Journal of Traffic and Transportation Engineering 11 (2023) 138-144
doi: 10.17265/2328-2142/2023.03.005

Vehicle Assessment Management, Monitoring and Planning System for Regional Road Authorities

David Freer
SMEC, Melbourne, Australia

Abstract: Resource energy projects present a number of challenges to road authorities who need to formulate a response that allows for the appropriate infrastructure upgrades to be planned, constructed and paid for. Too often the road authority is overwhelmed by individual traffic reports from the proponents without having any reference to a system or process such as a network traffic model on which to test options and cumulative impacts. Yet to set up a functional traffic model will take time, is costly and will need some in-house capability to maintain. At the other end of the scale spread sheet style options are cumbersome to use and often out of date. This paper describes a system that allows the authority to effectively manage the transport task. The latest proposed vehicle movements can be displayed on an active GIS screen and referenced against agreed operational parameters. Various report outputs are also available upon demand. Such a system would assist state and local government authorities to manage the new development generated traffic in Qld.

Key words: Vehicle assessment, transport, traffic network, GIS.

1. Introduction

Regional road authorities are faced with a dilemma. Existing financial and technical resources are already stretched and the recent extreme weather events, which have seen whole sections of the highway washed away, have only exasperated the issue. Added to this are growing demands from the resource energy companies for the upgrade of local roads so that they can carry their traffic [1].

Although these new developments provide the opportunity for much need investment into the local community including improvements to the road network, the road authority may need to consolidate information they have received, such as traffic reports, presentations and other such documents in order to manage the road network. Therefore, to make an informed decision the authorities need answers to some fundamental questions:

- What is the certainty that predicated traffic volumes will occur over the project lifecycle and how can they check on what is currently actually happening?
- What about all the other developments taking place and their traffic? What is the cumulative impact on the network?
- How can the authority respond when a local resident/farmer or business complains about the traffic thundering past their property, damaging the road and raising safety concerns for sensitive road users such as school buses? – How can the authority identify who is responsible?

Inevitably it is the already overstretched road authority that has to attempt to answer these questions, but without the necessary data, it is a challenge to make an informed decision.

So what is the solution? The authority could simply hire more staff (if they could) - but they will still be dependent on manually collating the data and making assessments that could quickly become out of date. The data therefore needs to be managed in a way that allows the authority to quickly assess existing and predicted traffic movements. The answer would traditionally be the development of an in-house traffic model. The

Corresponding author: David Freer, research fields: land use and mobility.

authority probably always wanted one. However, in reality these models are costly to set up and then have to be maintained over a long time period by trained staff. Alternatively the authority could opt for a simple excel spreadsheet traffic model, which provides a cheaper and less technically based alternative to set up and run but they are generally cumbersome to use and often out of date.

An alternative option is available. One which utilises the data regularly produced by the resource energy companies on their vehicle movements, and allows the authority to accurately view predicated and actual traffic movements. It puts the authority back in control of their roads.

The system we have developed is called the Vehicle Assessment Management, Planning and Monitoring System (VAMMPS).

2. What Is VAMMPS and How Does It Benefit the Road Authority?

VAMMPS is not yet another 'solves all' traffic model. In fact, it's not a model you can buy. It is a process derived from a software tool kit from which you build a system to suit your needs. It specifically looks at the traffic from defined major users along listed roads and is regularly updated by actual traffic movement data. Best of all it can be built at a fraction of the cost and time when compared to a traditional traffic model. It can also be run off any computer, is simple to use (so you don't need a maths degree to operate it), and would be fully owned and operated by the authority. Fig. 1 identifies the components and processes for establishing this system.

Perhaps contrary to perceptions, the resource energy companies do carefully plan their vehicle movements. Safety of movement and meeting project timeframes are of fundamental importance to these companies, as delays can be costly. They are however constrained by constant changes in market conditions and the internal business operations which impacts on actual transport movements. This makes robust predictions of traffic movements almost impossible to be accurately recorded in the medium of a fixed-in-time document such as a Traffic Impact Assessment Report.

