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City Wide Bus Network Restructuring Using An Inclusive Planning Approach

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Abstract

Despite an overwhelming case for the redevelopment of historically based bus networks, reviews are difficult to implement because of limited funding, equity concerns, complex technical challenges, difficulty communicating technical issues to stakeholders and the potential displacement of existing users. This paper describes a bus network review process designed in Melbourne, Australia to address these issues. The process adopts evidence based planning and achieves a consensus of outcomes using an inclusive design process adopting advanced analysis tools to communicate technical issues effectively to a non-technical audience.

Previous research does not directly address the practical implementation of bus review processes and tends to either focus on short term bus planning approaches or consider theoretical applications with limited practical value.

The bus network review process developed is based on strategic studies aimed at opportunities to grow bus markets. The process is highly consultative to build stakeholder 'buy-in' and adopts a two stage program (1. problem identification inputs and 2. draft network review inputs) using nominal group techniques to ensure inclusive participation and quantification of outputs. The review process uses a simple to understand hierarchy approach to review services including assessment of Access, Time Factors, Ease of Use, Safety and Awareness. Graphical techniques including GIS are adopted for clear and simple presentation of technical outputs.

The process has been powerful in building 'buy-in' and has resulted in $A1.4B of investment in improved services with high ridership growth outcomes. Experience and impacts are outlined including areas for future research.

1. INTRODUCTION

There is a common view that bus networks are based on historical development patterns and have rarely adjusted as cities grow and transport systems change. While most systems undertake regular adjustments of frequency and service levels, (Wilson et al., 1984) major structural network revision is rare mainly due to the significant barriers to their re-development, e.g. user opposition to change. Funding of subsidies is the other substantive barrier since governments of all types have competing demands for limited funds.

Funding of bus network reviews is particularly sensitive since significant equity issues arise for the distribution of services and funding between authorities, operators and even electoral districts. To these issues are added the concerns of the existing ridership market. Fundamental revision of networks may make sense on a map but it often involves dislocation of some existing riders. Authorities, operators and politicians at all levels understand that the dislocation of even a few riders can involve considerable fallout regardless of the net effects in generating new ridership or in improving performance. Compounding these constraints are technical challenges.

Optimisation of networks is a complex task involving hard trade-offs between sensitive and often conflicting system development objectives. These technical challenges are difficult to communicate to a non-technical audience of users, operators and regulators. As a result maintenance of the existing (historical) bus network can be an attractive option even when far better technical alternatives have been identified.

It is within this context that emerging urban congestion and environmental issues have generated calls for significant reinvestment in urban public transport systems worldwide. Increasingly, authorities are being asked to consider the fundamental design of bus networks to ensure additional resources are not wasted on poor service options. However the barriers to redesign remain. The key question is: How can a bus network review process balance complex technical challenges, limited funding, equity concerns, and existing users opinions? Effective communication of the technical issues and engagement of a wider audience are two of the keys to success.

This paper describes a bus network review process designed by the authors (Booz Allen Hamilton, 2003) and implemented successfully in over 20 bus network reviews in Melbourne, Australia. The process addresses the barriers to bus network reviews by adopting evidence based planning where a consensus of outcomes emerges using an inclusive design processes and advanced analysis tools to communicate technical issues effectively with a non-technical audience.

The paper is structured as follows; section 2 outlines the research context to bus network reviews of this type. This is followed by section 3 describing the background to the review context in Melbourne including a description of the policy context and an outline of studies which informed processes development. Section 4 describes the bus review process and is followed by section 5 describing some of the techniques applied to undertake the review. Section 6 discusses the major outcomes and lessons learned from the review process. The paper concludes with a summary of major findings and a discussion of areas for future research.

2. RESEARCH CONTEXT

The research literature has relatively poor coverage of practical issues associated with wide ranging bus network reviews. Bus planning research has tended to focus on short range planning (Wilson et al., 1984) and issues of frequency determination (Furth and Wilson, 1981) and scheduling (Ceder, 2007). A fairly comprehensive planning literature concerns the planning and management of transit capacity (Kittelson & Associates et al., 2003) and factors which encourage higher ridership (Charles River Associates Inc, 1997, Yoh et al., 2003, Balcombe et al., 2004, Evans, 2004, McCollom and Pratt, 2004, Pratt and Evans, 2004) however these sources rarely venture into issues of network structure and approaches to the redesign of networks.

There is however a depth of theoretical research concerning transit network design theory (Wirasinghe, 1980, Ceder and Israeli, 1998, van Nes and Bovy, 2000). While these are technically sound analyses what is interesting is the lack of practical applications of theory in real world network design. Perhaps real world transit planners have little understanding of the advanced technical theory behind this research. There is a certainly a considerable gap between the technical complexity of these methods and the need for communication of their outcomes to a non-technical users and regulators.

There is also limited research about bus planning processes and methods. While all the major foundation authors in the field present strategic high level models for the process of transit planning (Vuchic, 1981, Fielding, 1987, Ceder, 2007, Vuchic, 2007) none go into depth about network design (or the more difficult redesign) processes. There are selected sources concerning issues of bus planning relative to performance assessment (Kittleson & Associates, 2003) including practice reviews about pro-active planning processes (Toronto Transit Commission, 1985). There is also a recent guide on North American best practices in transit planning (Mistretta et al., 2009). However again there is a tendancy for these sources to emphasise short range planning with little coverage of network planning or restructuring.

One UK study reviewed the nature and occurrence of major bus network reviews (Chua, 1984). Some 82% of UK authorities had undertaken a “major bus network” review over a 10 year period between 1970-1980 suggesting such large scale analysis were not quite as rare as has been suggested. The approaches adopted were primarily manual analysis of data (71%) with 21% adopting market research based analysis and 7% a systems analysis approach. Interestingly none of the authorities during this time were using advanced computer based techniques or the mathematical or heuristic methodologies associated with transit network design theory.

A fairly recent European ‘best practice guide’ has been developed to assist transit operators in the design of networks (Nielsen et al., 2005). While this guide provides a solid basis for understanding planning trade-offs in network design there is little practical guidance on planning approaches and processes.

Overall there is clearly much scope to develop research to better inform bus planners on network redesign in practice.

