tool built by the NCHRP).
- Applying the NCHRP framework to Ballarat, Bendigo and Geelong is viewed as being impracticable at this time given data limitations.

5 *Options for addressing data deficiencies*

WHAT APPROACHES TO MEASURING the cost of congestion to businesses in key Victorian cities would be practical? This chapter of the report proposes a range of approaches that draw on the data that is available.

Review of the literature suggests that it is assessing the direct and indirect costs of traffic congestion for business would be valuable. The NCHRP framework developed in the US is viewed as being useful for identifying how traffic congestion is affecting particular industries and particular travel zones in a highly disaggregated way. The methodology The NCHRP report drew on an extensive range of data sources available in the US and, where data was insufficient, used existing data to approximate the data they needed.

The analysis in preceding chapters of the report found that that there are significant constraints that would limit the application of the NCHRP framework to analysis of issues in Melbourne, Geelong, Ballarat and Bendigo. While there are many appropriate data sets in Victoria or Australia at large that could be extended to provide an estimate of the costs of congestion to business, notable deficiencies exist. Furthermore, aggregating the existing data is likely to require a substantial investment of resources (both in terms of cost and time) and the process is expected to identify further deficiencies as more details are explored.

This finding does not preclude assessment of the cost of congestion to business in metropolitan areas in Victoria. There remain several options:

- improve collection of business statistics;
- performance indicators;
- survey businesses,
  - cross-sectional — collecting information from business over a city to test the relationship between congestion and business performance (costs, productivity and competitiveness); and

  - longitudinal — collecting the above information through time;
- compare congestion 'hot spots' with other regions: composition, costs and competitiveness;
- use the currently available tools,
  - extend the capabilities of the Melbourne Integrated Transport Model (MITM), and/or
  - use a general equilibrium model to measure the economy-wide impacts of congestion.

Improved collection of business statistics

Assessing the business costs of traffic congestion is impeded because of limitations in statistical collections. Areas where improvements would be beneficial in ABS collections regarding Victoria are:

- Transport statistics — origin-destination data for commuters by their occupation and industry and for freight movements by industry.
- Business statistics — at present the ABS is able to provide information about the numbers of businesses by postcode, industry and employment size. It would be valuable if information could be obtained about wages paid by businesses, other business costs differentiated by type of cost, business revenue and other indicators of performance (margins or profitability).

It is likely that obtaining better data in these areas would be of value in any case in assessing the efficiency and competitiveness of Victoria in general.

Performance indicators

Indicators for traffic flow and associated costs could be used to provide a better appreciation of the costs of congestion to business in metropolitan areas in Victoria. Data already exists for developing some of the required performance indicators. The key constraints are often about making the data more easily available or accessible. Different data sets are 'owned' by different agencies that focus on different issues and an overall view is not always put together.

A reasonable picture of the costs of traffic congestion for business could be assessed by obtaining information about the following factors and tracking change over time:

- estimates of average traffic congestion in a city at large and in regions of those cities;
- estimates of business transport costs (time and other costs) by region;
- indicators of business numbers (by type of industry) in each city and region;
- employment by region;
- wages paid by businesses by employment region;
- journey-to-work data by employment region (rather than by residential location); and
- develop travel cost indices for various types of business-related travel or freight movement.

Performance indicators provide a relatively cheap, albeit imperfect, method for estimating where and how the cost of congestion is affecting business. For example, an increase in the journey-to-work times could be examined in conjunction with wages by employment region to analyse the effects of increased congestion on wages. The effects on wages could be used to infer the increase in cost to business arising from congestion.

There are three major disadvantages to using performance indicators. They:

- provide only a rough or approximate picture, possibly drawing attention to trends where increased congestion results in difficulties for business where this is happening, but little more;
- are likely to obtain only limited information on the indirect costs affecting businesses, which are not generally measured; and
- provide limited forward-looking information on the cost of congestion.

