Paper Template

Paper Title:	**Transport advocacy through smart data analysis and visualisation**
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What's the strategic, technical or professional context for your paper? *Context should outline your intent to develop knowledge in the profession and demonstrate the value of looking beyond your personal interest or that of your employer.	**Context** The context of this paper is to share knowledge and demonstrate the value, applicability and flexibility of opensource technologies in solving complex transportation issues through visualising the data in ways that end-users can utilise for decision making.
What will attract people to read your paper and attend your presentation? What kinds of people or roles would benefit most? *This is your main selling point – for the people attending the conference	**Relevance** This paper is relevant to all with an interest in transportation, data analysis, data visualisation and geospatial technology.
What is the particular question, issue or idea you intend to address in this session? * Consider this an executive summary but be specific and relevant to your audience.	**Focus** The problem that we set out to solve was how to visualise, and then understand, public transport accessibility and frequency over a peak period over a geographic area to identify service shortfalls

Transport advocacy through smart data analysis and visualisation

Theme: Future Transport and Cities

Presenter: Neal Johnston

Authors: Neal Johnston and Santosh Seshadri

Acknowledgements: Solution was developed in consultancy with City of Casey, Melbourne

Background

Providing efficient and convenient public transport is a key issue facing cities world-wide today. Public transport enables communities to thrive economically and socially, and to become more environmentally sustainable. Improving public transport is acknowledged as one of the most significant strategies to address car dependence and urban congestion.

Local and central governments work constantly to provide public transport services that meet travellers' demands. They must cater for travellers with different needs, provide attractive services with adequate frequencies and maintain high patronage rates to be economically viable. Urban centres with growing populations face the challenge of connecting new and existing areas of growth with public transport services. Public transport must also connect residents with access to key essential services such as hospitals, schools, community centres and areas of employment.

Melbourne metropolitan area has experienced significant population growth in recent years, which has placed enormous pressure on the city's transport infrastructure. One major growth area absorbing residential expansion is the City of Casey, which is located 40km south-east of Melbourne's Central Business District. Its population has doubled in the past 10-years and is expected to exceed 500,000 people by 2041. This has put pressure on its transport infrastructure, meaning that services can't keep pace with population growth and the City of Casey is heavily reliant on the car.

Consequently, the City of Casey Council decided to advocate for adequate planning and investment into public transport so it could offer a level of service that would make public transport a legitimate alternative to the car. The advocacy campaign's aim was to achieve

the local and state government goal to ensure that residents can access essential services within 20 minutes by sustainable transport modes.

To achieve the 20-minute neighbourhood goal, cognise the advocacy requirements and understand the current service provided, it was necessary to first visualise the current state of public transport accessibility and frequency. Traditional accessibility modelling in GIS results in catchment maps that show the geographic coverage of public transport; however, coverage alone does not illustrate whether there is good public transport service as frequency is a significant component. A public transport service may have a large geographic coverage, however, a low frequency and especially a frequency that does not match demand, has a major impact on patronage.

Tools

This paper illustrates the process by which we can use publicly available datasets such as GTFS feeds of public transport, census data and Vic Roads centreline datasets, in conjunction with open-source tools such as Postgres, Geoserver, and DeckGL to achieve this understanding.

First, all the publicly available datasets were sourced from:

1. GTFS feeds: https://transitfeeds.com/p/ptv/497
2. 2016 census data: https://www.abs.gov.au/
3. Road network: https://www.data.vic.gov.au/data/dataset/road-network-vicmap-transport
4. Key services: City of Casey

Process

GTFS feeds come in the form of eight text files. These were imported into a PostGRES table. Details of the schema setup can be found at: https://github.com/tyleragreen/gtfs-schema. This provides us with the geometries and attributes of all the routes for all buses and their respective stops and stop times. Subsequently, 2016 census data at the ward level, road network for the Melbourne area and key services (provided by City of Casey) were downloaded as shapefiles and imported into the PostGRES database.

The road network was converted into a routable network within PostGres/PostGIS. Using this routable network, a 400m walking buffer along the roads was created for each of the key services. This provided a catchment of walking distance to the key services. These

catchments were overlaid with all bus and train stops, thus producing a set of stops for each key service that was accessible by walking distance.

The analysis then selected all the bus/train routes from GTFS that intersected the stops found to be accessible by walking distance. Because of the intersect, the output illustrated all the bus and train routes that passed through those stops at different times. These routes were then able to be separated for each key service.

As an output of the analysis all the unique routes to a key service identified. These routes were then intersected with the stops to understand which of the public transport stops serviced a key service (and associated walking buffer) at different times. As the study looked at understanding the current levels of public transport accessibility, the selection of an appropriate time period in which people would use public transport was essential. Therefore, in consultation with City of Casey council, the morning peak time period of 7–9 am was selected. This also restricted the time period available to calculate frequency.

Following the analysis above, it is understood which routes intersected which stops, and from GTFS feeds' stop times dataset, what time each route serviced a stop. Using this information, the next step calculated how many times a route (that services a key service) passed a stop in a given time period. Therefore, stops that had multiple routes passing through them, which serviced a key service, would have a higher frequency, attracting the public to use public transport at that stop.

