

Performance Measurement for the better utilisation of New Zealand's existing Transport Network



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Abstract

With a growing requirement for Road Controlling Authorities (RCAs) to focus on making better use of our existing transportation infrastructure there is a corresponding need to have effective methods of measuring the operational performance of the transport network.

This paper looks at best-practice guidance from the US Department of Transportation on the concept of 'objective-driven performance-based planning' and how it is relevant to RCAs through the objectives of the latest New Zealand Transport Strategy (NZTS 2008).

This includes evaluating the range of performance measures / metrics that are available to RCAs based on operations data and the greater availability of data produced from Intelligent Transportation Systems (ITS). There is coverage of next-generation ITS tools including ARTIS, ANPR and SMR, which are reducing the cost of collecting and analysing operations data for the reporting of network and corridor performance.

The paper concludes that New Zealand will need to invest in further ITS infrastructure to enable better optimisation of the use of our existing infrastructure, although with the latest ITS technology this investment is now many magnitudes lower in cost than in the past.

1. Introduction

In 2009 New Zealand, like many other developed nations is looking to invest in the national transportation network to provide for and enhance economic activity, in combination with positive social and environmental outcomes.

While there is additional funding entering the National Land Transport Fund in the coming years, many of the initiatives to improve the efficiency of the transport network will come from better utilisation of the existing network.

There is currently criticism of central and local Government's ability to deliver against organisational goals and value for money, with the lack of relevant indicators and the inability to measure and report on performance being key factors. The future effectiveness of the amended Government Policy Statement (GPS^[2]) on Transport will depend on how well national goals are linked with performance measurement and the choice of KPIs.

This paper examines the benefits of enhancing New Zealand's approach through the implementation of the principles from Objective-Driven Performance Based Planning^[3,4] (ODPBP) and investing in new-technology Intelligent Transport Systems (ITS) to provide monitoring of and feedback from KPIs.

2. Better Utilisation of the Network

2.1 General Concepts

The general concepts behind improving the utilisation of the network include improving travel efficiency, safety, multi-modal capacity (for major urban areas), and appropriate balance of movement on the network hierarchy.

Travel Efficiency has long been a part of New Zealand's methods for evaluating projects, with the NZ Transport Agency's Economic Evaluation Manual containing procedures and values for different components of travel efficiency. Travel is most efficient when travel times are unaffected by congestion or unreliability.

Safety too is well embedded in the way that the effects of projects and initiatives are considered.

Multi-modal capacity is relevant only for certain corridors in major urban centres, but the success of particular initiatives such as the Auckland Northern Busway and other public transport infrastructure improvements show how by targeting investment, other modes can allow more people to travel along an existing corridor.

The appropriate use of the network hierarchy is important for network efficiency so that the right vehicles can use the part of the network most suitable for that part of their trip. Where one part of the hierarchy becomes congested or demand exceeds capacity then less efficient routes or modes will be used more, leading to poorer use of energy, time and potentially reduced safety.

2.2 2009 Amended Government Policy Statement (GPS)

The recently released draft of the amended GPS on transport does not contain a direct statement on the importance of improving the utilisation of the existing network, but does identify the expected key impacts of transport investment, which in themselves support increasing utilisation.

They are stated in Section 12 of the amended GPS as:

- improvements in journey time reliability
- easing of severe congestion
- improving transport connections to areas that have economic growth potential
- increasing access to markets
- improving transport efficiency
- improvements in road safety.

Improvements in reliability, easing of congestion and improving transport efficiency can be made through improving the way the existing traffic travels on the existing network, and the options for this are described in the next section of this paper.

3. Options Available to Agencies and Councils

There are a range of options available to Councils to meet the objectives of the amended GPS. These include examining maintenance programmes, longer term land use and demand management initiatives, as well as operational improvements. The range of operational improvements are as below:

- Route Optimisation (physical)
- Route Optimisation (operational)
- Public Transport Infrastructure
- Incident Management / Construction Traffic Management
- Traveller Information
- Freight Management
- Pricing.

