DEVISING A METHODOLOGY FOR AN IMPACT ASSESSMENT OF THE EFFECTS OF THE JUBILEE LINE UNDERGROUND EXTENSION, LONDON

PETER JONES
Transport Studies Group
University of Westminster
35, Marylebone Road
London NW1 5LS

KAREN LUCAS
Transport Studies Group
University of Westminster
35, Marylebone Road
London NW1 5LS

Abstract

This paper is intended as a contribution to the debate which surrounds the evaluation of the benefits of major public transport investments, including the extent to which such investments can be linked with increased economic activity in the areas adjacent to improved services. Through the working example of the development of a methodology for the Jubilee Line Extension Impact Study, the paper offers a critique of previous impact study research and identifies key theoretical and conceptual gaps in the body of existing knowledge. The paper takes the position that a better understanding of the impacts of major new transport investments is needed which includes the underlying and on-going processes at work, to record when and where the new transport investment impinges on these various processes.

INTRODUCTION

It is important to consider the identification and evaluation of the impacts of the JLE in the wider context of contemporary transport policy and in particular, in reference to the debate surrounding the relationship between transport infrastructure investment and increased local economic activity. Until recently, it has been generally accepted that major improvements to the transport system in areas of poor accessibility will serve to encourage property developers to invest in the area as a result of increased accessibility. It has been argued that transport infrastructure investment leads to changes in the nature and/or scale of development, increased development intensity and enhanced land values. In addition, local jobs are created during the construction stage of the project and have an income effect that, in turn, stimulates local trade. Once the project is complete, businesses moving into the area will also create jobs and attract customers. From this perspective therefore, increased accessibility is seen to allow existing and new residents greater job opportunities through wider access to the hinterland and effectively brings about the regeneration of the local area (Cheung, 1993).

However, a number of recent research studies challenge both the nature and extent of this assumed relationship. For example, Grieco (1994) in her review of the impact of transport investment projects on the inner cities, found that empirical evidence does not conclusively confirm that transport investment in any area leads to increased development activity. While she does not deny the existence of some link between these two events, she argues that the nature and extent of the relationship need further empirical investigation.

On the basis of the empirical evidence that does exist it is suggested that there are three key restraining factors in the realisation of increased economic activity through investment in new transport infrastructure. These are:

- areas which already enjoy a reasonable 'base' level of accessibility
- areas where land uses are already well established and opportunity for new development is restricted
- the type of development e.g. residential, office, industrial

The JLE Impact Study comes at a time when priorities for transport infrastructure spending are being re-evaluated and re-defined. Since 1990, Government policy has gradually shifted from a position which asserted that increased transport demand should be met by corresponding increases in road capacity towards a focus on reducing both the length and number of inessential journeys made by private motor vehicles, combined with tighter vehicle emission standards and encouragement of the use of more sustainable transport modes, including public transport. For this reason, it will be particularly important to assess the extent to which the significance cost of the JLE is justified by the benefits it is seen to bring to the areas it serves.

EVIDENCE FROM PREVIOUS PUBLIC TRANSPORT IMPACT STUDIES

One of the problems for public transport impact study research is the relatively few opportunities that arise to examine the effects of major investment. In Britain there have only been five major studies in thirty years, namely the Victoria Line (1963-1965), the Glasgow Rail Improvements (1979-1983), the Tyne and Wear Metro (1979-1986), the Manchester Metrolink (1990-1996) and

the South Yorkshire Supertram (1992-1996).

Increasingly, the methodologies developed have examined the effect of the investment, not only on transport use, but also on the economies of local areas served by new stations and/or in transport corridors served by new public transport services. This has led to a broader conceptualisation of 'impact', which includes not only first order effects but also second order (e.g. the effect of modal shift to public transport on traffic congestion) and third order impacts (e.g. the effect of the new transport infrastructure on economic activity which in turn has an implication for future investment and/or grant aid policies). In addition, there has been a recognition that people will perceive the effect of these impacts in different ways (i.e. what may be perceived as positive by one group may be seen as negative by another). Unfortunately, many of the studies have been unable to record the longer term impacts of public transport investment either because the length of the study has been too short to allow long term monitoring and/or because the investment is too recent for these effects to have occurred.