3. STUDY BACKGROUND

Melbourne, a city of around 3.6 million people, is the capital city of the Australian state of Victoria. The bus network design process described in this paper was formulated through a range of consulting studies undertaken by the authors over a 10 year period for the Victorian State Government examining bus network planning, the performance of the existing network and approaches to improve bus services. This commenced in 2000 with the 'Bus Improvement Strategy' (Booz Allen Hamilton, 2000a, Booz Allen Hamilton, 2000b) a strategic scoping review of opportunities for substantially improving bus services with the aim of increasing ridership. This was followed by a 3 year strategic review of individual bus sectors of the network aimed at developing strategic plans for network development (Booz Allen Hamilton, 2003, Currie, 2003). Three major factors drove these studies and their outcomes:

- A need to build a general consensus for change in the bus network which could counteract barriers between agencies and levels of government;
- A need to build an open and defendable evidence base which could be used to inform this debate; and
- A need to engage the general public and a non-technical audience and in doing so raise the general level of understanding about technical issues which affect bus network planning.

Several published papers have described the evidence base developed from these research processes in Melbourne. A meta study of factors driving bus ridership was undertaken including an international opinion study of bus planning experts using delphi techniques (Currie and Wallis, 2008). The studies also identified new methods to optimise bus service standards relative to economic evaluation processes (Currie et al., 2003).

Other studies demonstrated significant gaps in bus services relative to social needs particularly on Melbourne's urban fringe (described in Currie, 2009). Indeed a major overall outcome of the preliminary studies was a general consensus that buses were critical to the citywide transport objectives and that significant improvements in the bus network were needed. In 2003 these major benchmark findings provided the following facts about Melbourne and its bus network:

- More than two thirds of Melbourne residents live in areas with buses as their only public transport mode (a fact that remains today);
- Average bus headways were 40 mins in the peak, 50 mins in the off peak (low by Australian and international standards);
- On average the last weekday bus service finished at 6:53 pm; and
- Less than 20% of all bus routes operated on Sundays.

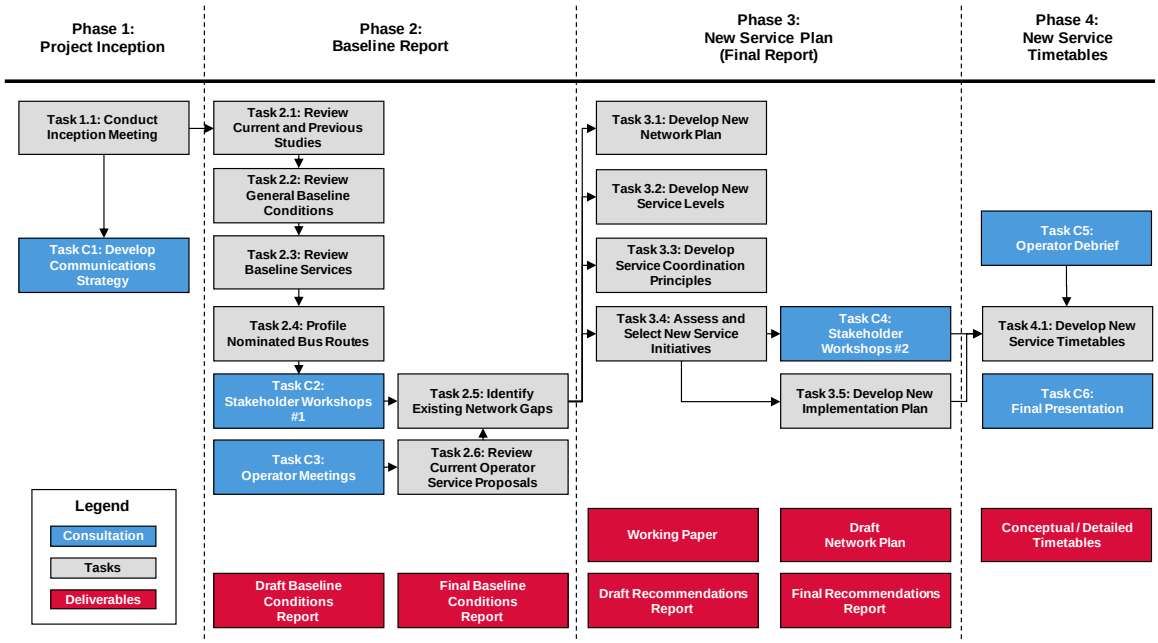
Another major outcome of the preliminary studies were the substantial scope to improve ridership on buses. The consultative processes adopted in these studies had acted to achieve substantial stakeholder support for improving bus services by increasing general service levels, adopting bus priority principles and bus rapid transit system design principles for major cross regional bus services. This consensus provided a powerful input to transport policy and acted to guide state government funding priorities. In 2006, the Victorian Government released a ten year programme entitled 'Meeting Our Transport Challenges'. This programme aimed to substantially improve bus service provision in order to encourage mode shift (Department of Infrastructure, 2006) and included a detailed bus network review process and expanded funding to pay for it. The funding includes a $A650M (over ten years) to improve local bus services and $A740M to upgrade major corridor bus routes to BRT like service features.

The area network reviews have been undertaken over the last three years and will be completed in mid 2010. Overall the review process includes every bus route (around 330 routes in total) in one or more of 16 geographic areas. The bus review process has proceeded in four tranches and improvements from the first 9 reviews have been implemented. This paper concerns the methodologies developed in these studies to undertake bus network reviews across the whole metropolitan area and their implementation outcomes.

4. THE BUS NETWORK REVIEW PROCESS

Figure 1 presents the outline methodology for the review process. The major components of the process are a comprehensive stakeholder consultation process, the detailed technical work to establish the baseline and the options evaluation which builds up into the revised network plan.

Figure 1 : Bus Network Review Process



An essential element of the review program is a two phase consultation process. The first phase uses community opinions on existing issues and suggestions for improvement to focus the revision of existing services. The second phase captures community views on the draft network plans, identifies missed opportunities and helps to prioritise the implementation of changes based on financial realities.

