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1 INTRODUCTION

1.1 The study

- 1:01 This Report has been prepared by David Simmonds Consultancy for the Department of the Environment, Transport and the Regions in response to a Specification issued on 22 December 1999.
- 1:02 The Specification called for summaries of the available evidence from existing ex post case studies into the economic impacts of major transport infrastructure investment, and for a review of these findings and their implications for the appraisal of future investment proposals.
- 1:03 The majority of the work in the present project has been devoted to identifying, examining and summarising the case study schemes. Our short reports on these are attached after the main text of this report. Their structure follows the outline defined for the wider OECD research project to which this study is a contribution.
- 1:04 The text of the Report itself is very simply organized so that
- Chapter 2 provides a brief summary of the Case Studies, whilst
 - Chapter 3 offers some comments on the methods used.

1.2 The search for case studies

- 1:05 The present study is a review of existing studies into the economic impact of transport schemes. The search phase of the study therefore began by listing studies already known to the consultants and the client, and attempted to expand on this list by making additional enquiries amongst organisations which might have commissioned or undertaken such analyses.
- 1:06 For the most part, the search process identified additional reports and papers about infrastructure schemes which were already known to have been studied. The number of ex post analyses available is, as previously thought, very limited.
- 1:07 There was therefore not a great deal of choice to be made in deciding which schemes to take as Case Studies. The only two substantial sets of material rejected were
- various studies into the overall impact of transport infrastructure investment or of the motorway system in total – these seemed to be rather outside the scope of the present study;

- various papers about the impact of the London Orbital Motorway (the M25), which are already summarised and reviewed in a recent book by Banister and Berechman (2000). We have however included a précis of their review.
- 1:08 There have been a number of studies into the impacts of light rail schemes. For the most part these are too local in scope and effect to be relevant to the present study. We have however included one of these in our Case Study work.

1.3 Case Studies chosen

1:09 For the purposes of this review we have ordered the studies chronologically according to date of completion. For several of the projects, completion was in stages, and we have used the completion of the last stage as the key date. This gives the following list:

- Severn Bridge (opened 8 September 1966)
 - M62 (stages from 1966 to 1976)
 - Humber Bridge (opened 24 June 1981)
 - M40 Motorway (London to Oxford opened in stages to 1973, followed by the link from Oxford to Birmingham opened in January 1991)
 - A55 North Wales Expressway (stages from 1969 to 1994)
 - the Sheffield Supertram (opened 1994-95).
- 1:10 Our summaries of the studies into the impacts of these schemes are contained in Annexes A to F. (Some of the schemes have been the subject of more than one study.) A very brief overview of these Case Studies is contained in the following Chapter. We have also summarised, in Annex G, the review of work on the impacts of the M25 in Banister and Berechman (2000).
- 1:11 The findings reported in Chapter 2 and in the Annexes are those of the studies referred to, not our own findings. For the six main Case Studies, we examined the original publications and reports. For the M25, we drew entirely on the Banister and Berechman book, without attempting to refer back to the different studies they mention.
- 1:12 We have included all the documents used in the Case Studies in the References to this Report, whether or not they are referred to in the main text, so that the References should represent a complete listing of all the material upon which we have drawn.

1.4 Other material of interest

1:13 For reference, we note here the other ex post studies we have identified but not used. Our search was limited to the UK, on the assumption that other countries would be dealt with by other members of OECD. There was an implicit focus on more recent work, ie towards the automobile-dominated transport systems which

have existed in recent decades and towards the quantitative methods of analysis which have developed over the same period.

