Australasian Transport Research Forum 2019 Proceedings
30 September – 2 October, Canberra, Australia
Publication website: http://www.atrf.info

Planning for disruptions across metropolitan Melbourne: experiences and learnings

Julian Laufer[1], Farid Javanshour[2], Zahra Shahhoseini[1], Wen Long Yue[1]
[1]Road and Traffic Design, Engineering and Road Management
[2]Planned Disruptions, Journey Services

Department of Transport, Kew, Vic 3101
Email for correspondence: Farid.Javanshour@roads.vic.gov.au

Abstract

Alleviation of congestion in metropolitan networks remains an issue for cities across Australia and in many other major urban areas. Transport modelling is one of the tools used by many authorities to find better solutions for the problem of congestion in their communities. While long term issues are identified through travel demand models, the short-term implications are rarely explored.

The Planned Disruptions team of Department of Transport (DoT) has deployed a model called DOMINO to gain a better insight into the repercussions of construction projects in the short term. The model assists the team to explore where the network may change due to specific construction projects. DoT can use this model to better plan for the forthcoming disruption through measures such as adjusting signal operations or development of messaging strategies to divert the traffic in the right direction.

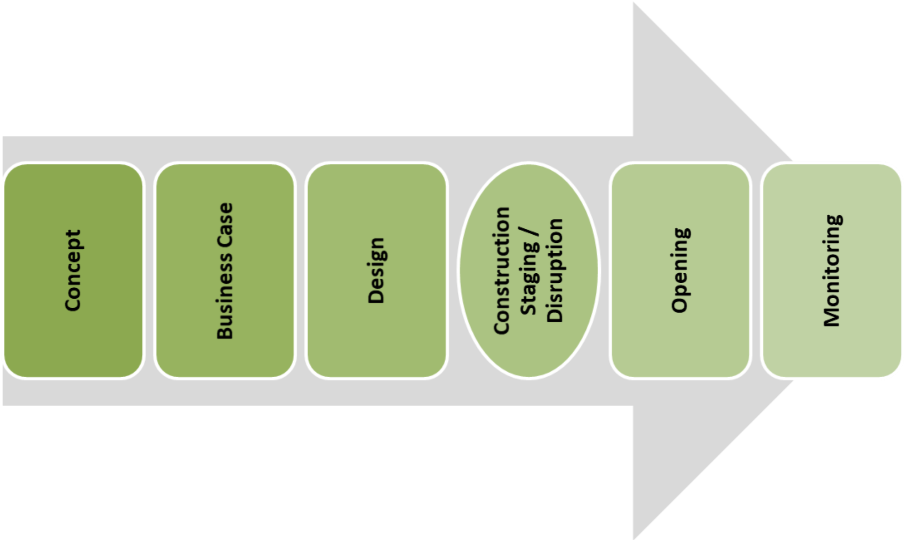
The main aim of this extended abstract is to describe how a model like DOMINO can assist road authorities to mitigate the adverse effects of planned construction projects in the short term. Dissemination of the knowledge obtained by DoT in this area could help other governments develop similar means for event analysis.

1 Introduction

To address the issues of traffic management during construction periods, DoT has developed a "Planned Disruptions" team. The intent of the role is to coordinate a multitude of long-term projects to be delivered as well as managing the disruption of the network that is formed over the shorter term to achieve these objectives. Such deliveries may include new roads, tunnels and upgrades to the rail system leading to notable impact on the network as commuters and service providers continue their journey requirements.

The flow chart in Figure1 describes a delivery process undertaken by most agencies. The process starts with conceptualising a scheme and developing a business case to outline the benefits. Once approved, the project goes through varied design stages while funding is sought to deliver the infrastructure. This provides a focus for delivery teams on their challenge but omits the equivalent challenges undertaken by other projects. Whilst it makes sense to explore alternate routes during construction staging, the formation of detours are rarely analysed outside the project bubble. This is the task for the planned disruptions team to ensure regular journeys can be made with as little interruption as possible while a multitude of projects are being developed.

