Developing business cases for regional rail stations: a Victorian case study

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ABSTRACT

The Victorian Government committed to regional transport improvement by "investing in country roads and rail to improve safety and reliability for Victorians and further grow the economy in country Victoria". In line with this commitment, the Department of Transport is planning for the development of a number of regional rail stations to serve and support the Regions.

The development of a business case is a critical phase of the preliminary planning stage as it provides a more detailed analysis of the potentially viable project options and informs the project governing body's decision on whether to invest in the proposed new regional stations. To ensure a good return for the taxpayers of Victoria, a detailed evaluation of the patronage demand and economic benefits associated with new regional stations is required.

Business case investigations were recently completed for Grovedale station (Geelong Region) and Epsom station (Bendigo Region). The investigations involved interviews at regional stations across Victoria, demand forecasts for the new stations and cost benefit analysis. The key observations included:

- Differences in regional rail travel patterns between regions can be very significant.
- Demand forecasting for the new stations needs to consider the improved access to regional rail services, the demand catchment, the competing stations (station choice) and the access modes to the stations (access choice).
- There are a number of factors driving the future demand growth such as service levels at the stations, population growth of the catchment, fare changes, fuel price and the broader economic environment.
- The economic benefits of new regional stations do not necessarily rely on a significant amount of patronage when compared to metropolitan stations,

because regional rail trips are much longer and individual trip benefits are much higher.

Further research and investigations are also recommended.

1. Introduction

The Victorian Government committed to regional transport improvement by "investing in country roads and rail to improve safety and reliability for Victorians and further grow the economy in country Victoria". In line with this commitment, the Department of Transport is planning for the development of a number of regional rail stations to serve and support the Regions.

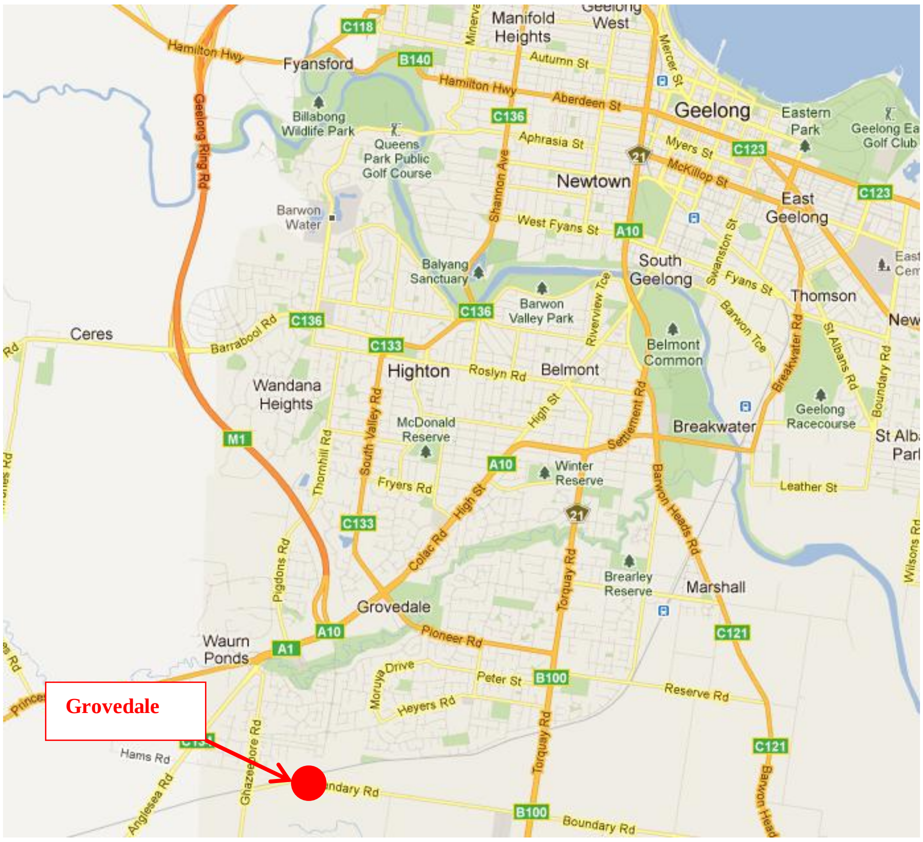
The development of a business case is a critical phase of the preliminary planning stage as it provides a more detailed analysis of the potentially viable project options and informs the project governing body's decision on whether to invest in the proposed new regional stations. To ensure a good return for the taxpayers of Victoria, a detailed evaluation of the patronage demand and economic benefits associated with new regional stations is required.

Parsons Brinckerhoff recently worked with the Public Transport Victoria (then the Department of Transport) to develop inputs for business case investigations for Grovedale station (Geelong Region) and Epsom station (Bendigo Region). The investigations involved interviews at regional stations across Victoria, demand forecasts for the proposed new stations and cost benefit analysis. This paper discusses the key findings from the interviews at the stations, the adopted modelling approach, and the key model outputs used to support business case.