- 1:14 We found it helpful to organize our search by type of project. We have identified material on
- major marine and estuarial crossings (road and rail – in practice, the Channel Tunnel is the only recent rail link in this category)
 - other motorways and roads
 - suburban and interurban railways
 - urban railways and trams
 - airports.
- 1:15 In all cases, improvements (whether to the infrastructure (eg rail electrification) or service increases) are taken as potentially relevant, as well as the provision of the infrastructure itself. In principle, case studies of service reductions or infrastructure closures would also be relevant, but no such material was identified. (For example, we are aware from other work that economic development authorities in the Borders region of Scotland believe that the area was disadvantaged by the loss of all its rail links in the 1960s, but we have not discovered any formal analysis into the impacts of those rail closures.)
- 1:16 We considered waterways and seaports, but did not find any references to studies of the induced impacts of changes such as the development of Felixstowe as a major deep-sea port. The decline of the London docks probably represents one of the largest reductions in accessibility ever experienced in peacetime. Hall (1998, p892) notes that following the closure of the docks between 1967 and 1981, “Other industries, dependent on the port, began to contract...”. However, we are not sure whether any studies have been carried out formally identifying the impact of the dock closures or comparing the history of the London Docklands with other inner-city areas where transport changes were less dramatic.
- 1:17 We have consulted previous reviews by
- Drewett et al (c. 1992)
 - HCG et al (1995)
 - Walmsley and Perrett (1992).

Major marine and estuarial crossings

- 1:18 The Severn and Humber crossings are discussed in case studies. The Dartford Crossings (tunnels and bridge) are implicitly included in M25.
- 1:19 Others major crossings within the UK which have to some extent been studied are
- the Forth Road Bridge, for which some limited analysis was carried out by MacGregor (1966) (summarised in Drewett et al, 1992); and

- the Skye Bridge, which is the subject of a study currently in preparation for the Scottish Executive.

1:20 The most obvious and most significant project in this or any other category is clearly the Channel Tunnel. So far as we are aware, there no ongoing project for systematic monitoring of the effects of the Channel Tunnel on the UK. A recent project at the University of Kent Centre for European, Regional and Transport Economics (Norman et al, 1999) provided some useful monitoring of freight trends and underlying factors up to the end of 1997, including the conclusion that “...in the longer term there may be substantial reorganization of locations, market areas, logistics and transport use. It is not claimed that this is simply a direct result of the construction of the Channel Tunnel, but, together with its associated infrastructure, it has made possible more substantial changes, not least because of the enormous increase in capacity which has had significant effects on prices”.

Other motorways and roads

1:21 Analyses relating to the M62, M40, M25 and A55 are considered among the Case Studies. These projects together with the estuarial crossings seem to account for the majority of the scheme-specific ex post studies carried out in relation to UK roads. Two other studies give some attention to such issues; these are

- the study of transport and development changes around Inverness (Scotland) by Halden and Sharman (1994) ; and
- the study of road improvements and economic development in Merthyr (South Wales), carried out by the Welsh Economy Research Unit for the British Road Federation (WERU, 1997).

Suburban and interurban railways

1:22 The effects of the 1986 reopening to passengers of the Bathgate line (a suburban route west of Edinburgh) were examined in detail by Piedad (1990).

1:23 The impacts of various railway electrification schemes on one specific variable - house prices - was examined by MVA and ECOTEC (1990).

Urban railways and trams

Project	References
Glasgow Underground	Gentlemen et al (1983)
Tyne & Wear Metro	Pickett and Perrett (1984) TRRL et al (1986) Davoudi et al (1993)
Jubilee Line Extension (London)	Study in progress: for methodological design see Jones and Lucas (1999)
Manchester Metrolink	Jackson and Laidler (1995) Law et al, undated

Table 1 References to urban railway and tramway impact studies

- 1:24 Table 1 lists studies known to us which have examined (or are examining) the impact of new or reconstructed urban railways and tramways. (Sheffield Supertram is considered in more detail as a Case Study.)

Airports

- 1:25 Empirical analysis of the economic impacts of airports tends to concentrate on the jobs generated by the airport activities themselves and the multiplier effects arising from expenditure of salaries and in purchase of goods and services. Banister and Berechman (2000) devote a chapter to the economic impacts of airports, with particular reference to Heathrow and Manchester. The classifications of employment effects which they use include “attracted employment” (Heathrow) or “spin-off economic impacts” for all the activities attracted by the accessibility which the airport offers. These categories are given very little further attention; the only figures quoted – an estimate by York Consulting Ltd of between 15000 and 25000 jobs due to the “transportation impact” of Manchester Airport - was apparently based on figures from the USA (Banister and Berechman, 2000, p304 and Table 11.12).
- 1:26 Other studies we have examined, and discussion with those involved has tended to confirm that accessibility effects, although politically important, receive very little empirical attention.