Figure1: Delivery process



The objective is to ensure the prioritization of project delivery and manage the scale of impact during condensed project construction intervals, known as a construction blitz period. Such intervals are often but not exclusively held during periods of school holidays as the reduction of peak period journeys can mitigate the impacts and scale of extended journey times experienced by residents. It is not uncommon that a construction blitz period may include ten to twenty projects occurring at the same time – and sometimes in adjacent roads.

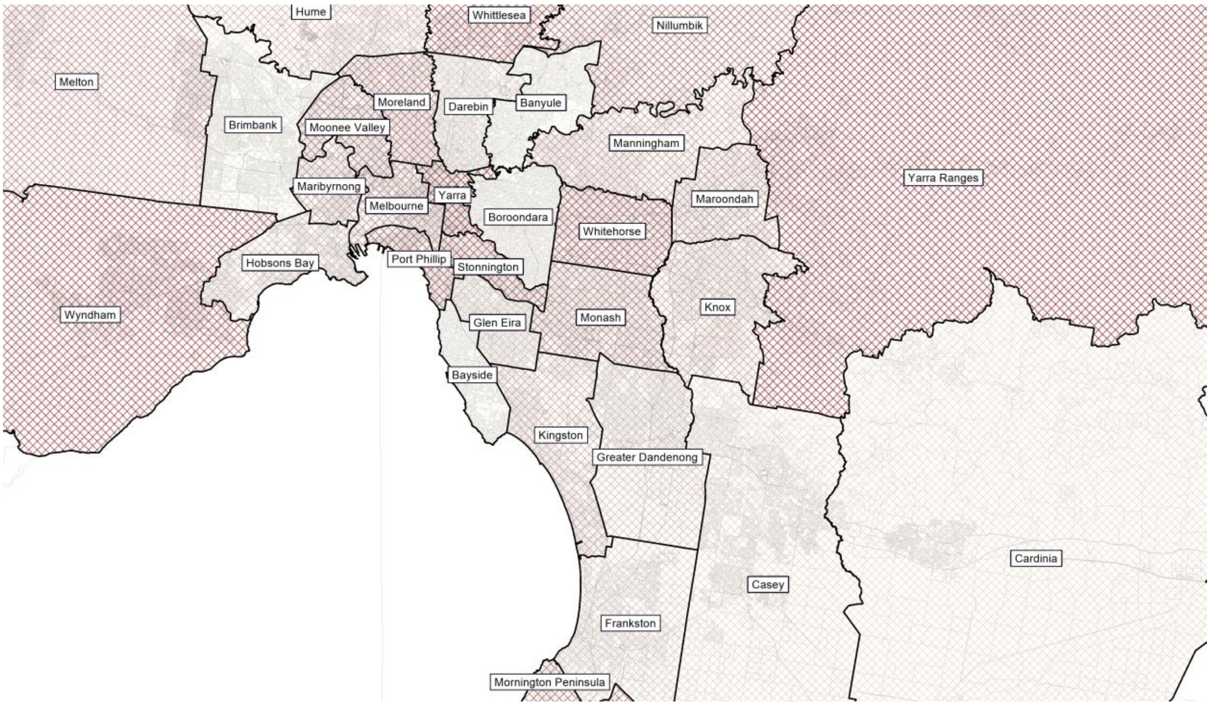
The Planned Disruptions team within DoT aims to minimise the disruption and additional congestion on the road network and coordinate schemes of projects (including road duplication and repaving, water mains replacement, bridge strengthening or rail enhancements).

DOMINO is one of the tools the Planned Disruptions team has deployed to achieve the aforementioned goals. This model assists the team to obtain a clearer insight into the potential consequences of construction projects and anticipate the scales of the network to be impacted. As a result, DoT can compare between competing needs and make the most informed decisions as to how the implications should be alleviated.