The two phase process is an essential element that builds stakeholder 'buy-in' to review outcomes. The first phase occurs early in the process and begins with a baseline presentation of critical performance information. This gives all stakeholders a high level overview of services and knowledge to make informed comments. Having this consultation before developing any draft plans, is important as it demonstrates how stakeholder views underpin and focus the upcoming efforts of the review team. The second phase cements 'buy-in' by empowering the stakeholders as the first to critique the draft network. This pro-actively engages stakeholders in the process of network development and builds a sense of ownership – "It is their network review". The final stage of the second workshop involves the stakeholders setting priorities as if they were

the Public Transport Minister and (as a table) the Parliamentary Cabinet. This process helps to identify those improvements that are most important to the stakeholders. It also provides a realistic experience for the stakeholders who must "trade-off" some improvements for others as they allocate their "limited" budget across all improvements.

The technical work stream commences with a series of 'base line' studies which provide an evidence base as a foundation for future work. A summary of this material is presented to the stakeholders at the start of the first workshop. The technical baseline report and feedback from community workshops on priorities are used as an input to phase 3 where new service plans are developed.

The approach does not use expensive and time consuming bus network demand modelling. Rather assessment of individual route performance and community views informs option development and analysis, detailed data (such as passenger movements at the stop level) is used to evaluate options and a simple benchmarking process is used to estimate ridership impacts. Options that seem logical but are not received well by the stakeholders are assessed in greater detail, often following additional ridership surveys and greater consideration of alternatives.

This simplified approach might be argued to be less efficient since the most complex and time consuming demand modelling tools are not used to assess all services. Rather the approach is seen as a cost effective use of time and resources to focus on problematic issues which deserve attention. Operational efficiency of the network is maintained because planning systems used to optimise timetables and schedules are applied to the whole network.

The final phase involves interaction with bus operators to identify optimal implementation plans. This includes writing timetables for each route and a detailed assessment of scheduling and resource implications. In many cases the final implementation still requires significant involvement from the bus service managers to facilitate agreement between different bus operators about how the new services should be provided.

5. ANALYSIS TECHNIQUES

Three types of analytical technique are considered here:

- Consultation processes;
- Service assessment; and
- Geographic Information Systems and other graphical techniques.

5.1 Consultation Processes

In each review area a number of workshops are held in each consultation phase. The number is based on geographic size, the need to cover times of the day/night and area demographics.

All workshops adopt the 'nominal group technique' (NGT) to ensure that feedback is constructive, inclusive and quantitative. NGT was first developed in education planning (Delbecq and VandeVen, 1971). In this case participants at the first workshop (concerning existing issues and suggestions) answered three specific questions covering:

- Strengths of the existing service;
- Existing problems issues; and
- Opportunities for improvement.

Use of the nominal group technique in the bus reviews requires stakeholders seated around tables (usually a maximum of eight to a table) each with a moderator. The moderator is a member of the consulting team who guides the work and facilitates discussion. Where possible participants are asked to sit away from people they know (in order to generate a mix of views and opinions at each table). This helps to stimulate debate and discussion around each table and highlights to all participants the complexity of issues that need to be considered in the network review.
The consultation process commences with a study team presentation on baseline review findings. This can then be used by stakeholders as (informed) input to their views. The "Nominal Group Technique" then includes:

- Individual contributions from each person recorded on "post it" notes;
- Small group consensus through grouping 'like' issues into themes;
- Prioritisation of themes through group voting; and
- Normalisation across groups by discussion of results amongst all workshop groups.

Each table member is asked to nominate the three strengths of the existing service they believe to be most important.. These three strengths are written on three separate yellow sticker notes. Stickers from each table member are read out to the table then assembled by the moderator on large white paper sheets. Where stickers cover similar issues they are grouped together. Once all table members have contributed their "top three" a voting process follows to identify the consensus view of the table. Each stakeholder is asked to allocate ten points across the topic (or topics) they believe to be most important. After voting a tally of table results is made. All table results are then reported back to the workshop facilitator and all participants. The workshop facilitator notes the most important topics on a whiteboard – to emphasise that the stakeholders are being listened to, and to highlight to the whole audience the general consensus within the room.

The same process is followed to then discuss issues and finally opportunities. This staged approach to collection of stakeholder views achieves many things, including:

- Focussing stakeholders attention to specific tasks (rather than a "rant and rave");
- Ensuring stakeholders recognise there are some strengths in the existing service;
- Engaging with the stakeholders and showing them that their views (and votes) are important;
- Enabling stakeholders to engage directly with the study team, the operators and other people involved in management of the bus system;
- Ensuring stakeholders hear the range of views present; and
- Identifying not just weaknesses of the existing service but also strengths and ideas for improvement.

This approach ensures each participant has a direct input to the process. A common concern over unstructured community meetings is that many people feel unable to speak in public and hence only certain voices (usually those complaining loudly) are heard. This approach ensures that everyone has an equal say and the views of one person cannot dominate over that of the wider group. The process also facilitates detailed input where appropriate. Stakeholders are encouraged to write detailed comments regarding specific routes or services and each is read out to the whole table before being included on the summary sheet. Any clarifications needed or discussion about "why" such a topic is important can occur amongst the table members and be noted by the moderator.

The final part of the first workshop focuses on improvement suggestions. Discussing improvements at a separate stage to discussing problems ensures that stakeholders