Lack of opportunity is not the only problem faced by previous public transport impact studies, however, in hindsight a number of additional conceptual and methodological limitations can be identified. These include the following:

1. Most studies seem to incorporate an **inherent assumption** that improvements to the public transport system will not only lead to transport benefits, but also to increased local economic and development activity, but such relationships have often not been demonstrated empirically. There are two issues here:
   - The issue of identification and causality of impact: because of systematic fluctuations in traffic levels, property prices etc. over time, detected **differences** in values at two points in time may not necessarily represent a **change** in the underlying state of the system. Also the absence of observable differences may result from transport driven change being neutralised by countervailing forces.
   - Furthermore, where changes are correctly identified, they may not necessarily be **impacts** that can be properly attributed to the new transport services, i.e. they may have been caused by other factors.
2. The methodology normally involves a comparison of the patterns of transport movement, land use activity and economic development at points in time >before= and >after= the opening of a new transport facility. Past studies have often nominated a single baseline date from which impacts can be measured. It is argued that this approach is too simplistic, since different types of impact operate over different time scales (e.g. trip re-routing versus new land use developments); some not only take longer to work their way through than others, but often start taking effect at **an earlier date some time before the research studies begin to observe local conditions**.
3. Different studies show the nature and extent of the relationship between public transport investment and economic activity to be varied; but it is difficult to determine whether this is a result of differences in methodological approach, analytical techniques and or specific locational or provision differences e.g. different physical and amenity characteristics of the cities studies and/or the influence of modal popularity with the general public.
4. Poorly matched control areas also make it difficult to attribute causality (Transport & Road Research Laboratory, 1982) and bring into question the reliability, adequacy and accuracy of the control method for confirming the nature and direction of causality (Nelson & Sanchez, 1997). It has been suggested that a more qualitative approach is needed if the processes leading to increases in economic and land use activity and the relationship between these and new transport infrastructure are to be more fully comprehended.

In practice, the nature and extent of the relationship between investment and impact appears determined by a number of additional factors. The type and design of the new service, the efficiency and design of interchange facilities, supportive policy conditions, local community backing and an already buoyant economy have all be seen to be important in determining the extent to which benefits are maximised (Cervero & Landis, 1997). The 'before' land use characteristics of areas around stations is also an influencing factor and evidence of benefit is usually most prominent in highly accessible, non-residential areas where a variety of other influences are also present. The degree to which transportation provision is integrated with land use planning has also been found to be an important factor in determining the extent to which benefits have been fully realised (Transport Research Board, 1996).

A number of key lessons were learned from previous studies and in the development of the methodology the JLE study has aimed to include consideration of the key methodological issues they raise within the research design. Particularly noted was the need for:

- consideration of the state of existing land use types
- identification of the type of new development which occurs (e.g. residential, commercial)
- evaluation of both the positive and negative attributes of the new transport infrastructure and service provision
- inclusion of the wider economic, planning and policy context and other influences which may mask or distort impacts
- recognition of the timescales of impacts, both forward and backward in time
- the need for a qualitative as well as a quantitative approach to better understand the process and dynamics of change

CONCEPTUAL FRAMEWORK

The types of impact

The first concern of the methodology was to identify the expected range and scope of the impacts. Four broad subject areas of impact were considered necessary to a comprehensive study of a major transport investment. These are:

1. Traffic, transport and movement patterns -This includes measurement of the level of provision of transport services; patronage of underground, rail and bus services; traffic flows (particularly car and taxi movements) on the road network; parking provision and use and patterns of travel of residents, employees and visitors to the area (classified by trip purpose, mode of travel, etc), as well as perceptions about the quality of service offered.
2. Land Use Activity - This covers the conventional mapping of land area according to standard land use classifications, plus measures of land values and rents, occupancy rates, re-letting rates, information on building type (age and height) and an indication of the amount of investment (including grants) associated with any redevelopment or refurbishment.
3. Socio-economic characteristics and site activity - The emphasis here is on the intensity of activity in the area, and the socio-economic characteristics of the people who live, work, shop or otherwise visit the area (e.g. for social purposes). Here, measures will include profiles of residents, their employment status and job search activities, health and fitness; patterns of employment across the area; and details of shopping and leisure activity, including estimates of income generated, as well as perceptions of the quality of service offered.
4. Environment, image and sustainability - This encompasses a range of qualitative and quantitative

measures of the state of the natural and built environment, and the image that residents, users and agents of change (e.g. planners, developers) have of an area and how it has changed. These measures include physical environmental impacts (e.g. air quality, noise/vibration), broader sustainability indicators (e.g. CO_2 emissions); measures of local image and quality of life, and an audit of townscape features and public space.