Survey of businesses

An obvious way to find the cost of congestion for business is to ask business. A survey of businesses is likely to yield valuable, industry and area specific information on the cost of congestion to business in various metropolitan businesses. The survey could be crafted specifically to address the issue of congestion and business costs.

There are two types of surveys that could be used, cross-sectional and longitudinal.

Cross-sectional

A cross-sectional survey could provide information on:

- the direct cost of congestion (time lost and vehicle costs etc) for business in different places (assessed over a particular time);
- indirect costs for the business including inventory and other costs and impacts of transport costs for staffing and obtaining specialised inputs;
- differences between regions and industry specific costs of congestion;
- how congestion impacts upon competitiveness and business outcomes (e.g. profitability);
- how businesses have responded to congestion or would respond to congestion; and
- relationships between congestion and business costs in different cities in Victoria to produce comparable data and insights.

A survey should be designed with care to elicit the right sort of information. For example, asking businesses directly about the impact of congestion on them is likely to result in biased survey responses.

The main benefits of this approach is that it would produce evidence about direct and indirect costs for business that arise from congestion at a reasonable cost. By taking a representative (random) sample of businesses it would be feasible to obtain the direct, indirect and economy wide picture.

A survey would provide one of the few means to directly test costs and benefits of congestion. This is essentially because the survey would take a neutral perspective and include information from a wide range of businesses. As noted previously, some businesses might perceive benefits from congestion and the survey would provide the most effective means for capturing those benefits.

The NCHRP report indicated that a key limitation of the survey approach was that businesses that moved or closed because of traffic congestion would be under-represented in a survey. Good survey design could address these aspects. Given a reasonable sample size and sufficient geographical dispersion of responses, it would be feasible to assess if businesses have moved because of congestion linked factors. Moreover, a cross-sectional survey could draw linkages between changes in congestion and changes in other factors for example, improvements in infrastructure. Testing to see if congestion resulted in businesses closing has to be tested over time with a longitudinal survey suggested below.

Longitudinal

Congestion costs are likely to change through time. A longitudinal survey could be designed to capture the impacts of congestion on businesses through time. The frequency of surveying should reflect the changes in road (or other) transport infrastructure development. Surveys conducted every two to three years would capture the changes in congestion costs to business. Longitudinal surveys might help to construct information on underlying contributing or alleviating congestion. This would enable identification of strategies that are successful in one part of a metropolitan area to be implemented in others.

Limitations of surveys

Key limitations are summarised below:

- large scale surveys (with many businesses in the sample) can be expensive;
- it is easier to observe perceptions than it is to obtain 'hard' facts;
- surveys often take much time to prepare and analyse (especially longitudinal surveys); and
- surveys tend to be built to examine the past — although they can be used to assess views about change or future conditions.

Assessing congestion 'hotspots'

Traffic congestion 'hotspots' are easily identifiable based on information available through VicRoads. By focussing on congestion 'hotspots', more information on which industries are affected by congestion costs can be estimated. The framework would build heavily on the framework established by VicRoads, who currently have the capability of collecting information on 70 per cent of Melbourne's freeways and have recently started collecting information on Melbourne's arterial roads. VicRoads are expanding their systems, with the potential for up to 90 per cent of Melbourne's congested roads to be monitored.

The aim would be to obtain additional information from businesses around congestion hotspots. Data obtained would relate to:

- the direct cost of congestion for business (time and vehicle costs etc) in the hotspot area;

- indirect costs for business in an area including inventory and other costs and impacts of transport costs for staffing and obtaining specialised inputs;
- how congestion impacts upon competitiveness and business outcomes (e.g. profitability);
- how congestion changes the mix of business/industry types in an area (with collection of information over time);
- and how businesses in the area have responded to congestion or would respond to congestion (for example, through a change in wages, or relocation); and
- views about traffic congestion and business costs.

The analysis could be expended to include assessment of similar information from non-hotspot areas. This would allow a comparison of the impact of congestion. The detailed comparison is likely to yield valuable information on route variations in congested areas and identify business responses to congestion.

Insights about of the impact of congestion on industry composition, costs and competitiveness could be derived from this information in conjunction with existing information about regional economic performance.