2 Methodology and discussions

DoT has developed DOMINO, a detailed transport network model of metropolitan Melbourne, containing 32 council areas (Figure2). The model features the entire road network including the intersections at a high-level of detail. DOMINO, coded in Visum, is a static assignment model and represents the peak hours (7-8am; 8-9am; 5-6pm; 6-7pm). Public transport systems such as trams, trains and bus services have also been modelled in DOMINO. The model has been calibrated and validated using SCATS count data and GPS travel time information.

Figure2: The network representation of DOMINO model featuring 32 council areas



DOMINO is a link-based model as opposed to a lane-based one. That is to say, all performance measures such as capacity, speed or number of vehicles are calculated for each link rather than for each lane.

The strength of the DOMINO model is that the link capacity is determined from the downstream constraints (intersections). That is, the model is established so that the vehicles drive through the link at free flow speed until they reach the intersection or join a queue formed at the intersection.

The modelling defines three distinct tiers of impact groups which are loosely defined as primary, secondary and tertiary tiers. Primary Impacts are those drivers that need to change a route courtesy of the road closure while secondary tier impacts are those journeys impacted with primary tier impact journeys now on their route. Many projects consider this to be the extent of the concern, without considering further ripples in the system as secondary drivers also explore new routes to improve the journey experience. This creates a third (and final) tier of impact of journeys that are hindered by secondary impact drivers changing their own behaviour.

DOMINO calculates delay using two different approaches: 1. Volume delay functions, 2. Highway Capacity Manual (HCM) approach. Volume delay functions assume delay on a link increases as volume grows, whereas HCM considers the carrying capacity at intersections. The signal timing, number of lanes, the proportion of traffic turning left or right and the percentage of heavy vehicles on the road are some of the parameters addressed by HCM which complement the delay function.

Some of the outputs that can be obtained through model runs are as follows:

a) Different performance measures such as Volume, Speed and Volume Capacity ratios can easily be mapped displaying their variations across the network.
b) Difference plots can be derived showing how a performance measure changes from the base case condition.
c) New bottlenecks as a result of new construction projects can easily be spotted in the network.

The model outputs can also assist DoT in determining the best locations for installing Variable Message Signs (VMS). VMS signs are intended to guide motorists through the shortest path towards their destinations in the event of any disruptions. Information relating to shortest paths for travellers is one of the valuable outputs provided by DOMINO utilised in designating the most suitable points for the installation of VMS boards.

It is important to note that DoT does not use this network as a strategic transport model and does not provide a focus on demand estimation but provides a greater focus on ensuring that the operations of the model have representation of the observed conditions.

3 Application and results

The Murrumbeena drain replacement project provides an excellent example of the challenges for the planned disruptions team and application of the Domino model. While the replacement of a water main appears to be an easy task in itself, the potential risk to the disruption was quite significant. The water mains are located on a key arterial adjacent to a major suburban shopping centre and also a well utilised motorway with limited (or no) spare capacity. Demand for both retail centre and motorway are busy through the entire week (including weekends).

The project was originally scheduled for action in a summer holiday period – but this was correctly identified by the disruption team to run parallel to a rail closure and the drain sit on location for the route of the rail replacement buses. The replacement scheme needed to be rescheduled to a more appropriate time away from such conflicting matters.

Finally, the project was implemented in the DOMINO model to advise how drivers would avoid this area if they had a perfect knowledge of traffic conditions in the network. This provided a means for delivery of a messaging strategy which appropriately moved journeys away from the project area, reducing the overall impact on the network. Additional mitigation measures of signal refinements (trims) and journey time boards alleviated the congestion in the network. The actions made use of nearby less utilised roads to deliver through journeys and reduced the extraneous journeys near to the road closure. The end result was deemed successful and in line with the modelled journey times that determined a median additional travel time of 10-15 minutes and the 80th percentile of an additional 30 minutes. The closure itself produced a maximum observed journey time of 32-39 minutes.

A presentation on this topic will provide similar case studies from recent projects explored. It will share how DOMINO model helped DoT’s Planned Disruptions team find the best answers to their questions on the implications of construction projects. It is hoped the discussions to be delivered in the presentation will be of benefit to other professionals in the field.