The relationships between system elements

Figure 1 sets out in general terms some of the main elements of the study and the relationships between them. The top section of the figure deals with the 'supply' side of the equation - the provision of services - showing the availability of transport and land uses, both in terms of the physical infrastructure and the functions that are performed using the infrastructure: the running of public transport services and the operation of the road network, in the case of transport; and the construction of buildings and other spaces, and their operation, in the case of land uses.

The boxes below the transport and land use supply deal with the use that is made of the facilities and services provided. In the case of transport, this covers the movement of people between different land uses by all modes of transport and for different purposes. Movement between sites has been conceptualised as a function of the transport and land use systems, both in terms of the kinds of transport services provided and facilities/services offered at different sites in the area and those people who use these i.e. as residents, employees or customers. Use of the land use system includes a whole range of activities carried out by people at the different types of site, whether as an employer, employee, resident, shopper, visitor, etc.

As a result of the range of transport and land use provision in the area and their utilisation, there are a number of externalities - both positive and negative - associated with these. Environmental impacts, wider measures of sustainability and images of the area are included under this heading.

Both the land use and transport systems are set within a much broader national and regional framework, which determines the planning, policy, regulatory and financial conditions within which decisions are taken.

Spatial coverage of the study

Previous public transport impact and access studies suggest that the size of area over which the JLE can be expected to have a primary impact will be within an approximate 1000m radius of stations. This defines the area within which people are likely to access the stations on foot, at either the home or destination end of their trips, and the maximum area over which employer activities, investment decisions and property prices are likely to be affected by the construction of the JLE.

Previous studies have also shown that the sphere of influence around stations is highly dependent on the type of impact (e.g. residential property values are usually affected over a wider area than commercial values) and by the presence of other influencing factors that may exert a similarly powerful influence over the surrounding area. Defining potential spheres of influence can also assist in identifying 'control' areas, i.e. areas in different locations from the identified study area but with similar characteristics (usually transport), used for the purpose of comparative analysis.