1.5 Acknowledgements

- 1:27 We are grateful to a considerable number of correspondents who found time to discuss the present project with us and who supplied us with useful material – or confirmed that certain topics have not been studied and that no such material exists.
- 1:28 We would also like to acknowledge the help and guidance we have received from the Department’s Project Officer, Mike Walsh.

2 SUMMARY OF CASE STUDIES

2.1 Severn Bridge

- 2:01 The Severn Bridge opened in 1966 providing a motorway connection between South Wales and South-West England. It offered a substantial reduction in distance – up to 80Km – for some journeys. It was completed some years ahead of the adjoining motorways north, south, east and west. A second parallel bridge has recently being completed nearby.
- 2:02 A substantial study was carried out in the four years following the opening of the original Bridge. This obtained and published a great deal of survey information about changes in traffic, transport patterns and business organization. It did not however come to any overall conclusion regarding the economic impacts of the Bridge.
- 2:03 A later study used a variety of methods, drawing upon both economic modelling and empirical analysis of data, to estimate the short and long-term impacts of the Bridge together with the adjoining sections of motorway. The total additional employment in South Wales (ie to the west of the Bridge) due to the Bridge itself and associated motorways was calculated as approximately
- 12000 to 14000 in the short term, and
 - 24000 to 34000 in the long term.
- 2:04 The latter would represent an increase in employment in South Wales of about 4%.

2.2 M62

- 2:05 The M62 is a motorway some 175Km in length across Northern England from Liverpool almost to Hull, opened in stages from 1966 to 1976. It passes through three of the main industrial conurbations of Northern England: Merseyside, Greater Manchester and West Yorkshire. Within Greater Manchester and West Yorkshire, particularly, it serves as an urban motorway in addition to carrying longer-distance traffic.
- 2:06 A number of studies have looked at the effects of the M62. Two of these have attempted to estimate the regional economic impacts. One of these, based entirely on modelling, estimated a gain of about 14000 jobs after five years. The other, based partly on modelling and partly on survey data, estimated a more modest long-term effect of about 10000 jobs.

2.3 Humber Bridge

- 2:07 The Humber Bridge, opened in 1981, provides a road crossing over the Humber Estuary on the eastern coast of Northern England. Unlike the Severn Bridge, the Humber Bridge is not connected to the motorway system; it was intended to promote the integration of the two banks of the Humber and their large-scale urban and industrial development. Neither the integration nor the development have been achieved.
- 2:08 The studies carried out concentrated on the impact of the bridge on commercial vehicle operation. These effects were limited by the fact that the Bridge is not part of a major trade axis. It is of relevance primarily for local trade between the relative small markets on the two sides of the estuary, whilst flows to and from the major conurbations use the east-west motorway links. Use of the Bridge is also discouraged by tolls which are set at revenue-maximising levels.
- 2:09 It seems unlikely that the Bridge has had any significant impact on the economy of the Humberside area; the east-west motorways are more likely to have made a positive contribution.

2.4 M40 Motorway

- 2:10 The M40 Motorway runs from the outskirts of London to the outskirts of Birmingham, via Oxford. The southern half, from London to Oxford, was opened in several stages up to 1973. The northern half was opened in 1991. It was included as a Case Study partly because the southern half falls within a prosperous area of South-East England, which make a contrast with the regions through which the other Case Studies projects run.
- 2:11 The analysis of the M40 concentrates on the way in which the building of the motorway has influenced local planning and development policies. It does not provide any quantified estimate of the net economic impact of the scheme, but it shows how the presence of the motorway has brought about changes in local planning which have allowed substantial developments to take place where they were not originally intended. It therefore provides significant evidence that motorways can affect development even in areas where no such effect is intended or considered desirable.