2. Background

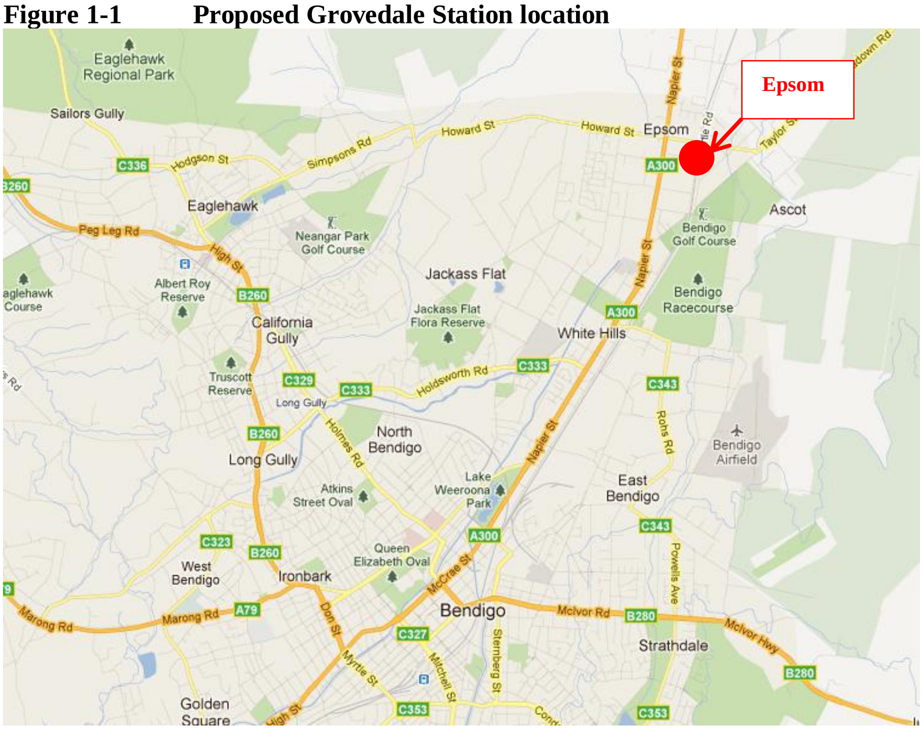
Grovedale station is a proposed new V/Line station on the Geelong to Melbourne railway line. The station will be located in the suburb of Grovedale, approximately 4km west of Marshall Station (refer to Figure 1.1). When constructed, Grovedale will become the new terminus for the Geelong to Melbourne service, which previously terminated at Marshall station, and it will serve the large Armstrong Creek development to the south of the railway line.

Epsom Station is a proposed station on the Echuca railway line, approximately 7.5km north-east of Bendigo (refer to Figure 1.2). It is proposed that in the future, Bendigo to Melbourne services terminate/commence at either Eaglehawk, Epsom or Bendigo.



(Source: Google maps)

Figure 1-1 Proposed Grovedale Station location



(Source: Google maps)

Figure 2-2 Proposed Epsom Station location

3. Travel behaviour survey

A travel behaviour survey was carried out for the DOT by Metlink at: Geelong, North Geelong, South Geelong, Marshall stations on the Geelong railway line; Wendouree and Ballarat on the Ballarat railway line and Bendigo and Kangaroo Flat stations on the Bendigo railway line. The surveys were carried out from 6am to12pm on a single weekday during the first week of August 2011. Rail users were asked to complete a brief interview which recorded information about their trip origin, purpose, mode of access to the station, destination and the regularity of their travel behaviour.

The regional travel survey results for Geelong line and Bendigo line stations formed a key input into the development of the base year model. It revealed a number of key differences in the travel characteristics of passengers boarding on the Geelong line compared to those on the Bendigo line. This indicated that patronage modelling for the proposed stations at Grovedale and Epsom would need to be considered separately.

As part of the travel survey, respondents were asked to nominate the nearest road intersection from which they travelled to the train station, allowing an assessment of the catchment area for passengers travelling to a station. As the two proposed stations will become the new termini of the Geelong and Bendigo station, it was important to establish the likely catchment for patrons using the new stations. At Bendigo station, over 65% of rail users were found to travel to the station from within 4 kilometres while over 86% came from within 10 kilometres, however, some travelled from 100 kilometres and further. In contrast, the majority of rail users at Marshall came from within 5 kilometres and all respondents were captured within 30 kilometres of the station.

Respondents were also asked to identify the destination station for the rail trip they were about to undertake. As shown in Figures 3-1 and 3-2, the results indicated that, during the survey period, rail users were predominantly travelling through to Melbourne with North Melbourne and Southern Cross station accounting for approximately 80% and 90% of rail users boarding at Bendigo line stations and Geelong line stations respectively.

For Geelong line stations, short trips within the Geelong area made up only 3% of respondents' destinations while on the Bendigo line about 6% of respondents were travelling to Castlemaine (approximately 40km south of Bendigo) with a further 5% travelling to Kyneton (approximately 70km south of Bendigo).