The advantages of the methodology are that it:

- would add to knowledge about the direct and indirect costs associated with congestion costs to business;
- targets areas where congestion occurs;
- is likely to identify the industries most heavily affected by congestion;
- indicates how costs of congestions change through time (based on traffic flows); and
- can be used to identify the return on infrastructure investment or other congestion minimisation strategies.

The findings would fall into the category of anecdotal evidence. It would not be feasible to measure the level of confidence held in the findings (in contrast to the analysis approach used in surveys). It is likely to require resources to consult with local businesses and disaggregate congestion by industries and occupations, although this should involve fewer resources than a fully-fledged survey.

Extending MITM

MITM currently provides a comprehensive model of transport use in Melbourne (and in other regions and cities). The framework could be adjusted so that particular information on freight or other business-related travel is captured, in addition to measuring the overall levels of congestion. Moreover, MITM could incorporate the cost of congestion for businesses from travel if appropriate inputs for the value of travel time for businesses are incorporated. DOI currently has plans to develop a Freight Movement Model, which would complement MITM and could be used to determine more about the cost of congestion to business.

The limitations of MITM are likely to occur through specifying the exact extent that different industries are affected by congestion. Potentially, these could be derived based on collecting similar data to the employment location data collected by CLUE, however, this would need to be done on a wider basis.

MITM could potentially provide some input into measuring the indirect costs for business by identifying the probability of unpredicted traffic delays. However, this is not sufficient to measure the reliability cost impost to business from unforseen traffic congestion. Nevertheless, it could be used as an input into measuring the cost of congestion to business. MITM is unlikely to provide information on other indirect costs such as business adjustment costs.

Currently, the major limitation of the MITM model is it does not capture industry adjustment in the way an economic model would. For example, when the cost of congestion increases in an area then businesses in that area competing beyond a localised level face comparatively higher costs than businesses from other less congested regions. With all other factors held constant, congestion would make those businesses in areas subject to congestion comparatively less competitive. Such competitive pressures are captured through elasticities in economic models, and are factored into the NCHRP report.

Economy-wide modelling

The direct and indirect impacts of traffic congestion in regions could be analysed within a computable general equilibrium (CGE) model. A CGE model is essentially an interactive map of economic activity. For example, TERM, a regional CGE model, provides a highly disaggregated representation of the Australian economy with considerable industry and

regional detail. It uses a 'bottoms up' approach that could explicitly capture the economic impacts the costs of congestion to business through generalised region or citywide estimates of the value of travel time delays (as is currently available from BTRE or Austroads). The TERM model was recently used to measure the cost of congestion (and other costs associated with inefficient transport use) in Sydney (CIE 2006).[13]

Congestion costs for business could be analysed in the TERM model by reflecting traffic congestion as a loss of productivity across all production inputs — labour, capital, fuel, etc — to the transport sector for the region affected. Input for the size of the productivity 'shock' could be derived from MITM or other frameworks (from the BTRE, Austroads or others). TERM could then be used to capture the demand for and supply of commodities, as well as their movement from producer to purchaser via various transport modes and wholesale and retail trade.

With economy wide modelling it would be feasible to assess:

- the likely implications of traffic congestion upon the economic competitiveness of a region and the state of Victoria at large — capturing direct and indirect implications within a single framework;
- how traffic congestion could be expected to change wage rates for different industries and alter to availability of labour and capital over time;
- the implication of traffic congestion for standard economic indicators such as:
  - gross regional output (the regional equivalent of GDP);
  - changes in industry output and prices;
  - changes in regional employment;
  - trade;
  - other factors; and
- changes in regional populations (with relocation of households through migration between regions and interstate).

Modelling could also be used to:

- fill in gaps in other, more data intensive techniques to measure direct and indirect costs of traffic congestion — providing, for example, an estimate of the likely wage response given changes in transport costs through traffic congestion;

[13] For a more academic demonstration of the use of a CGE model to assess the costs of congestion see Klaus and Heng, 2002.