2.5 A55 North Wales Expressway

- 2:12 The A55 North Wales Expressway is a dual-carriageway road of near-motorway standard running east-west close to the coast of North Wales, from Chester to Bangor. It was built not as a single project but as a long series of improvement and by-pass schemes from the late 1960s to the mid 1990s. Some of those predated the major decisions taken in the late 1970s about overall upgrading of the road. The Expressway includes a short but expensive tunnel under the Conwy estuary, which was included following public objections to proposals for a bridge and viaduct in this sensitive landscape.

- 2:13 The available material on the impact of the road consists of results from the use of an input-output model to assess overall impacts, and from small-scale surveys to discuss the processes of change.
- 2:14 The modelling results show a modest effect of +350 jobs across all sectors. Within this total there is a significant decrease (-160 jobs) in the transport sector itself.
- 2:15 The interview reports are interesting for describing the ways in which some individual businesses have responded to changed conditions. It must however be kept in mind that the businesses reported are those which have benefitted significantly from the improvement of the road. It is clear from their comments that their competitors (whether within the immediate area or elsewhere in the UK) and some of their local suppliers have been disadvantaged by the increasingly competitive situation.

2.6 South Yorkshire Supertram

- 2:16 The South Yorkshire Supertram is the largest and most expensive component in a substantial programme of transport and communication investment in Sheffield during the mid-1990s. It has provided a two-line system totalling 29Km of mainly on-road tram route. It opened in stages from March 1992 to October 1995. A formal monitoring study was commissioned, which has only recently (Spring 2000) reported. However, all the “after” survey work was carried out in 1995-96, very shortly after the system opened.
- 2:17 The construction of the on-road system caused considerable disruption, which was felt to have a negative impact on businesses. Initial passenger carryings were substantially lower than expected, for a number of reasons including
- the impact of road congestion on Supertram operation
 - competitive response from bus operators
 - non-occurrence of expected land-use developments
 - faster than expected decline in Sheffield city centre
 - absence of intended park-and-ride facilities.
- 2:29 Given the low initial usage of Supertram, the short “after” monitoring period and the depression of the Sheffield property market during that period, it is not surprising that no systematic influence on land-use and development could be identified, and that impacts of property values and business turnover appeared, if anything, to be slightly negative.

3 REVIEW OF METHODS

3.1 Introduction

- 3:01 This chapter reviews the methods used in the various ex post Case Studies, and comments on what implications they may have for future ex ante analysis.
- 3:02 The methods used fall into three main categories:
- surveys asking about the impact of a scheme;
 - statistical methods based on comparison with other regions or other periods of time; and
 - model-based methods of various kinds.
- 3:03 Some of the studies used more than one method. The following sections consider the key characteristics of each approach.

3.2 Survey methods

- 3:04 All of the case studies considered have to some extent involved asking firms or local authorities about the impact of the scheme in question. In the original Severn Bridge study and for the Humber Bridge, these were the main or only source of information. Such surveys are probably the only way of understanding the complex details of some of the business and planning policy responses to transport change.
- 3:05 The range of business responses is illustrated by the individual firm cases reported in connection with the A55; other aspects are indicated (though without giving such a picture of firms' overall response) in the Humber Bridge work.
- 3:06 Studies of named (or identifiable) firms, such as those in the A55 study, probably have an inherent bias towards businesses which are willing to advertise how successfully they have responded to the changed situation. However, with any such surveys, there are inherent difficulties in tracing negative effects. The businesses most severely affected may have closed down their operations within the affected area, or in the case of small local firms may have ceased trading altogether. If the former owners or managers of such businesses can be traced, they may be very difficult for them to give a fair assessment of the role that the transport scheme played in the demise of their business.
- 3:07 Similar problems of attribution arise even with ongoing businesses: where the transport scheme (or its construction) is creating an obvious problem (as in Sheffield during the building of SYS) it is obviously tempting to blame it for all the difficulties a business is facing, when in fact other factors (such as regional or

national economic trends) may be much more responsible. Conversely, if the impact of the transport scheme is not obvious, its role in changing the competitive conditions may not be recognized. The businesses surveyed in Gwynedd in relation to the A55 are part of a very small economy in which it is highly likely that businesses will notice that competitors from outside, using the A55, are now winning local contracts. In a larger economy, such as those of Merseyside or Manchester at the other end of the A55, the impact of increased competition from firms along the A55 might not be explicitly noticed but would appear as a more general pressure on prices or similar.