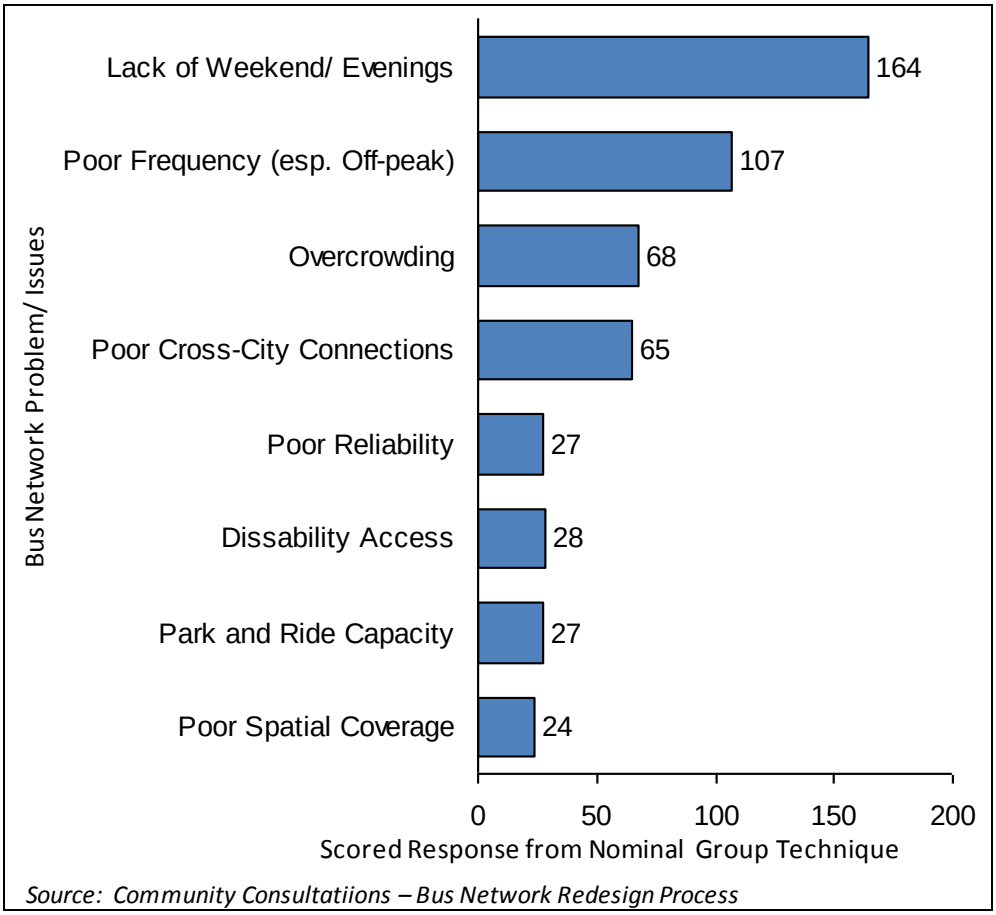
understand there are a range of problems to be considered (and some are likely to be contradictory). It also helps stakeholders recognise there may be a range of potential solutions to the specific problems they raised.

Following the workshop each of the yellow sticker notes are typed into a spreadsheet as community input for the consulting team. Every comment is then categorised based on the hierarchy of key service qualities (and sub-categorisation as required). This enables the broad view of different workshops to be identified and analysed. The final phase (back at the office) includes re-reading, evaluating and notating a response to every comment made in the workshop process. This ensures that all comments made are acted upon in the next phase of the network review process.

The second workshop commences with a presentation highlighting the findings from the first workshops (to reiterate that the network is based on their input) and a detailed presentation of the draft network plan. Detailed network plans (maps) of existing and proposed networks are also provided on individual tables. To streamline effort, larger study areas are typically broken into suburbs with each table focussing on a defined area of nearby suburbs.

The NGT is also used in the second workshop, structured around two parts; a. 'good things' suggested in the plans and b. 'suggested adjustments/improvements'. Voting adopts the same process to gain consensus around each table and show an overall workshop "election of issues".

Figure 2 : Example Summary Output – Community Consultation Process



In addition the second workshop seeks to set priorities and ensure stakeholders have a "reality check" or firm understanding about what is financially feasible. To achieve this the participants are presented with a "shopping list" of service improvements (such as the new network, increased service span, increased frequency, new buses). Participants are each asked to act as the Transport Minister and "spend" a nominal budget (such as $50). The shopping list has nominal prices that roughly equate to the "real" cost of each improvement. The "purchase" everything on the shopping list would cost many times the budget (and some individual items may cost more than one person's budget). This is a powerful tool that helps stakeholders understand the realities of funding. It generates informed feedback from stakeholders about priorities in a constrained budget setting.

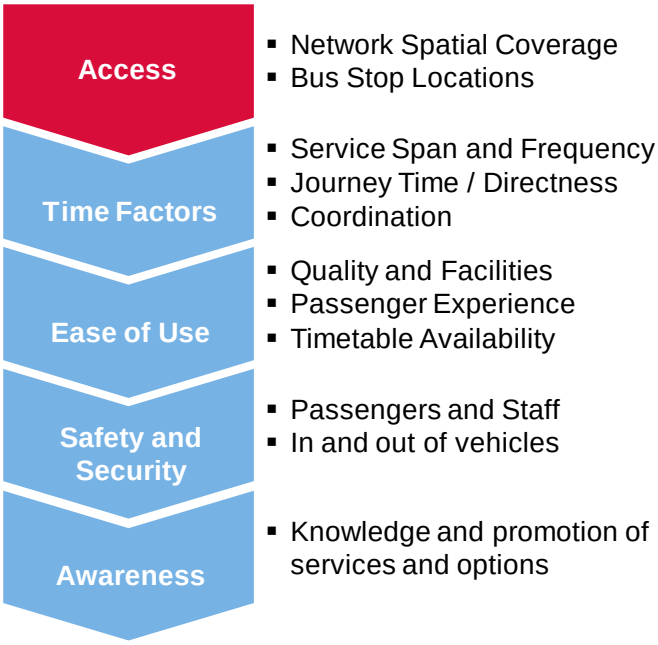
As with the other workshop stages participant's compare their thoughts and then are asked to act as the "Transport Executive" coming to consensus on what improvements their table will purchase. This represents the real-life complexity of shared decision making trade offs and highlights why not all stakeholders will get what they want. It also adds another useful layer of information about how a group of people with different views would like money spent.

Figure 2 shows some of the tabulated results from consultation processes adopting these approaches. As can be seen the outcomes can be used to readily target areas for service improvements. A major outcome of the whole process is a feeling of 'buy-in' and ownership of the plan amongst participants.

5.2 Service Assessment

The service assessment approach reviews the bus network using a hierarchy of key service qualities (Figure 3). The hierarchy is based around factors that need to be acceptable to a member of the public before they will use the service.

Figure 3 : Bus Network Service Quality Review Hierarchy



The hierarchy follows a simple logical order which can be used to focus attention on the critical elements at each stage of the bus service review. It is an 'issues based'

hierarchy in that it refers to the issues that need to be addressed in specific order. The hierarchy is:

1. Access;
2. Time Factors;
3. Ease of Use;
4. Safety; and
5. Awareness.

Access is at the top of the hierarchy because nothing else matters for a person who can't access the bus. Access includes geographic coverage of the urban area, destination selection and route directness (usually more direct routes limit access or increase walking distance to each stop).

Time factors are next and include service frequency, span and travel times. The implication is that a person who is able to access the bus, still will not use it unless it operates at the right time of the day or week to suit their needs. The route directness links between access and time factors as indirect routes usually improve access at the expense of journey time and vice versa.