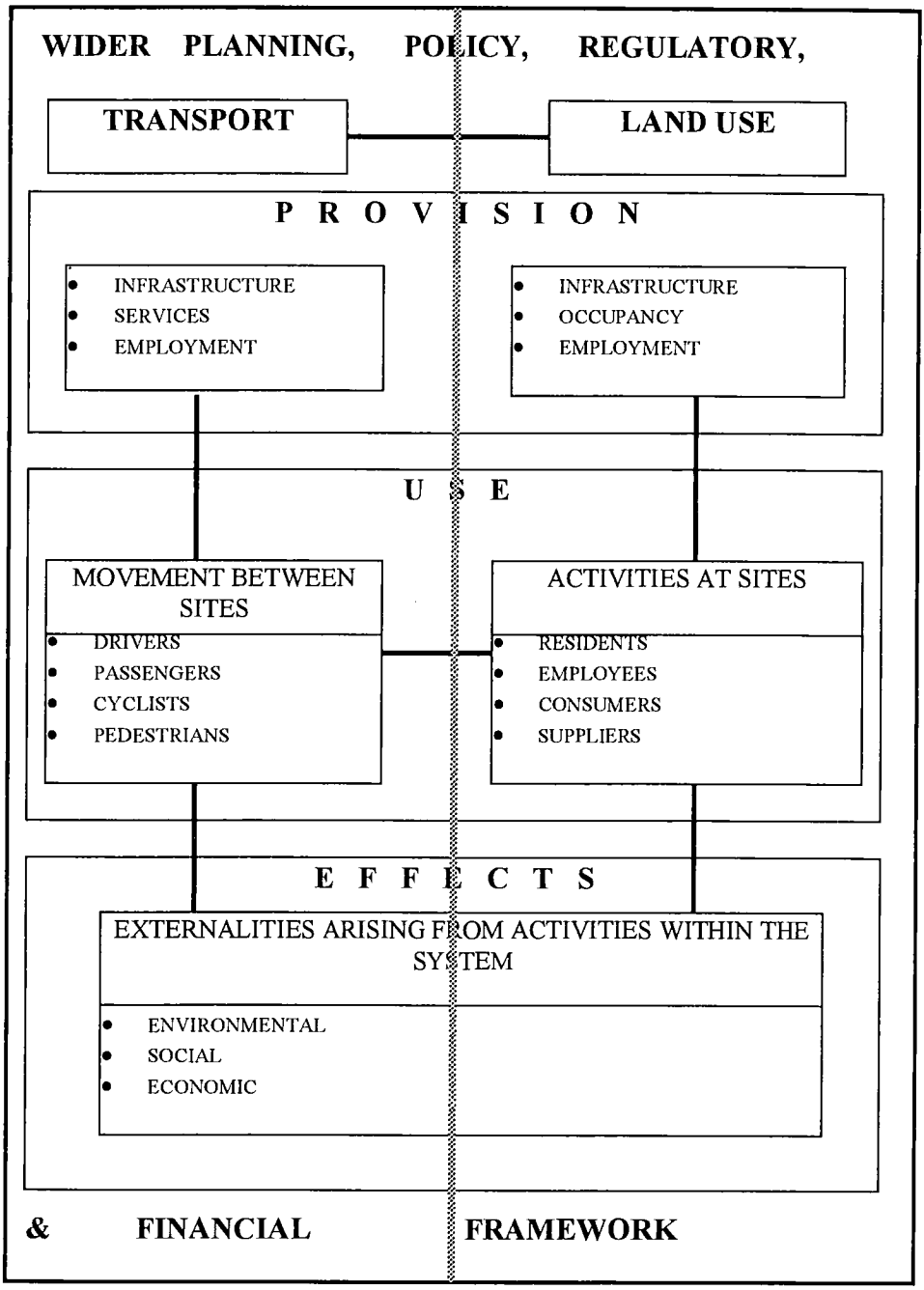


Figure 1: Diagram to illustrate the system elements of the JLE study

The time-scale over which impacts may be expected

It is evident that not all the impacts of the JLE will be observed as soon as the line opens, so there is a question of the temporal as well as the spatial sphere of influence. This is more complex an issue than may appear at first sight and needs to recognise that:

- Some types of impact can be observed to have taken place much more rapidly than others. For example, the re-routing of existing public transport trips to take advantage of the JLE (e.g. between Stratford and Bond Street, or Canary Wharf and Waterloo) is likely to occur mainly within a matter of weeks or months, as compared with adjustments in land use patterns which may occur over a ten to twenty year period.
- Some impacts will arise **in advance** of the line opening, the earliest impacts occurring after the submission of the Private Bill in Parliament. Previous studies have tended to assume that the appropriate 'before' benchmark for the study is almost immediately prior to the commencement of public service, and that this implies that little of significance occurs during the design and construction periods. Evidence suggests that the point at which impacts begin depends on the nature of the impact and in the case of the JLE there have been considerable property market effects some years leading up to the actual opening.
- The completion of the full set of impacts in the 'after' situation is much more problematic. For example, some land use investment decisions are still being influenced by underground and other transport services that were opened over one hundred years ago!

Approach to Identifying Impacts

It is essential to establish whether recorded changes would have occurred anyway as part of the ongoing process of inner city development and adaption or whether they are **impacts** that can be directly or indirectly attributable to the construction of JLE. There is a whole series of aspects to consider here:

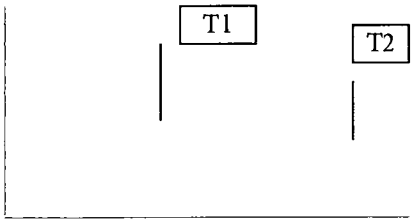
- **Variations** in the value of a variable may not reflect real **differences** in value;
- Differences may not reflect real **changes**;
- Changes may not necessarily be **impacts**; and
- Whether impacts are seen as **benefits** or **disbenefits** depends on the viewpoint taken.

The filtering process involved in identifying impacts is shown in Figure 2.

Finally, identification of benefit involves attributing a value to the shift, either from the perspective of worth to those social actors involved or from the point of view of its economic worth. It is recognised that people in various sectors of society will tend to be affected in different ways by the JLE and so will attribute different levels of value or worth to the impacts of the investment; for example, increased property values may be of positive value to home owners and estate agents in the area, but may be of negative value to those trying to buy for the first time. Similarly, the JLE may bring new employment into area, but this will be of little benefit to unemployed residents if skill requirements do not match their abilities.