3:08 Direct surveys of impacts experienced are also limited to identifying short-term effects, since they must be completed within the period that the individuals making decisions in response to the new infrastructure remain in post and are able to identify that particular changes they have introduced in response, without too many complications due to subsequent, unrelated events.

3.3 Comparative methods

3:09 Comparisons with other areas were used substantially in the Severn Bridge/M4 analysis and on the M62 (by the same consultants in both cases). Both of these were rather sweeping comparisons, but we are aware of other more sophisticated forms of comparison which have been applied in urban impact studies. Such analyses are obviously limited at the regional level by the difficulty of finding appropriate comparator regions and of isolating the various elements of difference between them.

3.4 Modelling methods

3:10 The modelling methods applied in the Case Studies we have considered are relatively simple, particularly when compared with the sophistication of modelling applied in some ex ante forecasting studies. A “standard method” can be discerned which involves

- estimating or assuming a level of transport cost reduction resulting from the infrastructure scheme;
- assuming an elasticity of regional output with respect to this cost reduction, and applying this to obtain the first-round induced effect of the scheme;
- using either an input-output model or a simple multiplier to estimate the total effects.

3:11 In fairness to the authors of the various reports considered, it should be acknowledged that they all make their main assumptions explicit. To varying degrees they attempt either to justify them or to explore the sensitivity of their results to alternative assumptions, such as different elasticities.

3:12 None of the Case Studies used a land-use/transport interaction model to try to account for observed changes.

3.5 Possible implications for ex ante appraisal

- 3:13 Ex post studies could in principle inform the appraisal of possible future schemes in two different ways:
- they could help to identify the kinds of effects which past schemes have had, and hence what ex ante studies should focus on; and
 - they could provide information about the scale of those effects in ways in the form of elasticities or parameters which could be directly used in appropriate ex ante forecasting methods.
- 3:14 Such inputs to ex ante analysis can only be obtained if the ex post studies make use of observed data. Some of the analyses considered used little or no ex post data – they were based entirely on data and models which were available, or could have been available, ex ante. The results obtained may be perfectly valid, but it would be perverse to use such results as the basis for suggested improvements in ex ante forecasting – which, as noted earlier, often uses more sophisticated models.
- 3:15 The use of observed data is complicated by the fact that many effects take time to become apparent. In most cases, economic effects will arise gradually, and may be particularly slow to come about if the infrastructure is completed in a period of regional or national economic stagnation. It could for example be instructive to compare the lack of development that occurred immediately after the opening of the M62 with the apparently buoyant demand for M62-linked commercial and industrial sites at present. In other cases, where a key piece of transport infrastructure is awaited in an area of high demand, developers, industrialists and private households may act in expectation of its opening, so that changes in key indicators will occur within the “before” period. Cases where significant economic effects occur and become apparent immediately after its opening are probably exceptional.
- 3:16 The prevalence of timelags leads to what has been called “the problem of the counterfactual” – the difficulty or impossibility of knowing what would have happened in the absence of the scheme under consideration. The analysis of impacts has to take account of changes in other factors over a period which would, ideally, run to several decades¹. Such controlled analysis can only be carried out by formal mathematical models or by fairly elaborate, statistical forms of comparison.
- 3:17 Statistical comparison may identify how much change is attributable to the transport scheme, but will not explain how it has come about. Mathematical models are based upon hypotheses of the processes of change, which need to be formulated by the analysts. It is therefore important that such methods should be