However, the data on these planned and actual traffic movements is available. Groups exist within each company that are charged with undertaking the transport deliveries that record the daily, weekly, monthly planned and actual traffic movements. In addition, all vehicles have In Vehicle Monitoring Systems (IVMS) that track vehicle movements along the road network and can be reported upon very quickly.

A possible additional source of actual traffic data on local roads is from project specific traffic count locations. The mining companies are mindful of the fact that a new sealed road is likely to attract additional traffic onto it bringing forward the maintenance program for which they have committed to help fund. As such they are keen to prove what vehicles are theirs that are actually using the road by placing permanent traffic counts (tubes) at key locations along upgraded roads and entry points to major facilities and camps.

Therefore, there is a wealth of data that can be used to identify actual and predicted traffic volumes. What is required is a reliable process to collate and report on this. This is where VAMMPS comes in.

2.1 How Does It Work

The system is developed using the Any Logic simulation tool, which utilises Java code, meaning that the system will operate on almost any computer which has Java installed.

The tool kit provides the opportunity to address a range of issues. For instance, logistic supply chain management where delivery schedules and system capacity constraints need to be aligned. Port operations are commonly assessed using this approach. For road transport planning the agent-based tools allow for the discrete movements of individual vehicles to be tracked on the road network so the movement of vehicles groups (say fuel, water or coal moving vehicles) can be assessed.