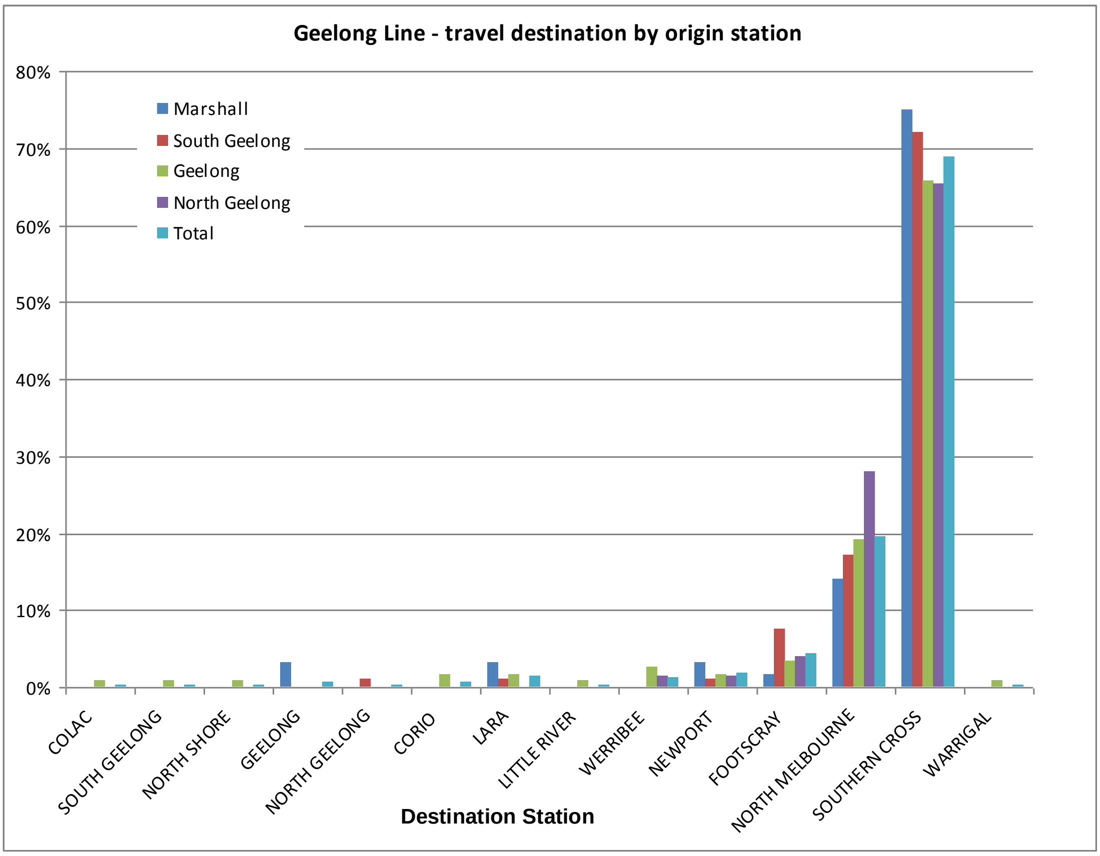


Figure 3-1 Geelong line: Travel destination by Origin Station

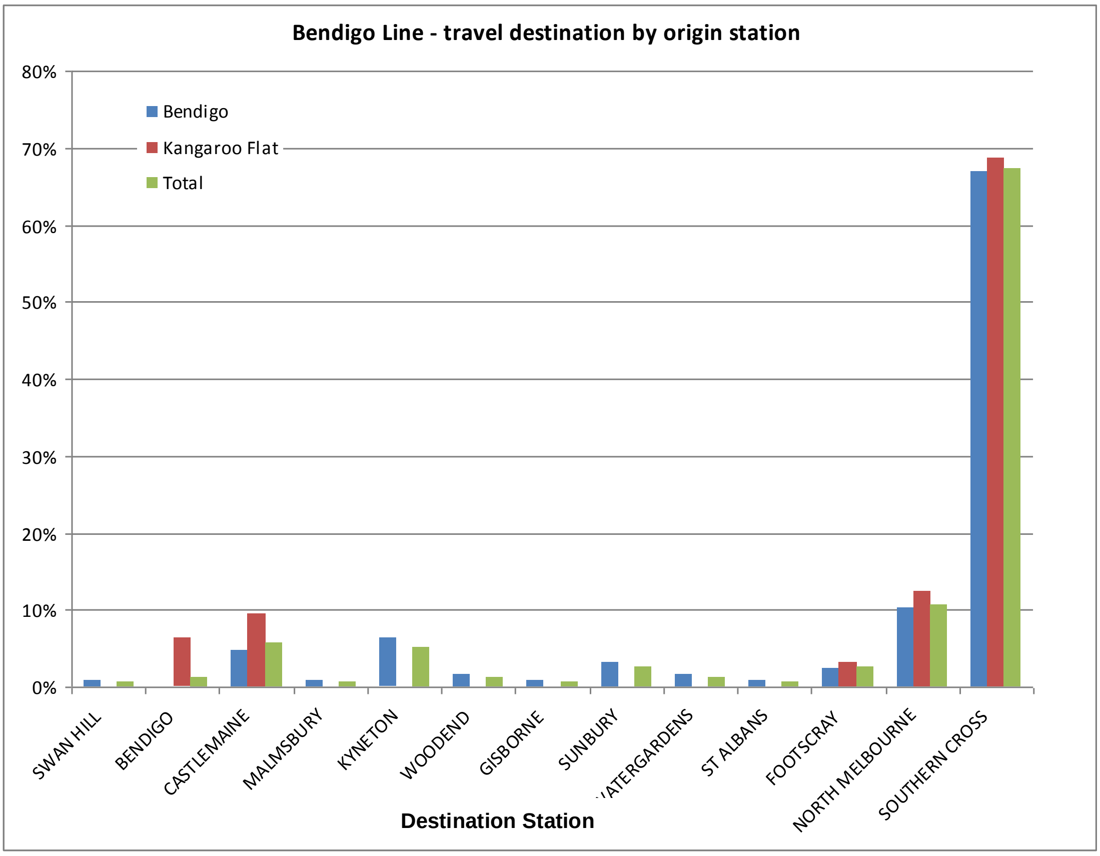


Figure 3-2 Bendigo line: Travel destination by Origin Station

As shown in the following two figures, the majority of Geelong line trips originating in the survey period were regular trips with most respondents stating they made the same trip either 'most days' or '2-4 times per week'. Trips made on the Bendigo line, however, were shown to be more infrequent or casual trips with the majority of respondents stating they made the trip 'Once a month' or '3-6 times a year'. This indicates that the Geelong railway service largely accommodates a commuter market for the Melbourne CBD and that the Bendigo area may be perceived to be beyond generally accepted commuter distance / travel time levels. Although the main destination for Bendigo line travel is the Melbourne CBD it is largely infrequent and not indicative of a commuter market.