For those that have access to a service that operates at the right times to suit their needs the route then needs to be easy to use before it will be considered. A wide range of factors can influence ease of use, including stop facilities, driver behaviour, fares, network legibility, transfer conditions and journey planning. It is worth remembering that everyone in the community has different perceptions about what makes the service "easy to use", the bus review process aims to highlight the common perceptions and identify those improvements commonly considered to be "a priority".

Perceptions of (or actual) safety issues are the next barrier to many potential passengers. In many instances this key service quality works in favour of bus travel because passengers feel more safe with a driver being easily accessible. However other safety concerns persist, particularly regarding safe driving, waiting at bus stops and travelling at night.

Awareness is the final key service quality in the hierarchy. Once all the higher order issues are resolved (for each individual) the final excuse an individual will use for not catching the bus, is that they don't know about it, or don't have all the information necessary.

Examples of how these measures are implemented (with easy to understand outputs) are shown in the next section

5.3 GIS and Graphic Techniques

An important part of the bus review process is the use of graphical techniques including geographical information systems (GIS) as a means to communicate technical findings to a non-technical audience. These techniques engender informed discussion (and decision making) and can avoid alienating non-technical audiences with confusing text or tables of information. These positive outcomes are caused by the effect of GIS 'pictures' which are easier for the layperson to understand the spatial implications of service plans than a series of numbers and tables. In addition GIS maps enable a specific understanding of how service changes affect the individuals trip end locations and their specific 'trip space' environment.

Figure 4 (left) shows a typical GIS output concerning combined 'access' and 'time factors' analysis. Here a bus network is reviewed for conformity to bus minimum service standards (MSS) including: spatial coverage (catchment walk distance to bus routes); and temporal service span (services operating at night and weekends).

The nominal 400 metre distance from route thresholds are shown to scale for all bus routes which highlights (in white) areas beyond the MSS for access where spatial coverage is poor. The MSS for temporal service span is shown through colouring of the route buffer. The buffer for routes conforming to the MSS are shown in green. Blue buffers show routes that lack evening services, yellow lack Sunday services and red lack weekend services. Both geographic and temporal service gaps are readily apparent.

Figure 4 : Typical 'Access' and 'Time Factor' GIS Analysis

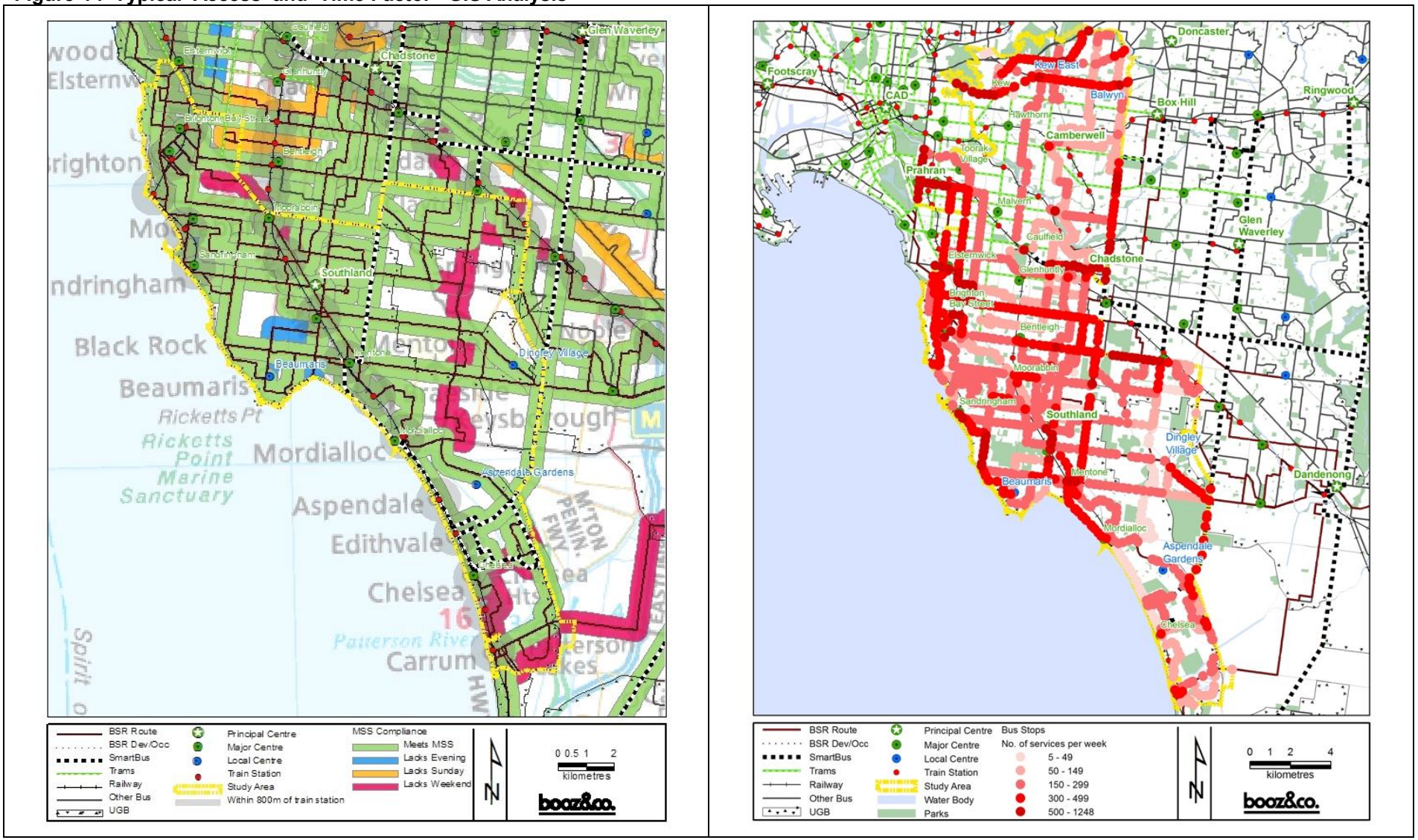


Figure 4 (right) shows analysis of 'time factors' specifically frequency of service – on a per week basis. Here the quantity of services on a weekly basis at each stop is categorised and displayed to demonstrate the quantum of service available at each individual bus stop. This is particularly useful at highlighting geographic service inequities or over and under-serviced areas. This analysis also highlights spatial coverage gaps through graphical representation of frequency by bands (or gaps) as the width of each dot representing a bus stop can be set to the nominal pedestrian catchment for the bus network (400 metre radius).

