Safety and efficiency in intersection projects

Recent research explored the feasibility of developing a framework to take into account both safety and efficiency, and quantify the trade-offs between them, when making decisions about intersection improvements.

The project, undertaken by Resolve Group in Auckland, reviewed current approaches to evaluate proposed safety and efficiency improvements at intersections.

While the NZ Transport Agency (the Transport Agency) and other road controlling authorities now have established best-practice approaches for evaluating and improving safety (eg the *High-risk intersections guide* (NZ Transport Agency 2013)) and efficiency (eg the network operating frameworks) at intersections, the objectives underlying the approaches often clash, resulting in an intersection design that does not balance safety and efficiency as effectively as it would have done, if an integrated approach had been used.

The report authors, Tim Brown and Steve Griffith of Resolve Group, say, 'Intersections can pose complex problems when attempting to manage the movement of people and goods on the transport network, so it is important to consider the needs of a range of road users and ensure that solutions minimise delays while maximising safety.

'Despite there now being robust design standards, plans and legislation in place (underpinning the importance of safety and efficiency as separate considerations), in practice the decision-making frameworks used by road controlling authorities tend to consider one aspect over the other, depending on the reason that a particular intersection is being constructed or upgraded – safety or efficiency. We currently have no acceptable way of developing projects that maximise outcomes for both safety and efficiency in a coordinated manner.'

Accordingly, the research aimed to develop an evaluation framework that incorporated best practice guidance relating to both safety and efficiency, to determine whether, in principle, it was possible to develop an optimum outcome that addressed the competing objectives of safety and efficiency.

Specifically, the research aimed to:

- identify the impacts of proposed changes to an intersection on a reasonably consistent basis, which could be applied to both rural and urban intersections. This required the impacts of safety and efficiency improvements to be measured in a common value, allowing any trade-offs between the two components to be identified and assessed
- put the safety and operational characteristics into a common framework to allow robust solutions to be developed.

It is important to note, while the research examined the benefits and impacts of different intersection treatments, it did not set out to provide guidance on the specific treatments to be applied at particular locations. Instead it aimed to produce a tool for road controlling authorities to support their decision making for specific intersection projects.

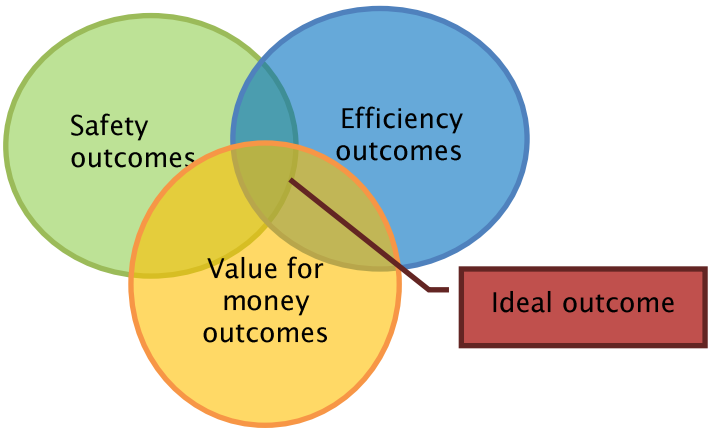
Developing the framework

An initial scan of national and international literature and best practice, found at present there is 'no known way of developing projects that maximise outcomes for both safety and efficiency at intersections in a coordinated manner.' It also found very little to define what is considered an acceptable trade-off between safety and efficiency at intersections.

'This is because the two jurisdictions or considerations are currently treated completely separately,' the report authors say. 'For the same reason, there was little information available about the interdependencies between safety and efficiency at intersections.'

However, it was clear to the authors that, for the optimum or ideal outcome to be achieved for an intersection, any framework they developed would have to consider both safety and efficiency, regardless of the focus that was driving the improvement projects.

Overview of achieving the ideal outcome



The resulting ‘proof-of-concept’ evaluation framework developed by the authors provides a shortlist of available treatment options, with a ranking assigned for each option based on the expected percentage improvements in safety and efficiency flowing from it. Safety improvements were assessed as the crash reduction percentage to be expected if a specific measure was implemented (in line with the *High-risk intersections guide*). Efficiency improvements were assessed as the difference between the level of service expected from the improvement (drawing on One Network Road Classification definitions of levels of service, and converted to a percentage) measured against the existing level of service for efficiency. The assigned ranking is referred to as the safety/efficiency framework trade-off score. In addition, the framework allows an indicative budget to be assigned to options, enabling users to consider those options that fall within their allocated budget.

To test whether the outputs from the framework were sufficiently accurate, it was applied to a number of case studies where intersection improvements had either occurred or were planned.

The report authors comment, ‘The case studies demonstrated that the ranking of solutions generated by the framework tended to place the constructed, or yet to be constructed, improvement schemes as high priorities on the list. From this, we were able to conclude that, in principle, the methodology appears to be relatively sound.’

The case studies also demonstrated a potential way of expressing the safety and efficiency elements of an intersection in terms of a common unit.

The authors state, ‘With further development, this approach would enable the framework to make a direct comparison between safety and efficiency, or to express the trade-offs involved between particular schemes, rather than, as at present, having to rely solely on arbitrary percentage improvements.’

The research report concludes on page 50, ‘This report provides a recommended process by which desired safety/efficiency outcomes can be measured against the existing levels of performance in a meaningful way. In many cases, improving safety at an intersection often comes at a cost to efficiency. The process developed in the proof-of-concept evaluation framework offers some way to better understand the trade-offs. However, the extent to which it quantifies the trade-offs (as a percentage difference between existing and proposed) assumes a 5% improvement in safety is as valuable as a 5% improvement in efficiency. This is a limitation that will be resolved in further development of the evaluation framework.”

The report contains several other recommendations for development of the framework ‘from first principles’. An appendix to the report contains the proof-of-concept framework/tool, which the authors recommend the transport sector consider using as a decision-support tool, when considering intersection improvement projects.