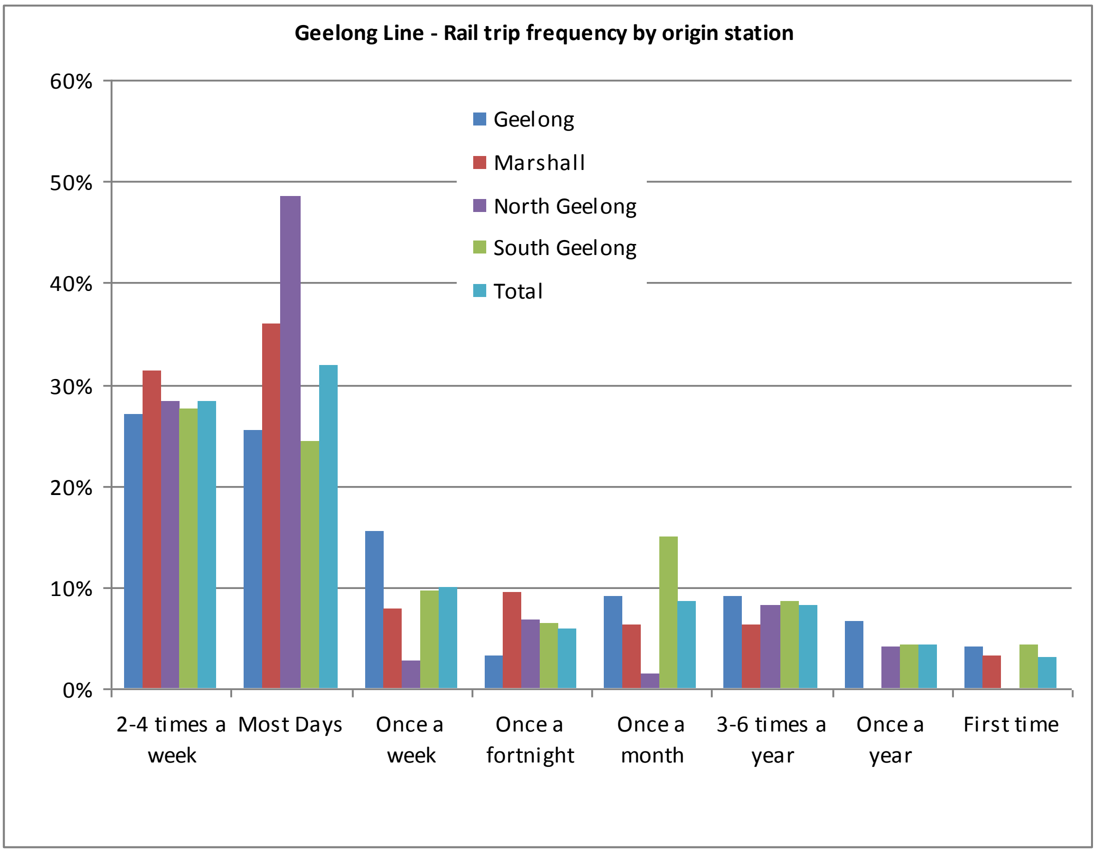


Figure 3-3 Geelong line: Travel frequency by Origin Station

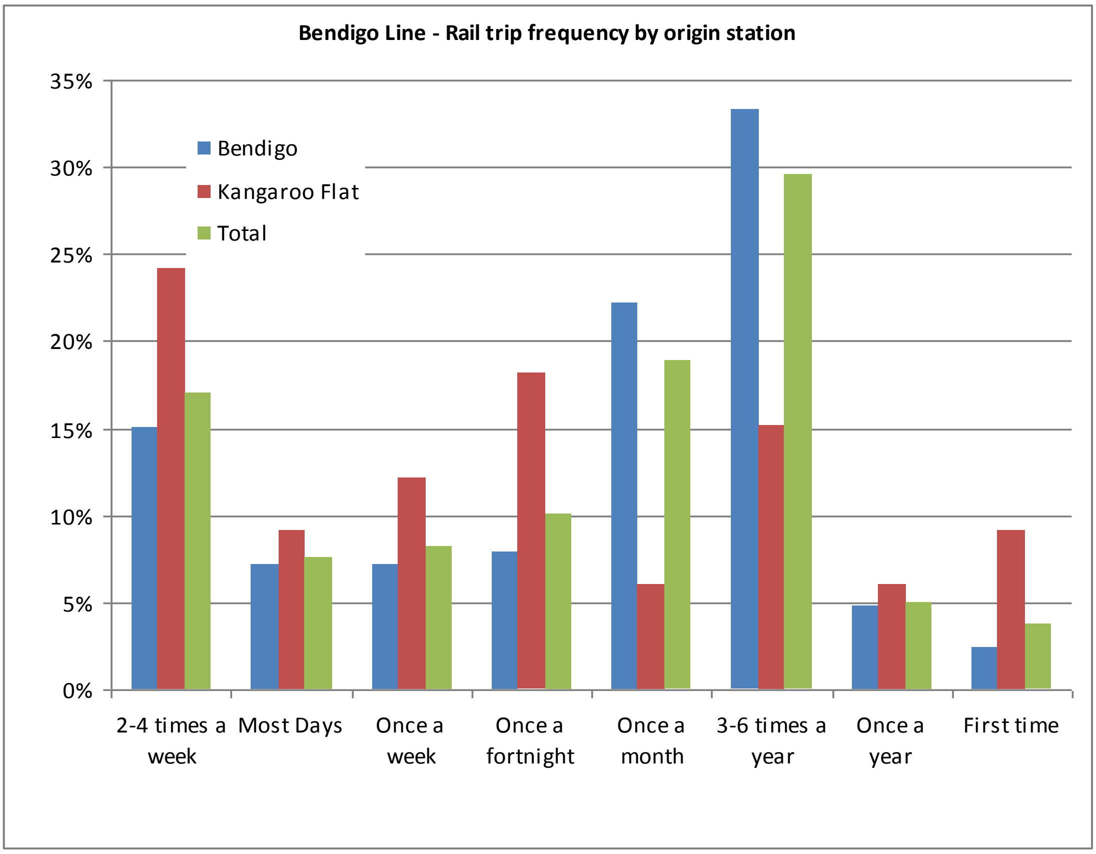


Figure 3-4 Bendigo line: Travel frequency by Origin Station

As shown in Figures 3-5 and 3-6 below, ‘Work/business’ was listed as the primary purpose for respondents’ rail trip on both the Geelong and Bendigo lines. This response, however, was far more dominant for the Geelong line than the Bendigo line, supporting the finding that the Geelong rail service is more likely to cater for a regular commuter market. ‘Education’ was the second most common trip purpose for Geelong line rail users with Bendigo line users travelling for a mix of other purposes including ‘Education’, ‘Leisure activity’ and ‘Personal business – appointment’.