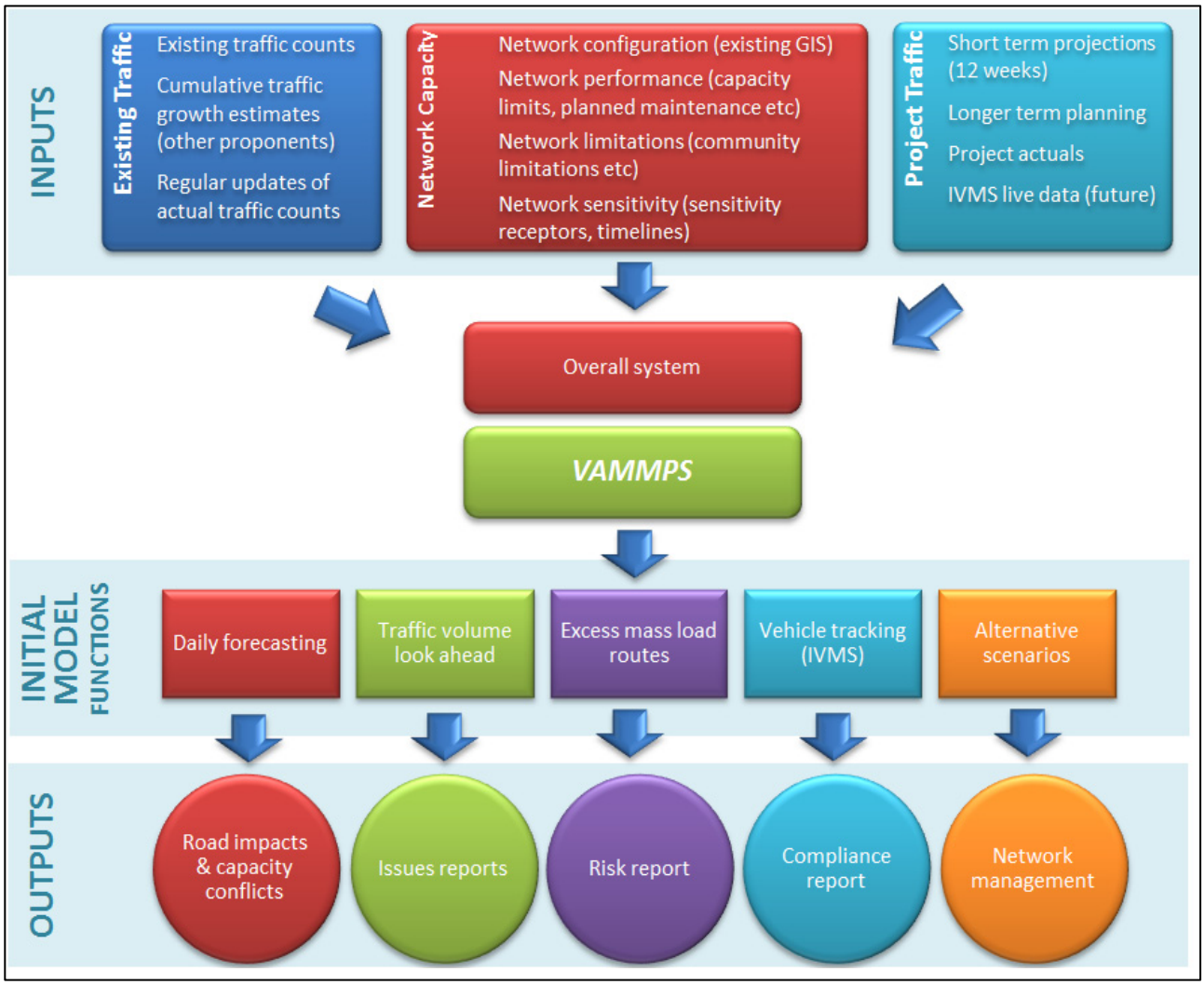

Fig. 1 Model Development Framework.

What the system can do is largely defined by the user and what they wish to see. At the beginning of the process the needs of the client will be identified so that a tailor-made system can be built.

The demonstration system identified in this paper is tailored to addressing vehicle movements associated with the mining industry. It was developed in support of a request by TMR to develop a heavy vehicle monitoring system.

2.2 Inputs

The network is defined by routes which the vehicles will or could travel along. Alternatives routes are defined to take into account scenarios where the planned route becomes unusable or constrained for any reason. The recorded characteristics of these routes can go beyond the traditional measures of capacity, pavement type and speed, to include parameters such as how a particular road is used. For example, school drop-off and pick locations may which to be defined where heavy vehicle movements are constrained at certain times of the day. Alternatively, a route may have bridge load/width limits, overhead power lines that restrict excess mass loads.

Existing background traffic can be defined by traffic count data and factored forward using agreed growth rates.

Project traffic is sourced from the resource company in terms of predicted traffic flows, updated by weekly

schedules and be validated by IVMS and traffic count data. This can also be compiled for all major developments in the area to give a complete picture of the cumulative traffic effect.

2.3 Initial System Functions

Having established the inputs, various assessment parameters can be defined and reported upon prior to, during, and after the planned traffic movements. Therefore, the suitability of routes and any associated infrastructure upgrades to carry all of the proposed traffic can be readily assessed prior to movements taking place. From here actual movements can be recorded on a regular basis putting the authority back in control of their roads.