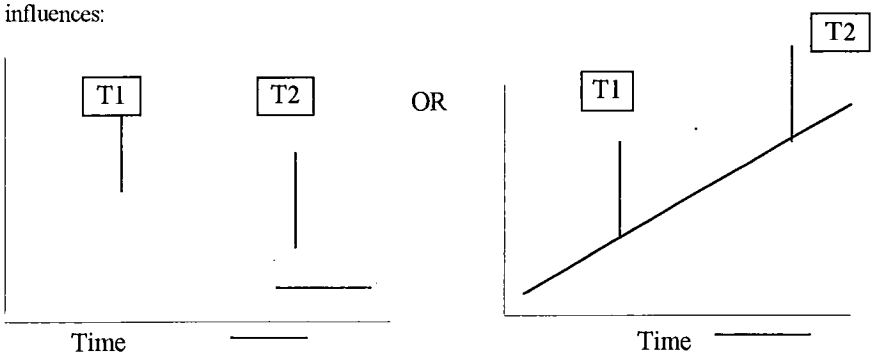
There are also issues to be considered about potential 'double counting' of benefits, and whether this should be netted out or not.

1. **Variations** due to sampling from the **same** distribution (differences not statistically significant):

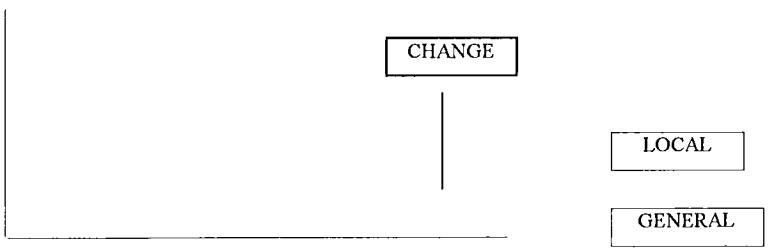


e.g. trips per day/week

2. **Differences** due to general developments in the economy , population structure etc., due to 'global' influences:



3. **Changes** in the local area that are outside the pattern of 'normal' cycles or trends



4. **Impacts** that appear to be due to JLE:

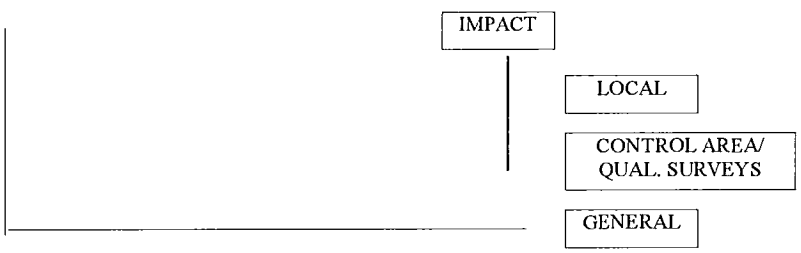


Figure 2: Stages of identifying impacts

Distinguishing JLE impacts from local changes

There are two ways of trying to disentangle impacts specifically attributable to JLE from those attributable to other local changes occurring in the area:

- Objectively, by trying to assess what would have happened without the JLE, and defining the impact as the difference between the observed and the expected, and
- Subjectively, by asking key actors whether their decisions were influenced by the JLE, and to what extent and in which ways.

The former approach usually involves the development of a baseline scenario (a counter-factual or 'do nothing' prediction), deviations from which can be attributed to the particular investment/policy. This baseline can be constructed from a combination of historical trends in the local area and by observing conditions in comparable control or more general reference areas that have not benefited from the investment/policy using, where appropriate, cross-sectional and time series models. Hedonic pricing models are a widely used version of the former, where local property prices would be related to a wide range of local and regional/national factors, including access to new JLE stations.

However, there are problems arising from this approach that can limit its value. Going back further to establish local trends, i.e. into the mid-1980s when economic conditions were so different to those of the present, would prevent extrapolation. Also control areas may be difficult to match well enough to provide reliable control data for all attributes of interest; conditions in the control areas will be influenced by other changes over the period of the JLE, some of which it will not be possible to allow for.

For these reasons the complementary use of subjective approaches is proposed to enable impacts to be correctly attributed to JLE. This involves the use of qualitative data from the key social actors involved, who are asked to describe factors affecting their locational and investment decisions, and to ascribe importance to each.