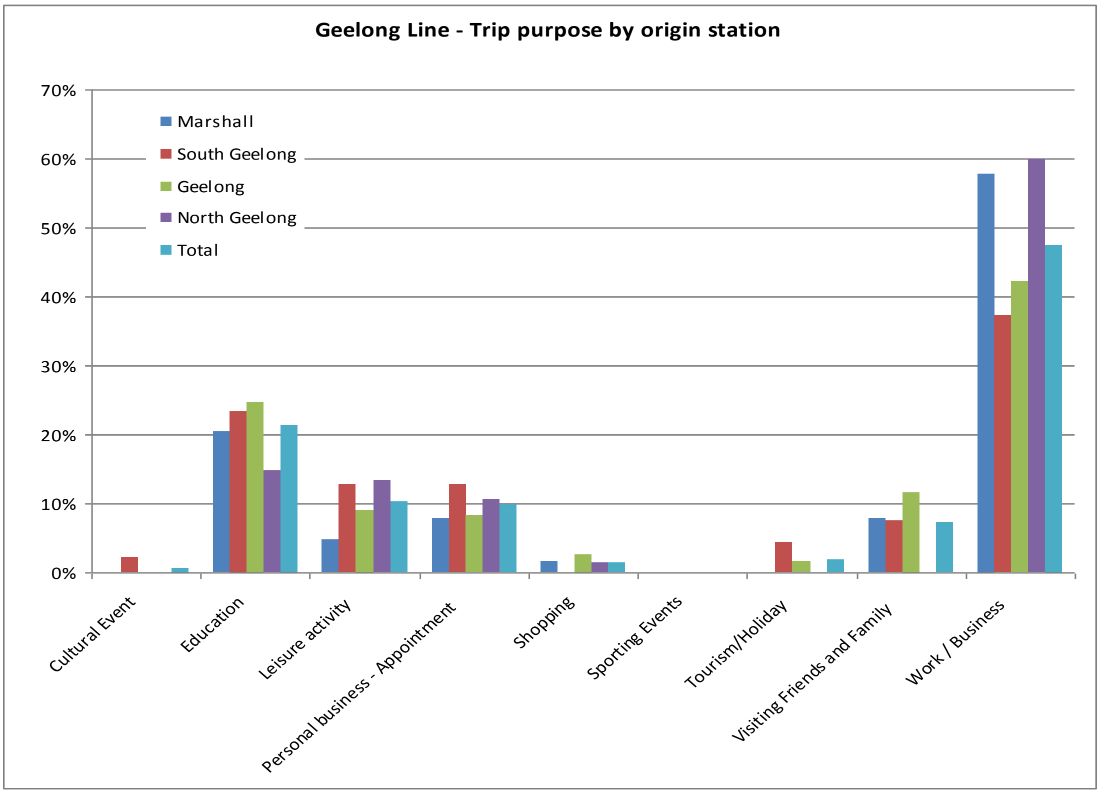


Figure 3-5 Geelong line: Trip Purpose by Origin Station

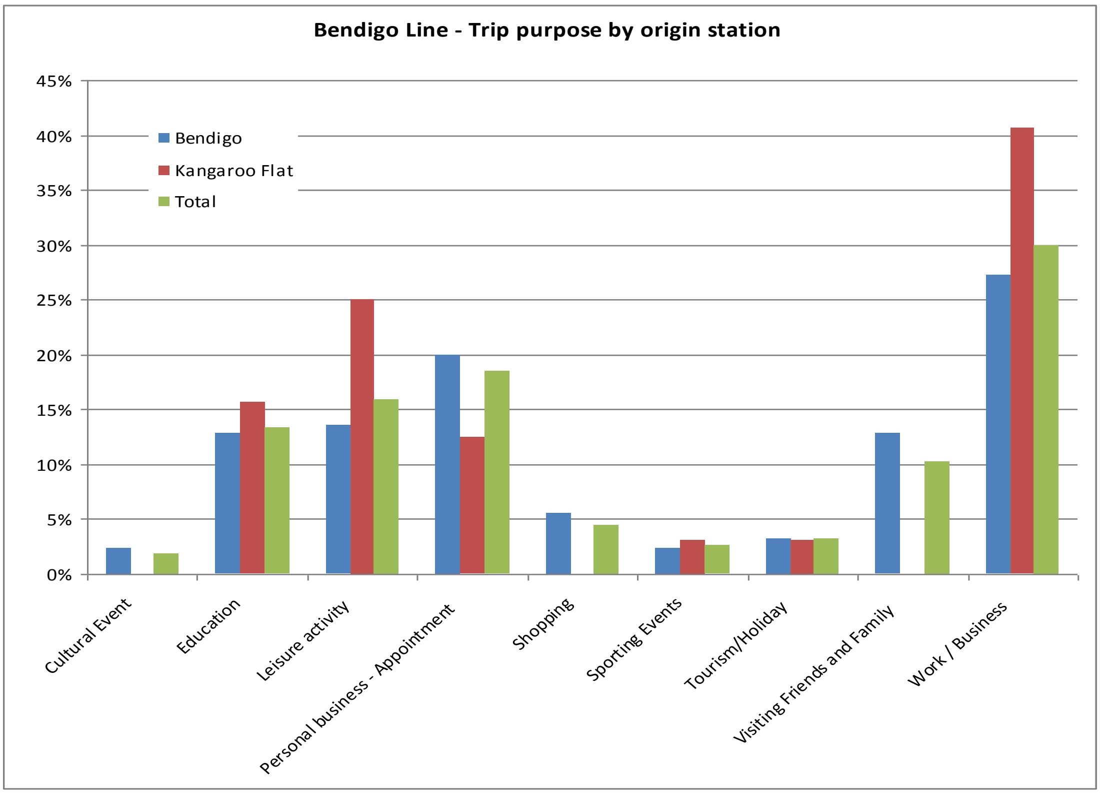


Figure 3-6 Bendigo line: Trip Purpose by Origin Station

4. Modelling approach

4.1 Methodology overview

Typically the Victoria Integrated Transport Model (VITM) maintained by DOT would be used as the basis for future travel demand forecasting for major transport projects in Victoria. However, the current version of the VITM only covers Metropolitan Melbourne and does not include the Geelong and Bendigo regions. Therefore spreadsheet based models were developed specifically for these regional stations.

The spreadsheet based modelling methodology was designed to estimate demand at each of the study rail stations along with any changes in demand at the 'competing' surrounding stations, and to provide an estimate of the likely mode share of access modes to the station. It contains three key steps as shown in Figure 4-1:

1. Rail trip generation – estimation of the number of rail boardings within the combined catchment area of the study station and surrounding stations where rail boardings may be impacted. A rail trip rate per head of population was developed for a set of distance bands from the station based on the results of the travel survey and boarding data.

2. Station choice – having estimated the total number of rail boardings, the proportional split of boardings at each competing station is estimated based on attributes such as travel time to the station, difference in rail travel time, fare difference and service frequency. A logit choice model is used for this purpose, providing a probability of using each of the competing stations at the zonal level. The output of this step is the total boardings at each competing station.