The key is that optimising performance is on the basis of economic efficiency.

4. Performance Measurement for Better Utilisation

The major challenge is not identifying the sufficient range of initiatives, rather it is prioritising and funding initiatives that deliver against national and regional objectives.

Some criticism of current performance of local and central government is delivering against objectives and delivering value for money is that sufficient KPIs are not measured and monitored for the purpose of performance improvement.

- "...deficiencies include the failure to develop relevant indicators that are clearly linked with organisational objectives" Office of Auditor General, June 2007
- "Value for money ...[includes]... improving the ability to measure & report on performance." Treasury briefing paper to incoming Minister of Finance, 2008

A key challenge for New Zealand is to have a system whereby relevant indicators are measured, clearly linked with organisational objectives, and feedback into prioritisation and strategy. This paper examines the use of Objectives-Driven Performance Based Planning, based in most part on the guidance from the US Department of Transport.^[4]

5. Objective Driven Performance Based Planning

Objective driven performance based planning (ODPBP) is an iterative process where performance measures are highly integrated into the transport planning and strategy development processes.

In the United States, the approach was a response to the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) ^[3,4].

This legislation specifically includes “promote efficient system management and operations” as a planning factor that must be considered when developing transport plans. It requires inclusion of not only capital projects, but also traffic management and operational strategies.

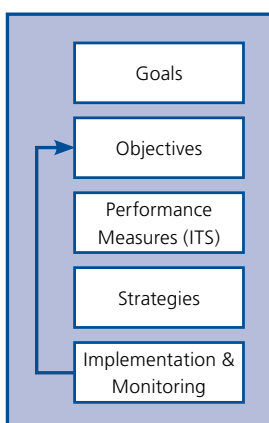
As the performance measurement will therefore involve traffic management and operations information, it encourages innovation in network efficiency, rather than static strategies or reliance on infrastructure projects.

ODPBP is particularly useful when / where there is a movement towards customer service-delivery orientation which requires a response to both the growing and changing demands on infrastructure as well as the impact of a sustainable transport approach.

A key part of the approach is the development of performance measures and the reliance on Intelligent Transport Systems (ITS) infrastructure for monitoring performance. As both ITS infrastructure and ITS network coverage improves, the benefits and relevance of the ODPBP approach will further increase.

The outline of ODPBP is shown below:

Overarching goals are developed in consultation with stakeholders.



From these goals more specific objectives are defined.

Performance measures are then driven by the objectives. Much of the performance data collected is through ITS infrastructure.

Strategies are formed to bridge the gap between current performance and that required.

Strategies are implemented with monitoring / evaluation carried out based on performance measures.

The ODPBP process loops back on itself, as outcomes of strategies and implementation are periodically used to guide and improve any next iteration of objectives.

5.1 Goals

Goals are essentially the way of communicating a regional or national vision of how the transport system should contribute to the social, economic and environmental facets of the community. These are likely not only to be about capacity but also elements such as reliability and safety.

5.2 Objectives

ODPBP guidance specifies that objectives flow from the goal(s) and are a critical component of creating an objectives-driven, performance-based approach. Operations objectives help to actualise what it means to accomplish the goal, and should specify clear measurements for evaluating progress towards the goal. They state what a region plans to achieve in regard to the operational performance of the transportation system, and thereby help to determine what strategies and investments to include in the MTP.

Objectives are specific, measurable statements relating to the attainment of goals. Given that the fundamental purpose of management and operations improvements is to better serve the transportation system user through increased system performance, operations objectives are preferably described in terms of system performance outcomes as experienced by users. Objectives focused on outcomes to the user address issues such as travel times, travel time reliability, and access to traveller information. The public cares about these measures, and in many regions, data may be available to develop specific outcome-based operations objectives.

As opposed to Goals, ODPBP requires that an objective should have the well known ‘SMART’ characteristics. By developing ‘SMART’ objectives, system performance can be examined and monitored over time.