Identifying the Processes of Change

In order to correctly identify impacts, the study has to recognise that there are continual processes of change involving all the groups of actors in the area, and that the construction of the JLE is just one additional factor in this process. It is not simply a question of measuring a 'before' and 'after' state against a constant backdrop. With or without JLE, there will be residential changes in the area, the creation of new jobs and the loss of old ones, changes in patterns of consumption, movement, planning and policy changes. To assess how the JLE investment impacts on these underlying processes of change, two aspects will need to be examined (see Figure 3):

1. The ways in which the JLE may impact on decision processes
2. The importance of market turnover

The influence of the JLE on decision processes

There is a wide-range of decisions that are continually being made in an area, either by a small or large number of actors, depending on the type of decision (see Figure 3).

Common types of decision include:

- Land use/property development decisions
- Business location or restructuring decisions

- Residential location decisions
- Employment decisions
- Shopping and leisure decisions
- Travel decisions

There are two broad ways in which the JLE investment can impinge on these various decision processes:

- By providing a stimulus for beginning the decision process. For example, the JLE may stimulate new job search among unemployed local people, lead to decisions to shop elsewhere, or encourage someone to move house (either into or out of the affected area);
- By being a factor that is taken into account in selecting from a number of options. This may apply to a property developer's investment decision, the decision of a householder about where to relocate, or decisions about where to shop or work;

Where the JLE is influential in the final decision, it is expected that some patronage would be generated as a result of the decision.

THE DECISION PROCESS

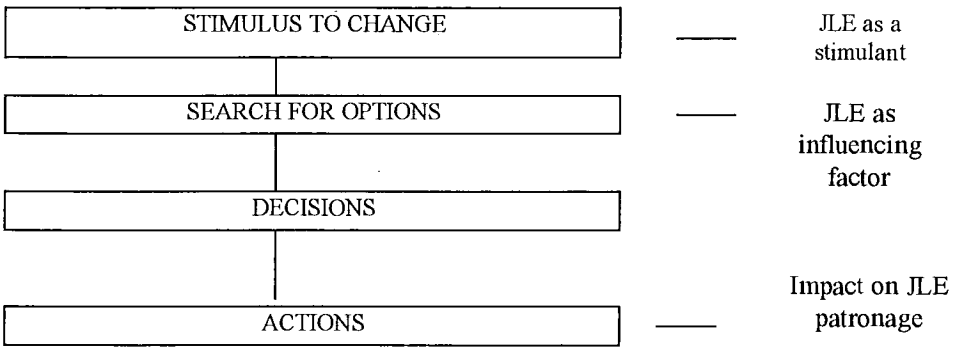


Figure 3: Diagram to illustrate processes of change

The importance of market turnover

The continual process of change in an area is a reflection of the fact that there is constant turnover of population and various actors in the area. These processes are poorly understood and often limited account is taken of them in impact studies. Population change occurs naturally as a consequence of ageing, birth and death; similar processes can be found among companies, where new companies start up, while others close or change in nature.

In addition to this in situ process of change, there are patterns of turnover due to people moving into and out of the area, to changes in work location and in chosen locations of shopping, entertainment, etc. These choices are in turn influenced by the JLE and activities that it stimulates. Turnover rates of population and businesses can be quite high and can rapidly lead to a change in the characteristics of an area, or in the profile of users of transport services or other facilities. This is an important aspect to consider in the JLE

studies, for three reasons:

- Turnover rate may itself be an important indicator of impact (e.g. both in terms of residential and commercial properties);
- Turnover rates have important implications for the types of tracking studies that can be carried out (e.g. affecting attrition rates in panel surveys);
- Profile changes as a result of 'natural' turnover need to be considered as part of the process of distinguishing impacts from changes.

PROPOSED ANALYTICAL APPROACH FOR IDENTIFYING IMPACTS

The methodological approach outlined above has been specifically designed to gain a better understanding of the various underlying and on-going processes at work, and to identify and evaluate the spatial and temporal dimensions of the changes which occur. The complexity and rigors of such an approach place increased demands on the need for accurate and comprehensive data. For this reason, has been necessary to develop a set of clearly defined impact indicators before the data collection process began. These needed to be comprehensive enough to be used independently and/or in combination to measure the influence of the JLE across each impact area. The selection of indicators in turn established the most appropriate data collection method.

Indicators of Change and Causation

Initially six composite sets of indicators were identified. These were defined as follows:

1. Measures of the background or wider context of the system - this relates to broad contextual factors which may affect the level and quality of provision of transport and land use system elements (e.g. planning policies, the wider legislative process, state of the national economy).