¹ It is often assumed that impacts occur within a finite period after the opening of the scheme in question. Not only do many studies consider too short a period, but there is no obvious reason why a permanent change in accessibility should have impacts only for a finite period. Jones and Lucas (1999, p491) rightly recognize this in pointing out that land-use decisions in London are still influenced by railway links opened over a century ago.

complemented by more open-ended surveys of economic actors who may have been affected by the scheme, to obtain insights into when, where and how changes come about (and into why likely changes fail to occur). If they related to a specific scheme, such surveys are necessarily limited to the fairly short term, as discussed above. More could however be done to understand the general effects of transport on economic behaviour, for example by focussing on different kinds of business decisions (location, investment, production, recruitment...) rather than on specific transport changes.

3:18 Further interesting discussion on the difficulties of devising methods for impact assessment can be found in the work of Jones and Lucas (1999) in relation to the Jubilee Line Extension.

3.6 Implications of the Case Studies considered

3:19 The following table tries to sum up the types of information available from the Case Studies we have considered in most detail.

3:20 In classifying survey we try to distinguish between

- detailed discussion of impacts on particular firms or sites
- surveys concentrating on a sample of firms within a particular sector, allowing for some discussion with each respondent
- surveys attempting to cover all sectors (or in some cases all traffic).

3:21 In classifying model-based work, we distinguish between the possibilities of

- using both before and after data, and developing an explicit forecast of how the region(s) would have changed without the scheme
- using only before or after data, and using hypotheses and sensitivities from other work to assess the impact of the scheme.

Case Study	Survey data			Comparative analysis	Model-based assessment	
	Selected firms/ locations	Small survey	Large survey		Using only before <i>or</i> after	Using before <i>and</i> after data
Severn Bridge		✓	✓	✓	✓	
M62		✓✓	✓		✓✓	
Humber Bridge		✓				
M40	✓					
A55	✓	✓			✓	
Supertram		✓✓				

Table 2 Summary of methods used

- 3:22 The Table highlights the tendency for the studies considered to concentrate on small (less than comprehensive) surveys and on limited modelling exercises. The small-scale surveys do indeed serve to provide insights into the ways in which transport change influences economic actors, and are supplemented by the even more detailed reports on particular firms and particular sites. The paucity of large-scale surveys (especially non-traffic surveys) is however both regrettable in itself, and a source of problems in that the lack of such surveys means that model-based studies are entirely dependent on standard statistical sources.
- 3:23 The limited use of comparative methods does not seem particularly regrettable, since it seems less likely that these will produce either new insights into the nature of responses or useful measures of the sensitivity of those responses.
- 3:24 It is also noteworthy that none of the studies we have considered used a formal model to predict both with-scheme and without-scheme situations starting from a before-scheme situation. The modelling work has therefore tended to use assumptions and sensitivities already estimated, rather than providing new information for use in future ex ante studies.

3.7 Conclusions

- 3:25 We can try to draw some conclusions both about the impacts of transport change in general and about the studies looking into these impacts.
- 3:26 The general conclusion about the impacts themselves is that there is little evidence of significant economic impacts occurring immediately after the opening of the schemes in question. In some cases, there is evidence of fairly prompt reorganization of business activities, but with little net economic impact; in others, there is little evidence of any response at all. These outcomes are related both to the scale of the transport change, measured in terms of output (the improvements in accessibility achieved) rather than input (cost of the scheme), and to the prevailing state of the regional or national economy. In the longer term, schemes that produce major improvements in accessibility have significant economic impacts, though of necessity this has to be deduced rather than directly observed.
- 3:27 As regards the studies themselves, the main conclusion must be that the volume and quality of the ex post evidence remains very limited compared with the considerable resources that are devoted to ex ante analysis. Further ex post studies, targetted on developing knowledge, methods and results which can be incorporated into existing or future methods of ex ante forecasting, would seem highly desirable.
- 3:28 A final point is that the present study has dealt exclusively with **impacts**. There are further questions to be considered regarding the identification and measurement of the **benefits** flowing from these schemes, building on the recent work of SACTRA (1999).

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