Examples identified in Fig. 1 include:

- Daily forecasting – this provides a snapshot of traffic demands on a day-to-day basis, or hourly basis. Compliance, maintenance and vehicle behaviour issues can be identified.
- 12 weeks look ahead – this provides the short-term planning requirements and helps to confirm the ability of the transport infrastructure to meet the requirements of the transport task. This is especially true where uncoordinated traffic movements are planned within the organisation itself that may raise route capacity issues.
- Risk identification – planned movements that will potentially fall outside the agreed bounds of behaviour on a particular route can be identified.
- Risk reduction – risk reduction measures, such as changing the timescale for non-priority movements (bring forward or delay), rerouting of trips, rescheduling of movements etc. can all be tested using the model.
- Impact of late changes – while planning will be done with the best intentions there will undoubtedly be late changes to project requirements, network capacity and other traffic. This model provides the ability to quickly consider and assess the viability of alternate traffic planning in response to these changes

2.4 Outputs

Using these considerations the following key outputs can be obtained from the system:

- Issues report – specific reports on a regular timeline which flag issues identified.
- Risk report – a summary of risks identified, which can be potential reduced using the tool.
- Performance audit – provides the actual transport movements to support government performance monitoring.
- "Live" vehicle movements on a GIS based road network that allows the user to get a visual impression of the traffic movements.
- A regularly updated transport movement schedule referenced against planned and actual usage so that the authority is always aware of what is happening on their roads A validation test of the maintenance program and proposed upgrades against actual demand.