The next four sets of indicators are applied to each of the main elements of the transport and land use systems, the different modes of transport and the different building types and land uses.

2. Indicators of the level of provision of the transport and land use system, both in terms of their physical infrastructure and their operation - these should also include consideration of both the quality and quantity of the provision.
3. Indicators to record levels of staffing or employment required to operate each of the system elements. In terms of the transport system, this relates to levels of staffing in the construction, maintenance and operation of the system. For the land use system it requires recording levels of available employment by standard industrial classification as well as employment in the construction and maintenance of properties.
4. Measures of the level of economic performance of elements of the system, this involves consideration of the costs of operation, system efficiency and consumer expenditure and profits derived from the system.
5. Measures of on-site and between site activity, these include employee characteristics and behaviour, travel and consumer activity. Consumer activity includes, retailing, leisure, services, social activity and tourism and is associated with particular land uses while travel is considered as a 'consumer' function of the transport system. In terms of employment activity, indicators will measure the nature of employee activity in the area e.g. person types, home location of employees etc. (levels of activity will be measured through 'staffing' indicators).

The final set of indicators applied to the transport and land use system as a whole.

6. Indicators which demonstrate the effects of externalties arising from construction and provision of

services within the transport and land-use systems - both the direct effects such as pollution and land blight and indirect effects such as pattern and density of development and the quality of the natural environment will be considered within this set of indicators.

It was then necessary to sub-divide each of the indicator groups into more specific sub-sets to describe:

- the level of provision and activity within the system elements at any given point in time (these are referred to as "indicators of change") and:
- associated background and causal factors which may have an influence on changes in the area (referred to as "contextual and causal indicators").

Identifying Change and Causation

These indicators will be used to construct a baseline scenario for the JLE which is capable of taking into account trends and fluctuations over time and compare these with trends and fluctuations in the identified control or reference areas. Using this information, predictions for the JLE corridor and the relevant "reference" area/s can be made on the basis of a continuation in the identified baseline trends. These predictions can be refined as more up to date information on trends becomes available for the control/reference areas and as more specific information is collected for the JLE corridor through the 'before' surveys. Data collected in the 'after' surveys will then be compared to these expected values, from which it will be possible to identify significant differences in levels, quality and/or incidence of impact to those predicted (see Figure 4).

Where significant changes in levels/quality/incidence of indicators are identified compared to the expected baseline trends in the JLE catchment areas, it will be necessary to use a comparison set of indicators to identify (wherever possible) the cause of these changes. These indicators may comprise objectively measurable influencing factors, such as increased levels of inward investment into a component of the system, or changes in population or employment characteristics. However, it is expected that often these indicators will be related to subjective factors describing the attitudes and perceptions of the individuals and groups who are affected, either in quantitative or qualitative terms.

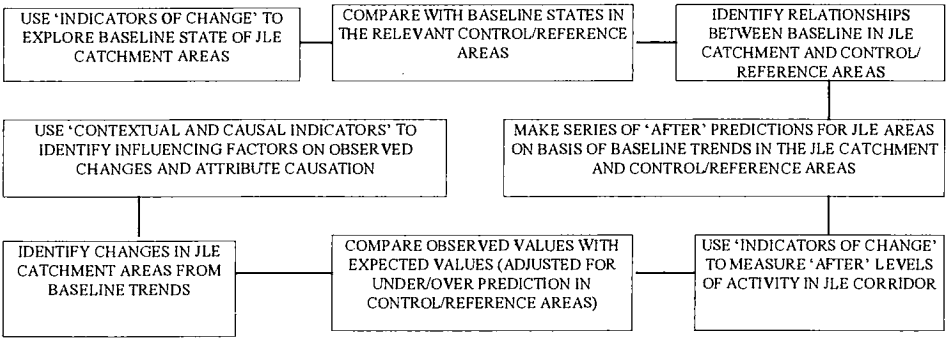


Figure 4: Diagrammatic Summary of Analytical Framework

THE SURVEY PROGRAMME

It has already been identified that the chosen methodology seeks to identify both the processes of change

and their outcomes, and this is recognised in the planned programme of surveys and studies. It was found that considerable data already exist for some of the topic areas in the study and this will be used wherever possible. However, where data is not available this will be collected through a series of specifically designed survey instruments.