An important input to this process is the quantification of existing service levels, comparison with other services and their subsequent illustration in a graphical form. In order to present such information to non-technical people quickly two specific graphical tools are used: a 'Harvey Ball' diagram of frequency and span across services; and bar charts of average connection times. For example Figure 5 shows the frequency and span of services at two locations on the railway network in Melbourne. It also highlights different frequencies that at each station that will make co-ordination particularly difficult (or impossible) for a bus route serving both locations.

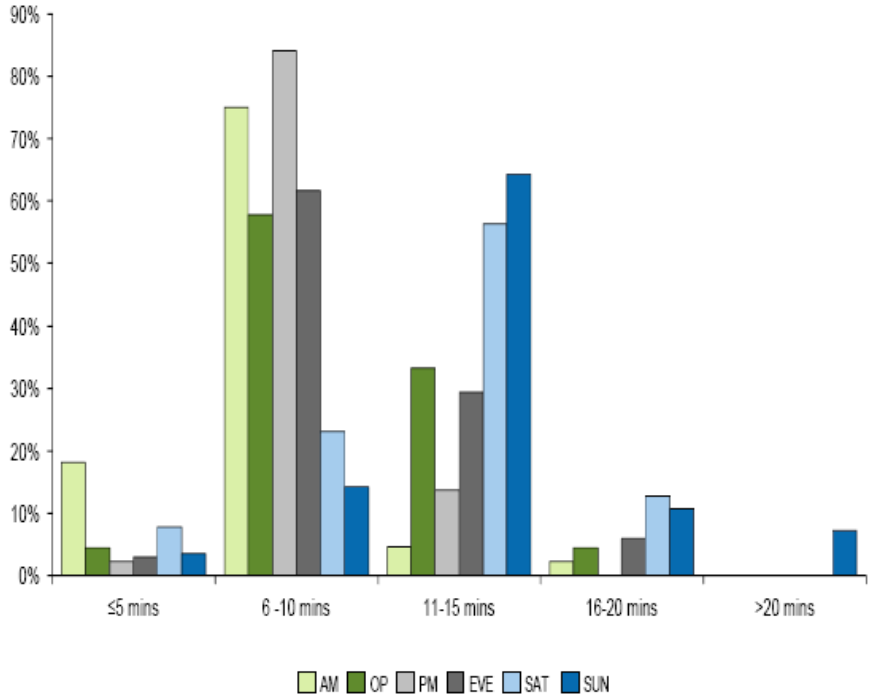
Figure 5 : Frequency and Span Comparison using Graphic Techniques

Station	Service Span		Average Frequencies (mins)					
	First Service	Last Service	Pre-Peak	Am Peak	Inter-Peak	PM Peak	Evening	Overall
Camberwell								
Mon - Fri	05:16 AM	01:23 AM	◕	●	◕	●	◕	◕
Sat	05:11 AM	01:23 AM	○	◔	◔	◔	◔	◔
Sun	07:41 AM	11:51 PM		○	◔	◔	○	◔
Caulfield								
Mon - Fri	05:01 AM	01:21 AM	◕	◕	◕	◕	◑	◕
Sat	05:04 AM	01:21 AM	◑	◕	◕	◕	◑	◕
Sun	07:32 AM	12:29 AM		◑	◕	◕	◑	◕

Legend: ○ 30mins ◔ 20-29mins ◑ 13-19mins ◕ 6-12mins ● <6mins
Source: Metlink Train Timetables

Figure 6 shows average bus-train connection waiting times at all train stations in a specific study area (an area where bus to train transfers are particularly important). It shows the proportion of waiting times in each time segment (using 5 minute segments) across six different time periods (AM peak, Off-peak, PM peak, and Evenings on weekdays, Saturday and Sunday). In this specific case over 90% of AM-peak transfer waiting times are under11 minutes while over 80% of Sunday transfer waiting times are over 10 minutes. This analysis can be further broken down by route or station to isolate those services that have poor connection times and investigate causes.

Figure 6 : Average Connection Times



Source: Metlink Bus/Train Timetables and Booz & Company analysis

GIS analysis can also be used to compare specific types of destinations such as Universities as shown in Figure 7. This particular map shows the number and catchment of routes that serve two major Universities in Melbourne's east and highlights gaps in the existing network with regards to similar key destinations.

Analysis of population demographics is a common application of GIS technology. Of relevance to bus network reviews there are four key demographic attributes that contribute most significantly to bus patronage. These are: Population density, Age, Income and Car Ownership. Mapping each of these attributes separately produces four maps that each need to be interpreted and this complicates the process of estimating the impact on bus patronage. To resolve this issue the authors have developed a process of weighting and correlation to help estimate the propensity for residents of a geographic area to use bus services. This "propensity index" is then mapped as shown in Figure 8.

6. EXPERIENCE AND IMPACTS

An important finding regarding this Bus Review Process is that it can build a powerful degree of ownership for improvements from a wide range of stakeholder groups. Indeed this has been difficult to ignore and resulted in much State Government investment. A ten year program of investment in new service is underway with funding of $A1.4B which was secured following a first round of reviews which used this process. Between November 2005 and July 2008 some 111 bus routes were converted to higher base service levels and 19 completely new bus routes were introduced. Overall, area wide bus service levels (measured as vkms supplied) have increased by 26% between 2001 and 2008.