3. Working Examples

The AnyLogic software package is a proven resource which is currently used by the Queensland Government for demand modelling of the Surat Basin, where it provides flexibility to model potential outcomes for various development scenarios and support economic assessments. It has also been used to manage passenger movements through airports as well as arterial movements at ports.

For this paper a basic demo model has been prepared and will be displayed during the presentation.

Figs. 2-4 show screenshots of the demonstration model.

In this case a hypothetical scenario has been developed which tracks mine vehicles traveling from an origin point –Cowra in the southern eastern sector to a destination site- Forbes, in the North West by three alternative routes. These routes are shown in Fig. 2.

When the program is run this screen provides a "live" simulation of vehicle movements along the three routes. In this case three types of vehicles have been defined – light, medium and excess mass load vehicles.

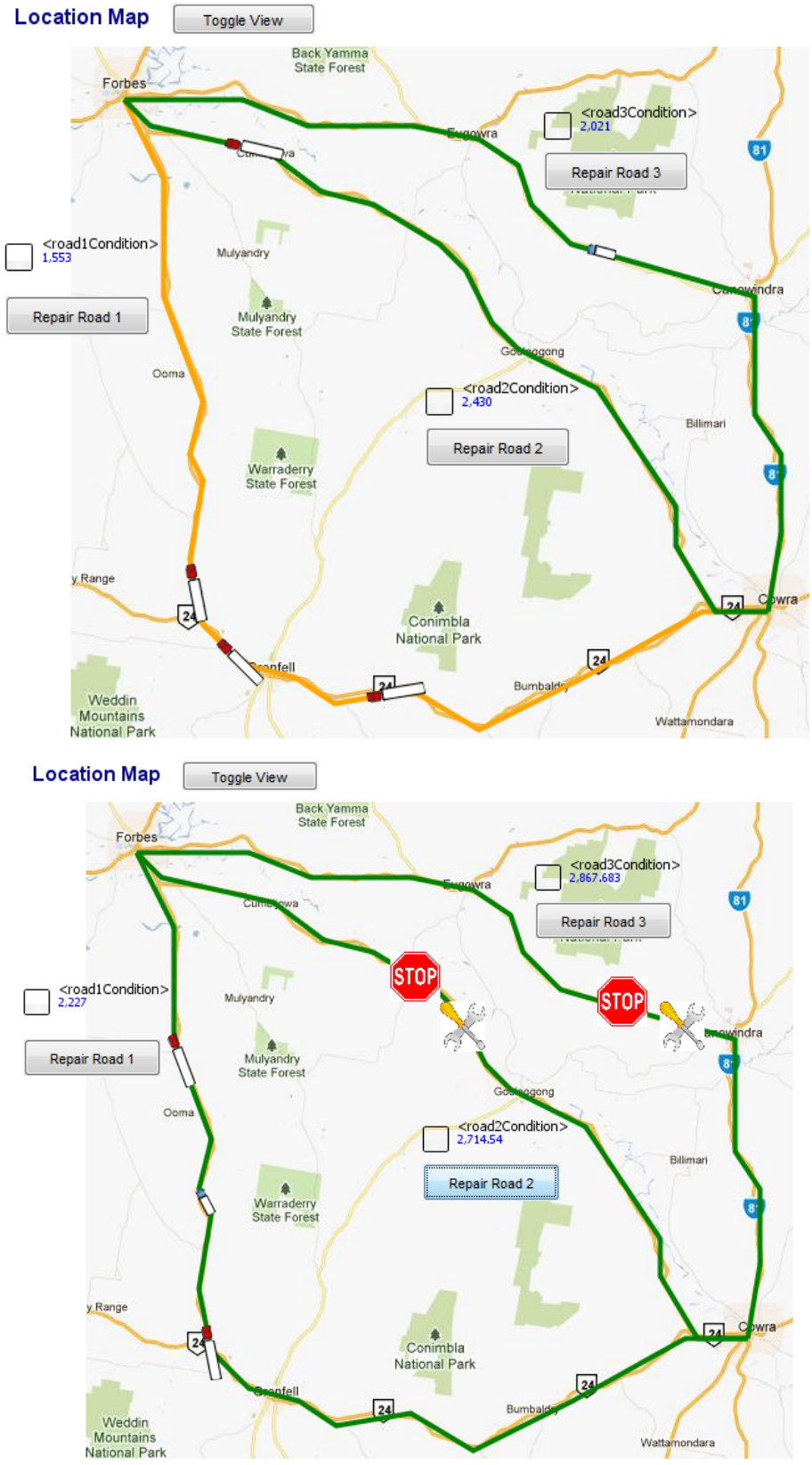

Fig. 2 HVMS Traffic Simulation.

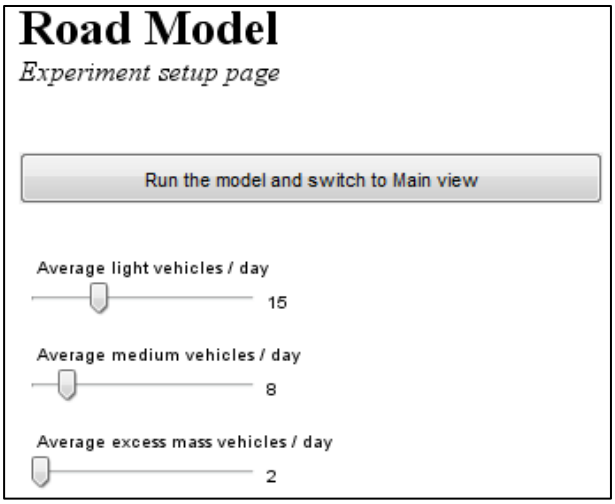

Fig. 3 HVMS Interface.