In most instances surveys will be conducted once before the line opens and at appropriate intervals after opening and will include the following:

- Exploratory Focus Groups
- 1000m radius Land Use surveys around all JLE stations
- Household panel surveys involving 1600 household
- Employer panel surveys with 600 local employers
- Passenger origin and destination surveys
- Local traffic and parking activity in the vicinity of the JLE stations
- Local property and land values assessment
- On-street interception surveys
- Qualitative interviews with identified 'agents of change' i.e. planners, investors, developers etc.

CONCLUSION

There is a widely held assumption that improvements to public transport infrastructure will not only lead to transport benefits, but also to increased local economic and development activity. One of the aims of the impact study is to explore the potential for establishing the extent and nature of this relationship. In order to achieve this aim it has been necessary to develop a research methodology which is not only capable of correctly identifying changes in the transport and land use systems but also of establishing where these changes can be attributed to the impact of the JLE.

A review of the literature from previous impact studies found that impact study methodology normally involves a comparison of the patterns of transport movement, land use activity and economic development at specific points in time 'before' and 'after' the opening of a new transport facility. This paper has argued two potential major problems with this approach. First there is the issue of identifying 'real' changes in the state of the system and establishing causality. Because of systematic fluctuations in traffic levels, property prices etc. over time, detected **differences** in values at two points in time may not necessarily represent a **change** in the underlying state of the system. Furthermore, where changes are correctly identified, they may not necessarily be **impacts** that can be properly attributed to the new transport services, i.e. they may have been caused by other factors. Secondly, impact studies usually start with a 'before' datum point against which change can be measured. Past studies have often nominated a single date from which changes can be measured. It has been argued that this approach is too simplistic, since different types of impact operate over different timescales; some not only take longer to work their way through than others, but often start taking effect at an earlier date in advance of the completion of the scheme.

This study has taken the position that, instead of comparing snapshot 'before' and 'after' states, a more comprehensive understanding of the impacts of major new transport investments is needed. This requires an examination of the various underlying and on-going processes at work, together with a recognition of the spatial and temporal dimensions of the changes which occur, in order to more accurately record when and where the new transport investment impinges on these various processes.

The described methodology involves the collection and analysis of data within the JLE catchment

areas and in appropriately selected control and reference areas to enable for the construction of a 'baseline' scenario which will allow predictions to be made on future trends and outcomes in a 'without the introduction of the JLE' scenario. In this way it expected that it will be possible to identify local changes and to differentiate between instances where these changes would have occurred regardless of the introduction of the JLE and those where it has been a crucial factor.

Whilst it will be possible to identify the influence of many factors through the analysis of quantitative data, it is recognised that some impacts and processes of causation will only be identified via qualitative data on the decision processes of individuals and/or groups. The collection and analysis of this qualitative data is, therefore, an integral part of the methodology. This will contribute to a more comprehensive documentation of the relationship between public transport infrastructure investment and economic activity.

It is recognised that, in some instances, it may not be possible to separate the role of the JLE from a combination of other factors influencing the areas it serves. In these instances, it may be appropriate to conclude that the JLE has been a necessary but not a sufficient factor in bringing about the changes that have occurred, or that it has been a codetermining factor.

REFERENCES

CERVERO R. & LANDIS J. (1997) Twenty Years of the Bay Area Rapid Transit System: Land Use and Development Impacts **Transport Research Part A, Vol. 31, No. 4,** pp. 309-333

CHEUNG Y.H.F (1993) Socio-economic impacts of large scale transport projects **Proceedings 21st PTRC Annual Meeting**, University of Manchester Inst. Science & Technology, England

GRIECO M.B (1994) **The Impact of Transport Investment Projects upon the Inner City: A Literature Review** Avebury, Aldershot, UK

NELSON A.C & SANCHEZ T.L (1997) **The influence of MARTA on population and employment location** Transport Research Board, Washington D.C. USA

TOWNROE P. & DABINETT G (1994) **The Evaluation of Public Transport Investment within Cities** Centre for Regional and Economic Research, Sheffield Hallam University, UK

TRANSPORT RESEARCH BOARD (1996) Transit and Urban Form Volume 1: Urban Form and the Built Environment: A Summary of Knowledge **TCRP Report 16** National Academy Press, Washington D.C. USA

TRANSPORT & ROAD RESEARCH LABORATORY (1982) **Proceedings of Symposium on the Effects of Rail Improvement in Glasgow and Other Cities** November 1982, Mitchell Library, Glasgow, UK.