Figure 7 : Comparison of Single Boarding Catchment of Selected Universities

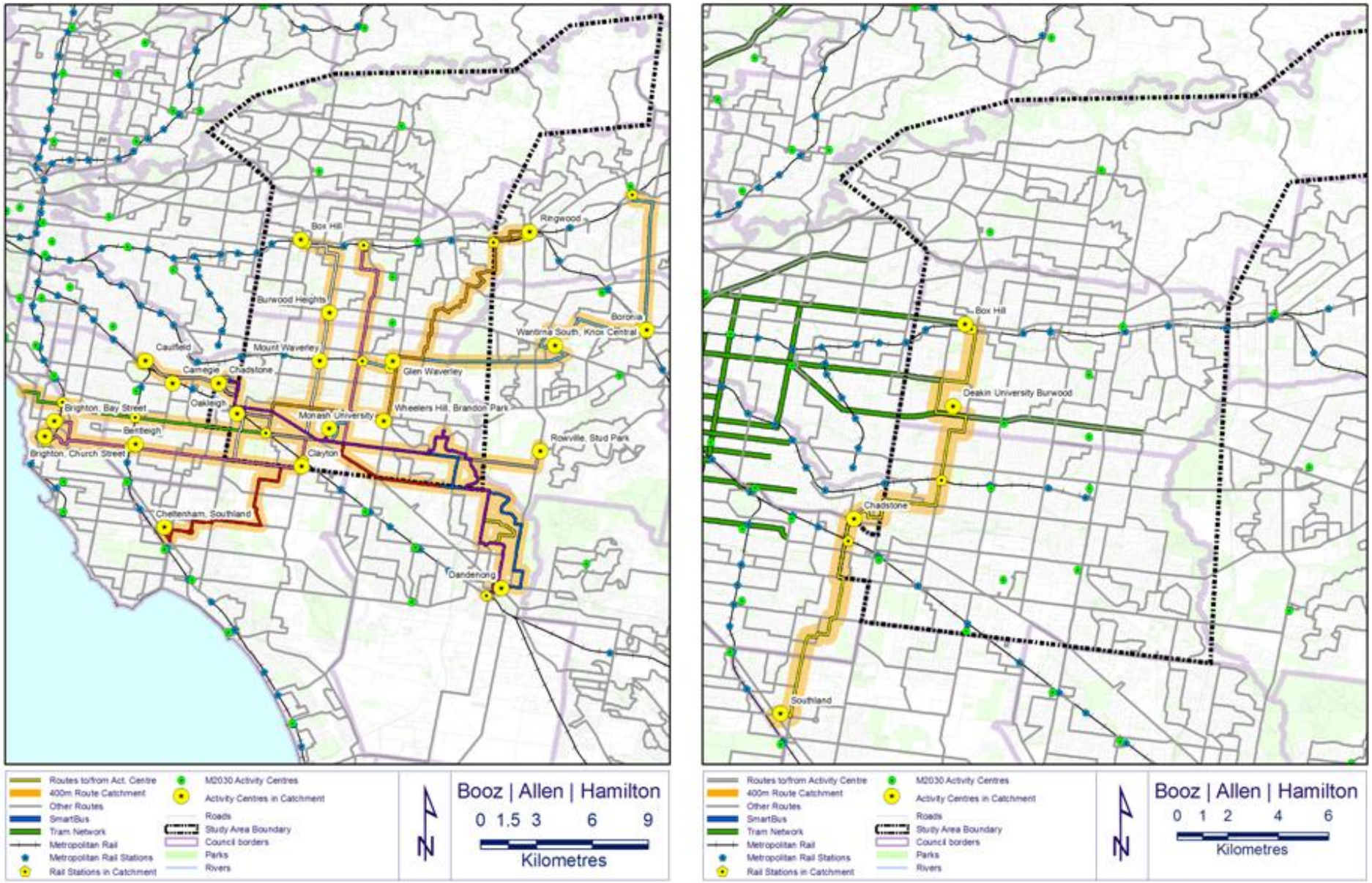
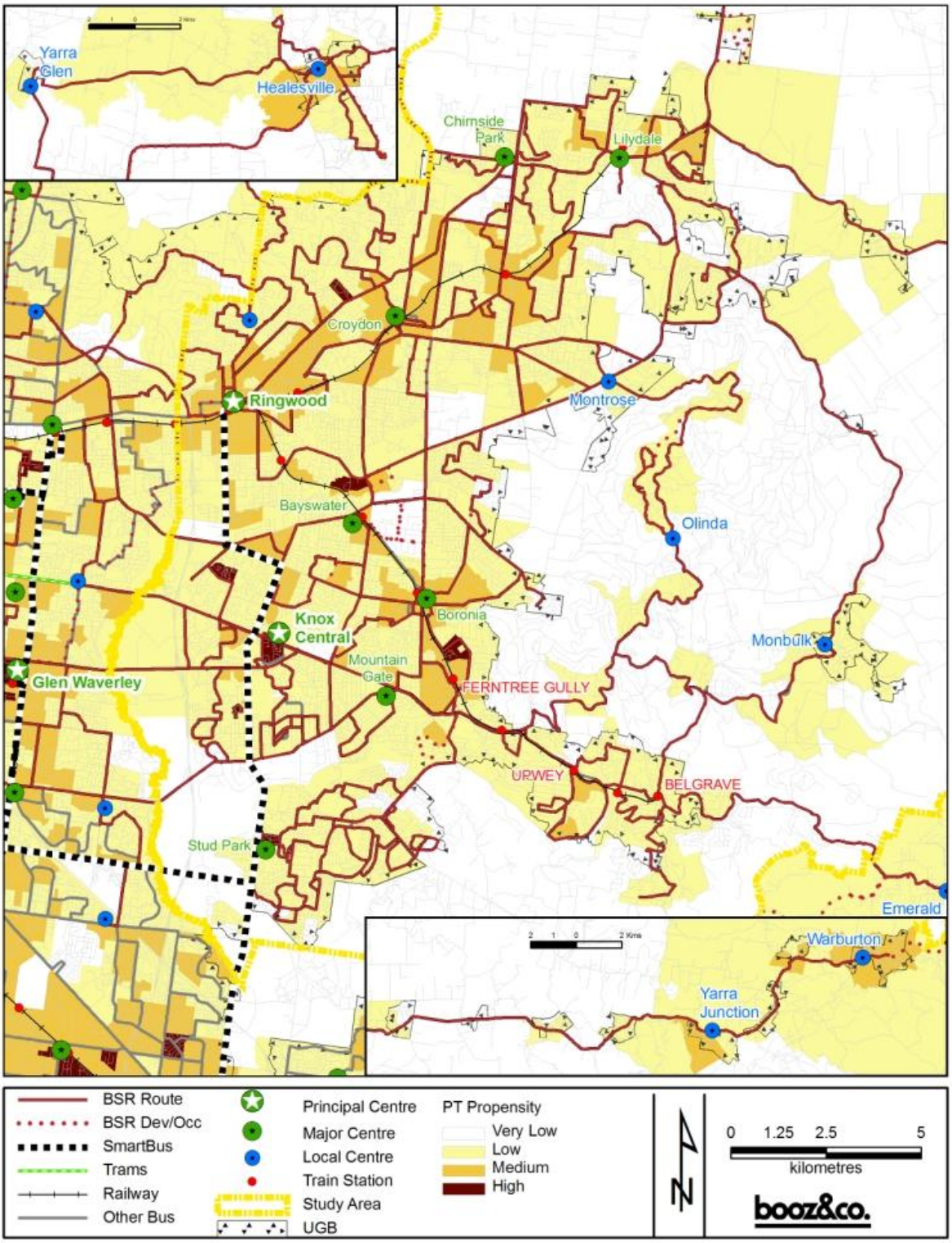