This process categorised all the bus stops as high or low frequency and all train stops as a separate category.

Based on the frequency, a service area was generated for each stop:

- High frequency: 800m catchment
- Low frequency: 400m catchment
- Train stops: 3km catchment

The rationale that if a stop had a high frequency of buses, then people were willing to walk a bit further than a stop with low frequency, was behind creating such catchments. Additionally, since trains are a faster public transport service covering a greater distance, people are willing to drive to a train station and take the train to get to their destination.

At this point of the analysis, it is understood which public transport stops are serviced, their frequencies and the catchments they serve. The next step involves calculating the population served by each stop to a key service area. To do this, the population information from census was transferred to the road centreline. Public transport serves bus stops that are on streets rather than houses, therefore the population information was transferred to the street centre lines and then aggregated to the catchment level per stop.

Finally, to infer the distance between each stop and the time at each stop, the routes were intersected with stops. Using the stop times information provided the time and distance on each route.

The above process produced the following datasets:

1. A service area catchment with population for every stop that served a key service – served as a polygon through Geoserver
2. Routes that served each key service – stored in PostGRES
3. A frequency value on each bus stop per key service – served as a point layer through Geoserver
4. A point layer with distance along the route – stored as a JSON file

The above datasets were then applied to a web application to illustrate this data in a user-friendly interface. The app was developed using React Map GL and Deck.GL. The following functionality was implemented (see Figure 1):

1. Key service areas were grouped into various suburbs
2. Bus stops were symbolised based on frequency
3. Time ticker to show elapsed time 7–9 am
4. Within a suburb, clicking a bus stop would highlight the service area covered by that bus stop, which serviced the key services in that suburb
5. Turn on high frequency, low frequency and train catchments to illustrate overall coverage of public transport accessibility to key services in a suburb
6. Visualise the movement of public transport only between 7-9am to show the reach of public transport at any given time
7. Ability to show all buses and trains in all of Melbourne area between 7-9am
8. Ability to show population catchment for each bus stop for a key service
9. Show overall accessibility coverage by high, low frequency and train stops.

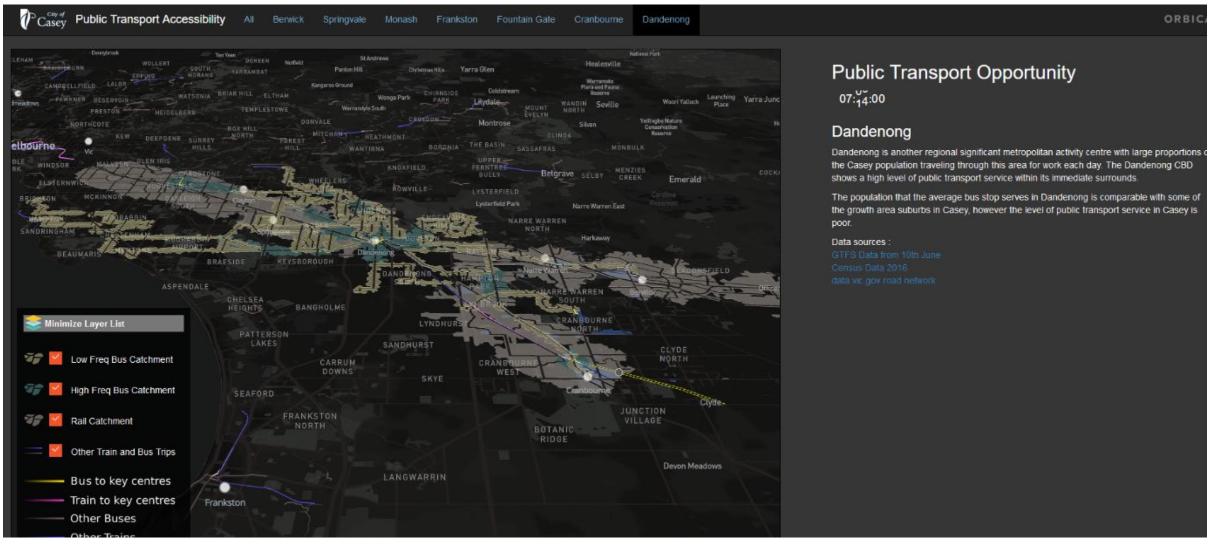

Figure 1 https://ptadvocacy.casey.vic.gov.au/

Delivery/results

The City of Casey was able to use this application as an advocacy tool to illustrate current levels of public transport throughout the city and where additional public transport service was required.

The tool found that some parts of the City of Casey were close to experiencing a "20-minute" neighbourhood. Nevertheless, many parts of the City of Casey - such as the greenfield growth areas has poor public transport services, which meant that new residents could not access essential day-to-day services such as education, medical and community facilities by public transport.

The tool provides a multi-faceted analysis of public transport accessibility with spatial and temporal analysis, coupled with the population aspect. City of Casey was able to demonstrate in its advocacy that there is a significant resident population that requires additional public transport services. The tool contributed to the 2018 City of Casey advocacy to the state government, which was its most successful campaign to date.