Of interest, there are two distinct interpretations on the meaning of the ‘A’ in SMART:

- Agreed ^[4] – Partners come to a consensus on a common objective. This is most effective when the planning process involves a wide-range of stakeholders to facilitate collaboration and co-ordination, or
- Achievable ^[3] – Objectives should be realistic and within the reach. Objectives should not represent a ‘wish list’, but should take into consideration projections and trends available.

We would suggest that both of these are relevant and required. Our experience is that a trade-off can occur between the two, where negotiation and compromise to reach agreement can lead to inclusion of 'wish list' items. The challenge to transport professionals is how to achieve both 'agreed' and 'achievable'.

Guidance on ODPBP suggests that in developing objectives, a common concern is the recognition that transport network performance may worsen without the implementation of new strategies or programmes, particularly in regions where population is growing rapidly not all objectives will be 'improve on current conditions' and the guidance recommends careful consideration of how to communicate with elected officials and the public on this. The example in Section 4 of this paper expands on this.

5.3 Performance Measures

Linkage to Objectives and Strategies

Performance measures are indicators of how well the transportation system is performing, and are inextricably tied to objectives. Under ODPBP, performance measures need to be identified and data collected in order to select appropriate regional objectives that are specific and measurable.

Measures for Performance-Based Planning

The US Department of Transportation provides a range of categories of measures suited for ODPBP ^[3], including:

- Accessibility & Mobility [Examples: average travel time from origin to destination, average trip length, percentage of employment sites within x miles of major highway, number of bridges with vertical clearance less than 4.5m, origin-destination travel times, average speed or travel time, vehicle km travelled (VKT) by congestion level, lost time or delay due to congestion, level of service or volume-to-capacity ratios, vehicle hours travelled or VKT per capita, person km travelled (PKT) per VKT, customer perceptions on travel times, delay per ton-km, PKT per capita or worker, person hours travelled, passenger trips per household.]
- Economic Development
- Quality of Life [Examples: lost time due to congestion, crashes per VKT or PKT, tons of emissions, customer perception of safety and urban quality, average number of hours spent travelling, % population exposed to noise above certain threshold]
- Environmental and Resource Consumption [Examples: tons of emissions, number of days in air quality non-compliance, fuel consumption per VMT or PMT]
- Safety
- Operating Efficiency (System and Organisational)

- Transport Network System Preservation [Examples: % VKT on roads with deficient ride quality, % roads and bridges below standard condition, remaining service life, maintenance costs, roughness index for pavement]
- Outcomes (Operational) Performance Measures
 - Quantity of travel (users' perspectives)
 - Quality of travel (users' perspectives)
 - Utilisation of the system (Agency's perspective)
- Outputs (Agency's performance).

Analytical Methods

Current methods of data collection in widespread use which could support development of multi-modal performance measures include ITS (including network, vehicle and tolling and other technologies), manual surveys and surveillance and user surveys.

As covered in Section 4 where the ARTIS tool is discussed, it is important for the success of transport strategies that the data collection infrastructure is in place and transport planners are aware of the range of cost-effective ITS tools that can be deployed.

5.4 Strategies

The development of performance measures under ODPBP necessarily focuses strategies on objectives and hence goals. A key but potentially controversial component of ODPBP is that as strategies and projects need to relate to specific performance measures, currently un-measurable strategies cannot form part of the ODPBP. However in our view this leads to these important things:

- Investing in new ITS infrastructure (or other data collection methods) that will enable performance measurement of the components of the strategy.
- The removal of ineffective objectives which lead to un-measurable strategies or revision and re-statement of the objectives in order to enable performance measurement of all strategies.
- The strategies that flow from performance measures will be measurable, and this makes performance measurement of the responsible agencies and roles within those agencies practical. We see this as a key difference from prior methods where the impact of strategies and the corresponding effectiveness of agencies was difficult to ascertain.