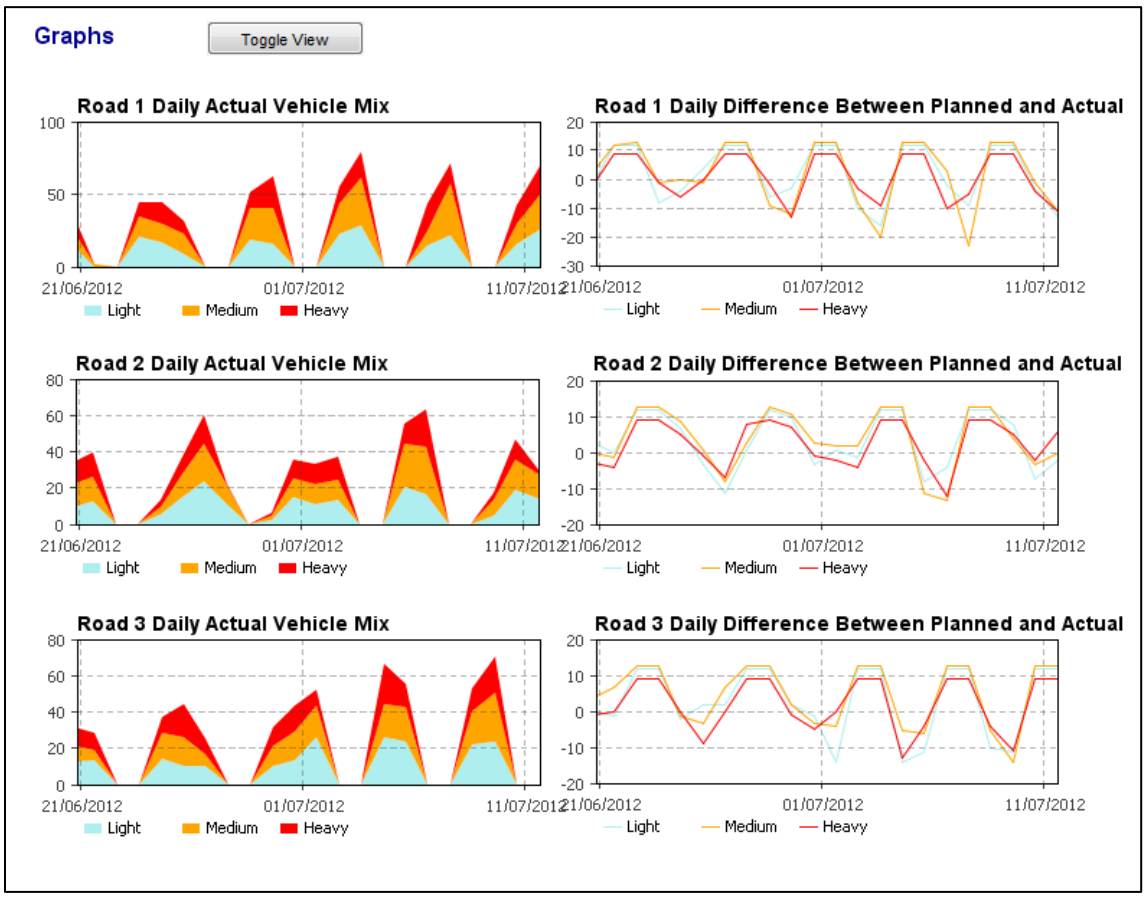

Fig. 4 Model Outputs.

The characteristics of these routes have been predefined in terms of the impacts of these vehicles, as referenced against:

- Vehicle weight
- Road repair threshold
- Vehicle movement schedule (both hourly and daily)
- Planned road works
- Unplanned road works which are activated by clicking the Repair Road icon

Fig. 3 provides a snapshot of the front-page interface. Within this simplified version of the system, light, medium and heavy traffic volumes are set by the user and are assigned equally to the three alternative routes.

Fig. 4 provides "live" graphs which are continuingly updated as the program is run. The graphs provide information along each route for vehicle class split and differences between actual and forecast traffic volumes.

The user can determine the number and type of vehicles which will impact on the viability of the route. For example, a higher number of excess mass load vehicles will mean the road reaches its repair threshold quicker and will be closed for a defined time period as identified by the Stop and Tools icons. Traffic is then diverted to another route, which of course consequently results in a quicker road repair status being achieved for that route.

The user can also manually determine a road closure by clicking on the Repair Road icon which will close this road and traffic will be diverted. This function can also be used to reflect other road closure scenarios – road accident, flooding etc.

Although this is a very basic example, this demo provides an insight into the capability of this system.

4. Applications

This paper describes a potential system to allow the road authority manage the transport task on their road network from mining generated traffic in a relatively simple and cost-effective solution.

Examples put forward here in Fig. 1 include:

- A look ahead schedule of planned moves to help the authority determine if the route is suitable and to address any potential conflicts. There may be capacity issues with other major users, planned road works that will restrict capacity and so forth
- An excess mass load risk assessment
- A compliance check that allows the authority to keep track of actual movements and referenced against proposed maintenance and infrastructure upgrades
- Network management plan that allows the identification of viable alternative routes in the case of accidents, road works, flooding etc.

The options are many and can be defined by the road authority to meet their needs.

4.1 How Much Does It Cost and How Long Does It Take to Set Up

Costs are dependent on the system required. The example highlighted here was developed in support of a request by TMR to develop a system that could assess excess mass loads routes proposed by the Coal Seam Gas (CSG) industry in central Queensland. This provides TMR with a clear picture of proposed such traffic movements on their road network and impacted on their ability to project manage and fund works on their network. The approximate cost of establishing a standard excess mass load route system is $60-70,000 and a delivery date of 3-4 weeks.

Acknowledgment

The author wishes to thank his work colleagues past and present in helping him prepare this paper in particular Paul Henderson and Graham Wallace.

References

[1] References on the capability of the proposed system are drawn from the authors work previously undertaken when he worked for Evans & Peck – Worley Parsons.