- illustrates how improvements in the efficiency of the transport sector translate to benefits in other industries (similar in concept to identifying a 'mulitplier'); and
- identify regional impacts, including the implications that higher congestion costs in Melbourne would have on efficiency and competitiveness in surrounding regions and the rest of Australia;

The main value of a CGE framework in this context is that it already factors in the things that make up direct and indirect costs for business, and is readily able to assess if factors such as labour costs and other costs change.

While the TERM model could provide estimates for the cost of congestion to business for various industries, it would not be able to localise the data available within the regions that the model is based on (ABS statistical divisions). Therefore, there are limitations in using the CGE model to quantify the costs of congestion in specified parts of Melbourne or for regional cities such as Geelong, Ballarat or Bendigo (although it could provide region-specific indications of the cost of congestion).

Another limitation of economy wide analysis is that it is vague about the transport system specifics. In CGE models the transport system is typically assessed in economic terms, which boils impacts down to relationships between the cost of inputs and the value of outputs. Factors that are normally important in transport planning, such as travel time and transport mode shifting, are treated in a generalised way. It would be most useful if the economy-wide models were used in conjunction with other inputs. Examples of potential combined analysis follow.

- Assessing transport network implications of a change in congestion over time, or the response to an augmentation of the transport network infrastructure with MITM, combined with the use of the TERM model to assess what would happen to business and economic outcomes, such as changes in economic performance in Melbourne and in other regions;
- Assessing the relationship between congestion and business costs from a city wide survey of business and combining this information with an assessment of the economy wide implications using TERM testing the question 'what if a greater share of business is subject to congestion in the future?', or 'what are the implications if some of the existing congestion was relieved?'

Key points

Key approaches that could be used to improve understanding about the business costs of traffic congestion include the following:

- seeking an increase in ABS data collections related to business traffic congestion issues and business performance in general;
- developing performance indicators for traffic and business costs;
- undertaking a comprehensive survey of businesses in the major Victorian cities;
- surveying the impacts of congestion upon businesses over time — assessing in particular how they adjust their businesses, relocate or close in the face of congestion;
- examining the performance of businesses in congestion 'hotspots' — focusing attention upon areas most likely to be affected by congestion;
- expanding current modelling by DOI and/or VicRoads to incorporate freight costs is likely to produce the best localised estimates for the cost of congestion to business; and
- combining existing data and frameworks with existing CGE models to assess the broader economic costs of congestion.

While the views reflected in the literature about the nature of the costs to business due to traffic congestion vary, a recurrent general theme is that the costs are substantial although the relative contribution of indirect costs seems inadequately measured in the current literature. Given this, it seems likely that investment in an additional approach (or a number of approaches) to obtain better information about the problem and possible solutions is warranted.

The sequence for obtaining the necessary information to obtain the cost of congestion to business would be to initially conduct a comprehensive cross-sectional survey. The data could then be used in the MITM to obtain highly localised estimates for the cost of congestion to business. The survey data could also be used in an economy-wide model to capture the impacts on a range of industries and regions of a change in the costs for business of both congestion in Melbourne or major road corridors entering Melbourne. Using both models is the most comprehensive way for estimating the direct and indirect cost of congestion to business and identifying precisely where those costs are felt.

A Sources consulted

Industry groups

- Business Council of Australia (BCA);
- Victorian Employers Chamber of Commerce and Industry (VECCI); and
- Committee for Economic Development of Australia (CEDA).

Expert input

- Institute of Transport and Logistics Studies, University of Sydney;
- Philip Sayeg, Managing Director, Policy Appraisal Services; and
- Victoria University of Technology, Institute of Logistics and Supply Chain Management.

Councils

- City of Melbourne

Statistical and transport data agencies

- Department of Infrastructure — Melbourne Integrated Transport Model (MITM) staff;
- Australian Bureau of Statistics (ABS);
- Census of Land Use and Employment (CLUE);
- Bureau of Transport and Regional Economics (BTRE);
- VicRoads; and
- Austroads.

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