5.5 Implementation / Monitoring / Evaluation

Through following an ODPBP approach, appropriate performance measures will be in place for monitoring and evaluation of strategies and projects.

Using the ODPBP approach, periodic performance reporting provides a method of directly informing decision-makers and the responsible government organisations how well the strategies are performing in delivering towards the goals and objectives of the regional and national transport strategy and targets.

Through this there must be a process whereby the objectives could be altered to match changing characteristics and the ability to contribute towards the transport goals. Efficient automated processes for routine reporting are therefore valuable.

6. Performance Measurement of Utilisation

6.1 Performance Measurement on Identified Key Routes using ARTIS ^[5]

For the NZTS and GPS to be effective in both delivering and reporting on the performance of strategies and investment, there needs to be the appropriate data collection infrastructure and analysis available to match the performance measure.

One of the requirements of the NZTS is to measure the user perception of the performance of key routes through travel time and travel time reliability. Traditionally the expensive ITS sensors that are capable of monitoring these characteristics are either not installed or limited to motorways, leading to the use of 'floating-vehicle' surveys to monitor performance.

Only very recently have tools been developed to make use of the sensors that are present at all intersections controlled by traffic signals and other sensors used to monitor traffic flows and speeds to collect data sufficient to report on these key performance measures. Previously this SCATS traffic signal data has been underutilised in corridor performance measurement.

ARTIS (Advanced Real-Time Traffic Information System) is add-on software that uses actual and dynamic traffic data available from SCATS and through mathematical analysis, provides traffic system performance reporting such as congestion, travel times, unit delay, level of service, a mobility index and spare capacity.

ARTIS has been used with the Auckland SCATS system to test the monitoring of particular arterial and motorway segments; the figure to the right shows some of the graphical output from the **ARTIS** system.



Through **ARTIS** it is also possible monitor trends on the performance of arterial corridors including pedestrian delay information in a manner that has not been previously possible. **ARTIS** is a key tool for delivering effective arterial corridor strategies in support of the NZTS.

Our view is that more emphasis needs to be placed in New Zealand on the use of ITS and data fusion whereby different sources of ITS data are combined, making use of the advantages and reducing the effect of the some of the disadvantages of each.

For example fusing the following data sources will provide an effective picture of performance that will then enhance the value of the NZTS, GPS and RLTS:

- Floating Car Surveys (accurate, limited routes, small sample size)
- ARTIS data (all traffic signal controlled routes 24 hours / 7 days)
- Public Transport Real-time Systems (mode specific)
- User Perception Surveys (covers non-motorised modes).

This is particularly effective as an integral part of any route optimisation activities.

7. Conclusions

The Objective-Based Performance Based Planning model which is becoming best-practice in the United States is relevant to New Zealand, especially so with the recent release of the New Zealand Transport Strategy 2008 and upcoming RLTS.

The key process within ODPBP is the development of performance measures aligned to objectives / targets which are then used to both develop strategies and report on the success or otherwise of the strategies and organisations responsible for these strategies.

One risk for the government in the NZTS 2008 arises from the goals and objectives which do not currently have measurable targets set. Without prompt development of measurable targets and performance measures, there is a risk of misaligned strategies and a corresponding difficulty in refining poorly performing strategies or being able to determine the value for money being delivered by the strategy and the responsible organisation(s).

There is a need for New Zealand to invest further in Intelligent Transport Systems (ITS) infrastructure and analysis tools to support the NZTS based on ODPBP guidance. Efficient automated processes for routine reporting are required, in particular ones which are able to fuse data from different sources.

There is risk from introducing environmental goals in that there will be an unresolved conflict with any 'quantity of travel' performance measure – it is important that New Zealand move to a 'person km travelled' (and corresponding ton-km travelled) measure.

This requires the use of tools such as ARTIS and the embedding of the NZTS/RLTS performance measures into strategies and projects will provide more certainty that the NZTS / RLTS will be effective in delivering strategies that contribute directly to government's regional and national goals.

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