3. Access mode choice - the mode split between the access modes of Walking, Car and Bus is estimated based on distance from the station, travel time by each mode, vehicle operating cost and the quality of bus service provision. A separate logit choice model is used for this purpose, providing the probability of using each available mode to reach the station at the zonal level. The output of this step is the percentage split of station user demand by access mode. The spreadsheet model adopts the VITM zone system so as to be consistent with population forecasts for the project.

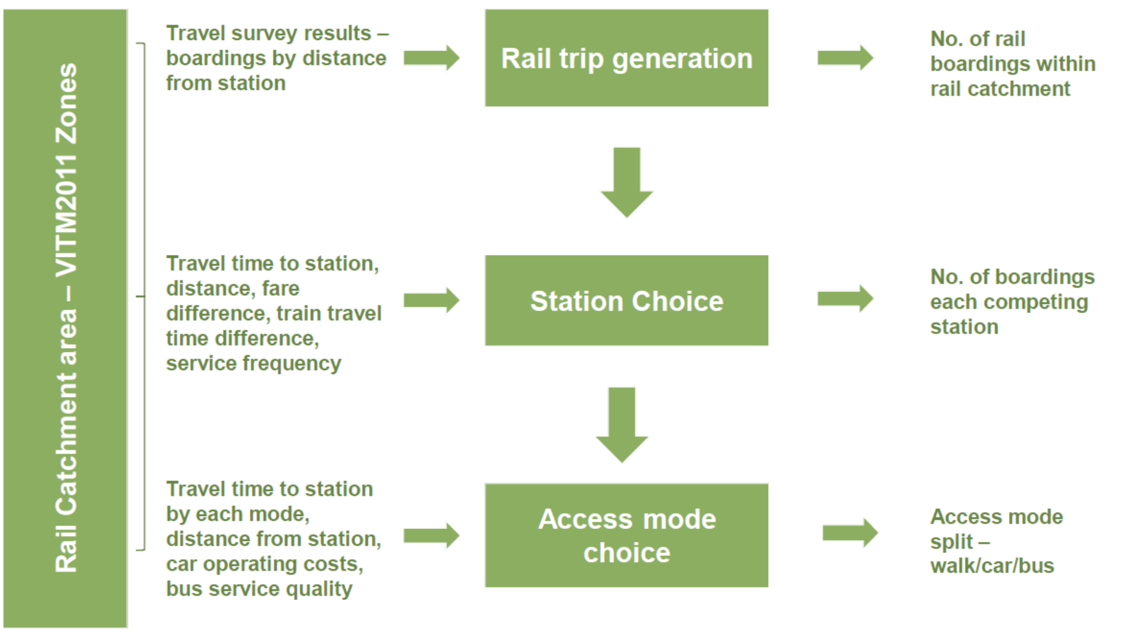


Figure 4-1 Modelling Framework

4.2 Rail trip generation

As part of the regional travel survey, respondents were asked to nominate the nearest intersection from which their trip to the station commenced. This information allowed an assessment of the catchment area for the stations used in model estimation. The survey responses were expanded to the average daily boardings total at each station. A distance-based rail boarding rate per head of population was estimated, based on the distance between each catchment zone and station, along with the 2011 population for each zone.

4.3 Station choice

A logit choice model was used to estimate the proportional split of rail users within a particular zone using each station, within the catchment area. The logit model is based on travel time to the station, regularity of service (i.e. wait time at the station), fare difference, and difference in rail travel time.

The logit model was calibrated to the existing boarding split proportions noted at Marshall and South Geelong for the Grovedale model and Bendigo and Kangaroo Flat for the Epsom model. Estimating the probability of using competing stations at the zonal level allows any reductions in patronage of existing stations when the study stations are implemented to be calculated. The input parameters for the station choice models are shown in Appendix B.

$$P_{Station\ i} = \frac{e^{\gamma \times U_{Station\ i}}}{e^{\gamma \times U_{Station\ i}} + e^{\gamma \times U_{Station\ j}} + \cdots}$$

Where;

$P_{Station\ i}$	*Probability of using station i*
$U_{Station\ i}$	*Utility associated with using station i considering travel time to the station, service frequency, fare, rail travel time difference, fare difference and preference factor*
γ	*Scale factor controlling how sensitive station choice is to utility changes.*

4.4 Access mode choice

A second logit choice model is used to estimate the access mode choice at individual stations and provides, at the zone level, the probability of a station user accessing the station by car, on foot and by bus. Again, this choice model is based on variables such as travel time by each mode, vehicle operating costs and bus service quality. It is calibrated to the existing access mode shares noted at Marshall and South Geelong for the Grovedale model and Bendigo and Kangaroo Flat for the Epsom model. The input parameters for the access mode choice models are shown in Appendix B.

$$P_{mode\ i} = \frac{e^{\gamma \times U_{mode\ i}}}{e^{\gamma \times U_{mode\ i}} + e^{\gamma \times U_{mode\ j}} + \cdots}$$

Where;

$P_{mode\ i}$	*Probability of using mode i for station access*

$U_{mode\ i}$	*Utility associated with using mode i considering travel time to the station by various modes, bus service quality, vehicle operating costs.*
γ	*Scale factor controlling how sensitive access mode choice is to utility changes.*

It was assumed in the access mode choice model that walk trips would only occur where a rail user originates within a 2km radius of the station as walk trips outside of this area would be negligible.