Figure 8 : Transit Use Propensity Index



The ridership responses which have resulted have also been impressive. Melbourne is experiencing a boom in transit ridership with a 20% increase in system wide ridership between 2001 and 2008 (Department of Transport, 2009). Bus ridership increases have been particularly high for the smart bus routes (with BRT like service features) and for expanded weekend and evening services (Currie and Loader, 2009).

To an extent the bus review process has built upon itself acting to encourage buy-in from traditionally resistant stakeholders. For example some individual operators have lost responsibility for some of their traditional bus routes as part of the review process. However since overall service levels and commercial incomes have grown as a result of bus service increases many bus operators have taken the changes in their stride. Overall a plan based on expansionist objectives will always be easier to implement than one involving rationalisation.

The bus review process has also identified significant cost savings (in the order of 10-15%) in some areas where service capacity is significantly under-utilised. With buy-in from the community some of these savings have been reinvested into different services which better meet local needs and generate additional patronage across the broader public transport network. Over time the increased patronage may even justify expanded service spans or additional increases in service frequency.

The consultation methodology is evaluated by participants at the conclusion of each workshop via a short survey that includes open ended questions about what worked well or could be improved and specific questions that elicit responses on a Likert scale from 1 to 10. While many participants make suggestions about how the format can be improved the methodology consistently achieves average overall satisfaction ratings above 8/10 and often achieves an average (across all participants) over 9/10. More significantly is that the average Likert score for the question “Do you feel your views were listened to?” is consistently in the highest scores for each workshop and often is higher than the overall score for the workshop.

There are some important issues which need to be considered in applying bus review processes of this type. It can be dangerous to adopt ‘buy-in’ development processes of this kind if service providers don’t follow them up with action to address the issues identified. In effect the process builds expectations (even if they are moderated by some elements of the process). If at least some of these expectations aren’t fulfilled then the community (and voters in particular) will be unhappy.

Adopting ‘buy in’ processes can however be a powerful means of achieving change that is needed. An interesting question concerns the investment that resulted from the bus reviews; was that level of investment envisaged by Government or did the process itself act to influence decision makers to make more investment? It is the firm view of the authors that the ‘buy in’ process has increased investment. In effect decision makers face difficult trade-offs in allocating scarce resources. The ‘buy-in’ process acted to create a large enlightened community informed about the benefits of bus improvements pushing for change. This most certainly was an influence on decision makers seeking opinions on their difficult investment decisions.

There are also dangers associated with the consultation process. The success of the NGT in the bus reviews has seen its widespread adoption across many other areas of government. There is a danger of ‘burn out’ for some communities in their continuous involvement in consultative processes. Nevertheless the overwhelming outcome of the bus review consultations has been highly positive.

7. DISCUSSION AND CONCLUSIONS

Despite an overwhelming case for the redevelopment of historically based bus networks, most authorities find it difficult to implement bus network reviews because of limited funding, equity concerns, complex technical challenges, difficult communication of

technical issues to stakeholders and the potential displacement of existing users. This paper describes a bus network review process designed by the authors and implemented successfully in over 20 bus network reviews in Melbourne, Australia. The process addresses the barriers to review implementation by adopting evidence based planning where a consensus of outcomes emerges using an inclusive design process adopting and analysis tools to communicate technical issues effectively to a non-technical audience.

Previous research does not directly address the practical implementation of bus review processes and tends to either focus on short term bus planning approaches or consider theoretical applications with limited appeal to practitioners.

The bus network review process developed in Melbourne has been based on a range of strategic studies aimed at identifying approaches and opportunities to grow bus markets. The process itself is highly consultative and is designed to build stakeholder 'buy-in' and ownership of results by adopting a two stage consultation program and using nominal group techniques to ensure inclusive participation and quantification of outputs. The review process uses a simple to understand hierarchy approach to review services including assessment of all factors grouped into Access, Time, Ease of Use, Safety and Awareness. Graphical techniques including GIS are adopted for clear and simple presentation of technical outputs so as to ensure non-technical stakeholders make informed comments about existing services and the draft network plans.

The analytical techniques adopted to develop new bus networks incorporates analysis of individual routes and services without any adoption of complex transit network models. This acts to reduce the resource costs of data collection and modelling. Demand forecasting is still undertaken but is based on benchmarking of ridership impacts based on previous experience rather than network models. It is the authors experience that this reduces time and cost and is not particularly disadvantageous with respect to the accuracy of ridership prediction. This particularly holds true in situations where services are provided for reasons of social inclusion and transport need. Where specific routes are based on high ridership levels it is normal to apply an additional layer of patronage modelling into the process before developing timetables to ensure that patronage demands will be met by the route structure and timetables.

The implementation of the bus network review process has been successful at building 'buy-in' of numerous stakeholders and has provided a powerful momentum for improving services which has been difficult to ignore. A ten year program of investment has resulted including funding of some $A1.4B. Between November 2005 and July 2008 some 111 bus routes were converted to higher base service levels and 19 completely new bus routes were introduced. Overall area wide bus service levels (measured as vkms supplied) have increased by 26% between 2001 and 2008. Ridership responses have also been impressive.

There is clearly much scope to improve research relative to bus network redesign processes. Existing research is either too theoretical or overly focused on short term planning. There is scope for a synthesis of transit practices in relation to bus network reviews including an assessment of methods and the effectiveness of outcomes. Research should also focus on the barriers that constrain and slow implementation of bus network review outcomes. It should also examine the effectiveness of these techniques in alternative political and cultural environments. The effectiveness of the measures proposed in this paper should be critically examined in relation to these barriers and contexts so as to improve practical responsiveness of authorities to the needs for a redeveloped bus network.

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