Prioritising harm elimination: The effect of benefit-cost metrics and planning timeframes on perceived benefits

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Abstract

Benefit-cost analysis is extensively used to justify and prioritise road infrastructure investment but its reliance, when applied to road safety initiatives, can be counter-productive. Due to their substantial costs, primary Safe System-aligned treatments that virtually eliminate harm often come with low benefit-cost ratios (BCRs) and it can take many decades for their benefits to mature. The aim of this study is to compare the benefits of high-BCR supporting treatments and low-BCR primary treatments over both short- and long-term planning timeframes. The results show that primary treatments provide greater long-term benefits but require adequate investment for these benefits to be realised.

Background

Benefit-cost analysis (BCA) is extensively used to justify and prioritise road infrastructure investment (Hauer, 2011). When applied to road safety initiatives, the reliance on high benefit-cost ratio (BCR) treatments can be counter-productive (Elvik, 2001). Safe System-aligned treatments are those that are the most capable of reducing harm on the road system. Primary treatments are able to virtually eliminate harm and supporting treatments can achieve large reductions in harm. BCA can be used to prioritise supporting road safety treatments, which have high-BCRs and reduce but do not eliminate FSIs, over low-BCR primary treatments that prioritise harm elimination.

Due to the often-substantial costs of primary treatments, their benefits over a network-wide basis can take many decades to mature. Supporting treatments, on the other hand, mature in their benefits comparatively quickly, making them appear as better investments when looked through the lens of conventional 10-20 year planning timeframes. However, supporting treatments will ultimately result in a certain reduction of FSIs but are ultimately not as well-aligned to the objective of harm elimination.

The aim of this study is to compare the benefits of high-BCR supporting treatments and low-BCR primary treatments that have strong alignment with a harm elimination objective, over both short- and long-term planning timeframes.

Method

A model was developed to estimate the accumulation of FSI casualties, for a section of a road network over extended periods of time, for different road infrastructure investment scenarios.

Case study

The model, considering two treatment scenarios, was applied to South Australia's state-managed, two-lane/two-way rural road network.

The "supporting" scenario consisted of shoulder sealing and the addition of edgeline and centerline audio tactile line marking. The "primary" scenario consisted of treatments well-aligned to the Safe System: Continuous roadside and median wire rope safety barriers.

Two investment levels were considered: Low ($50 million per year) and high ($200 million per year).

Two planning timeframes were considered: short-term (20 years) and long-term (50 years).

Treatment rollout was prioritised by road volume, from highest to lowest volume. The maximum value of each investment level was assumed to be spent each year until all roads were treated.

Data

Road length and volume data, and road crash data was collected for the case study roads through the Department of Planning, Transport and Infrastructure in South Australia.

Crash modification factors (CMFs) were used to estimate the effectiveness of each treatment type. The aggregated CMFs (considering all lane-departure crash types) are 0.23 for the primary scenario and 0.71 for the supporting scenario.

Treatment (installation and periodic replacement) costs were estimated from various sources. Net present value was estimated using a discount rate of 3%.

Results

Benefit-cost ratio (BCR) and cumulative fatal and serious injury (FSI) savings are provided in Table 1. The supporting scenario's BCR remains higher than the BCR of the Safe primary scenario irrespective of the planning timeframe.

Table 1. BCR and cumulative FSI savings after 20 and 50 years for each treatment scenario and investment level

Treatment scenario	Cumulative number of FSI casualties saved					
	20-year timeframe			50-year timeframe		
	BCR	Number of FSIs saved		BCR	Number of FSIs saved	
		Low investment	High investment		Low investment	High investment
Supporting	3.4	553	849	4.0	1,696	2,249
Primary	1.0	355	988	1.1	1,313	3,220

For both the 20-year and 50-year timeframes, the primary scenario resulted in greater FSI savings under the high investment level (Figure 1); this difference was substantial for the 50-year timeframe.

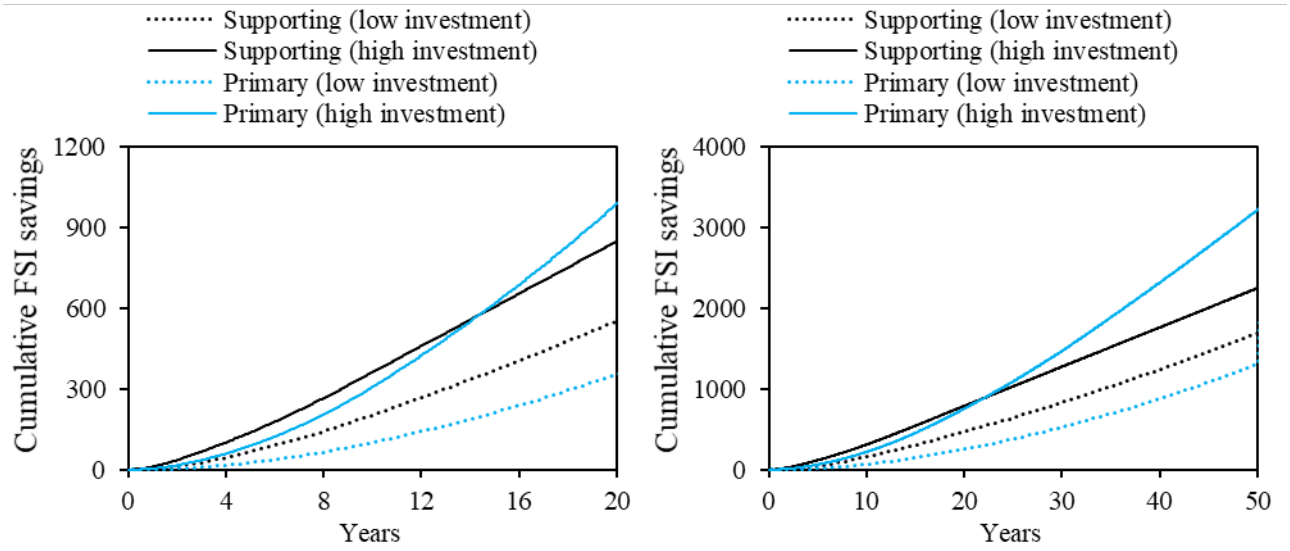

Figure 1. Cumulative FSI saved over time for each treatment scenario and investment level over 20 years (left) and 50 years (right)

Discussion

Using benefit-cost analysis, the supporting scenario could appear more attractive due to its higher BCR. The primary scenario is overshadowed in terms of BCR because of its substantially larger financial outlay.

Under a 50-year timeframe, the benefit of the primary scenario can be clearly observed. Despite the longer lead-time for treatment saturation over the network, FSI savings are substantially higher due to the greater emphasis on harm elimination of its primary treatments.

Conclusions

This study highlights two key messages. Firstly, despite the attractiveness of higher BCR treatments, substantially greater long-term FSI savings can be made with lower BCR treatments that place a greater emphasis on harm elimination. However, longer planning timeframes are required to observe such benefits.

Secondly, where there is a heavy reliance on safe roads for achieving the Safe System objective of harm elimination, adequate investment with an emphasis on harm elimination treatments is required if this objective is to be realised. Without this emphasis on primary Safe System-aligned treatments, harm elimination targets will not be realised, irrespective of the level of investment.

References

Elvik, R., 2001. Cost-benefit analysis of road safety measures: applicability and contraversies. Accident Analysis and Prevention 33, 9-17.

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