4.5 Key factors in forecasting

4.5.1 Land use forecasts

Population forecasting was undertaken by another consultant at the VITM transport zone level and is a key input to the station demand forecast. It assumes a population linear growth rate of 2.2% per year for Grovedale station catchment from 2011 to 2026 (a higher rate of 5.5% per year within 5km of Grovedale station), and 1.4% per year for Epsom station catchment from 2011 to 2026

4.5.2 Service level

The base boarding rates were estimated from the data collected for the existing stations. The service level at the new stations may differ from the current service level at the existing stations. Consequently, the boarding rates are adjusted based on the difference between proposed service level at the new station and current service level at the existing stations. If the service level at the new station is higher than the service level of the related existing stations, the boarding rates will increase. If the service level at the new station is lower than the service level of the related existing stations, the boarding rates will reduce.

As mentioned in the previous section, the service level is also an input to the station choice model as a component in the generalised cost function - in the form of waiting time. As such, it also impacts on the level of trips diverted from other stations to the new station.

4.5.3 Service elasticity of demand

The service elasticity of demand measures how sensitive patronage demand is to changes in the number of services provided at each station. It is used to adjust the applicable boarding rates based on the service level discussed in the previous section.

In consultation with DOT, the short-term service elasticity value of 0.35 recommended by Australian Transport Council (ATC) was adopted as the base assumption. It assumes that doubling services would increase the demand by 35%. In addition, the long-run service elasticity value of 0.7 recommended by both the ATC and Transport Research Laboratory in UK is also adopted as part of sensitivity tests.

4.5.4 Travel time differences between competing stations

The development of a new station reduces station access distance for some zones in the catchment, resulting in higher boarding rates for these zones. This increase represents new rail trips generated by the new station. This is also consistent with the findings of the surveys at recent new stations: the main reason for using the new stations was that their homes were near these new stations.

The distance from each zone to competing stations forms part of generalised cost used by the station choice model, which considers travel distance/time to the station, service level, fare difference, and difference in rail travel time – this influences the level of trip diversion from other stations to the new station.

4.5.5 Summary

The table below summarises the key factors and how they are incorporated into the demand forecasting process.

Table 4-1 Key model factors

Key factors	Model considerations
Land use forecasts	Population forecast at transport zone level is a key input.
Service level	The service level at the new station is used to adjust the boarding rates derived from the existing stations. If the service level at the new station is higher than the service level of the related existing stations, the boarding rates will be increased. If the service level at the new station is lower than the service level of the related existing stations, the boarding rates will be reduced. The service level is also an input to station choice model as part of generalised cost in the form of waiting time.
Service elasticity of demand	The service elasticity parameter is used to factor the applicable boarding rates based on the service level.
Travel time differences to competing stations	The new station reduces distances to station for some zones - resulting in higher boarding rates for these zones. This increase represents the new rail trips generated by the new station.

5. Model outputs for business case

A range of indicators derived from the model forecasting results were used to support the business case development, such as:

- Patronage forecasts for the new stations and the existing stations next to them
- New rail trips generated by the new stations vs. rail trips diverted from existing stations
- Reduction in vehicle kilometres due to new rail users switching from cars
- Reduction in station access time due to the new stations

The above provided the required inputs for the cost benefit analyses of the proposed options.

The analyses showed that the majority of benefits are from the reduction in vehicle kilometres due to new rail users switching from cars despite the fact that some new regional stations may attract a small number of new rail trips. This is because these regional rail trips tend to be long distance trips as demonstrated by the recent travel behaviour surveys at regional stations. For example, the average trip distance for those boarding at Marshall and South Geelong is about 75 km and for Bendigo and

Kangaroo Flat it is about 150 km.

For this case study, the proposed new stations are at the end of the rail lines and therefore do not add stopping delays to the existing rail users. However, if the new stations were to add stopping delays to the existing users, these delays would need to be recognised as disbenefits in the cost benefit analysis.

Following the completion of the business case study for Grovedale station, the Victorian Government has allocated $8.4 million to progress planning and establishment for this new regional facility.

6. Conclusions

The paper presents a simplified spreadsheet-based demand forecasting approach for regional areas that are often outside the boundary of existing strategic planning models for capital cities. The key observations include:

- Differences in regional rail travel patterns between regions can be very significant.
- The demand forecasts for the new stations need to consider the improved access to regional rail services, the demand catchment, the competing stations (station choice) and the access modes to the stations (access choice).
- There are a number of factors driving the future demand growth such as service levels at the stations, population growth of the catchment, fare changes, fuel price and economic environment.
- The economic benefits of the new regional stations do not necessarily rely on a significant amount of patronage when compared to the metropolitan stations, because the regional rail trips are much longer and individual trip benefits are much higher.

The travel survey carried out for this project provided a valuable source of travel behaviour information and formed a solid basis for the modelling carried out. Where time and budget permits, future modelling would benefit from the capture of surveys over a full day rather than just the morning period. This would be particularly beneficial at major regional stations which may attract both inbound and outbound trips.

The spreadsheet based modelling approach adopted for this project provided a practical tool for business case development and provided all of the required outputs for economic evaluations. The models that were developed are easily interpretable and can be modified for similar projects in the future.