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A Sustainable Road Safety Investment Plan for Persiaran Saujana Impian

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ABSTRACT

Persiaran Saujana Impian portrays a good example of how a road network 'inherits' poor design characteristics from poor town planning and particularly poor road safety institutionalization. As a result of increased traffic loading due to rising housing development projects along this 5 km road, the rate of road crashes has been rise over the last five years. Crash data obtained from the Royal Malaysia Police revealed that the most common type of collision involved passenger cars, and more than one-third of the total crashes occurred in dark environment. Crashes involving motorcyclist constituted less than 10% of the total cases and yet they over-represented the number of fatalities. A road network safety assessment showed that more than 50% of the road length was rated as high risk for passenger cars and more than 80% for motorcyclists. Aside from controlling the operating speed, the assessment confirmed that this road network requires improvement in relation to roadside safety and intersection design. Several intervention programmes were identified to have high benefit-to-cost ratio (BCR) and should be included in any road improvement plan to reduce the risk of severe crashes. This paper proposed a holistic road safety improvement plan based on crash evidence, scientific evaluation and strategic implementation framework. This paper also highlights the importance of localizing road safety intervention programmes which places emphasis on empowering local community to champion road safety. The proposed strategic framework can be replicated for use in other parts of the country as long as evidence-based approach is used.

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1. Introduction

Road network safety assessment to identify contributory factors to crash risks and determining high-impact mitigation measures is one holistic approach towards reducing the number of fatalities and serious injuries on 'problematic' roads. These roads are crash-prone areas with 'lock-in' design features that require extensive network safety assessment to identify high-impact treatment programmes. As opposed to the conventional blackspot programme which targets specific spots for treatment, road network safety assessment provides an overall picture of the safety conditions along the entire road length and tests the economic viability of multiple treatment programmes. Economic viability of a safety improvement programmes involves analysis of the benefits gained relative to the costs incurred of each programme for prioritization purpose (Dahdah & McMahon, 2008). It is especially useful when sustainable safety investment is being considered to improve the safety conditions on 'problematic roads' where a significantly large fund is required from the government. In Malaysia, Persiaran Saujana Impian portrays a good example of 'problematic' road due to poor design characteristics. Poor town planning is partly to be blamed but the fact that the problems remain unsolved for more than a decade points to a bigger challenge facing the country – poor institutionalization of road safety effort and unsatisfactory political will in addressing road safety. As a result of increased traffic loading due to rising housing development projects along the 5 km dual-carriageway road, the rate of crashes has been on the rise over the last five years. Concerted effort to improve the status quo safety conditions along this road seems to be missing until recently when more than 380 crashes (including 3 fatal cases) were reported in 2020 (Royal Malaysia Police, 2021). As part of the engagement process with local stakeholders, the Malaysian Institute of Road Safety Research (MIROS) conducted a safety assessment on the road network to study the road engineering risk factors and identify high-impact countermeasure programmes.

'Vaccines' for roads have existed worldwide and have proven in saving lives and preventing serious injuries due to road crashes. Many of these 'vaccines' or road safety treatments are not only sustainably effective in bringing down crash risks but are also cost-effective for wide-scale applications. The work by Elvik et al. (2009) for example provides a comprehensive compilation of proven treatments implemented worldwide and is frequently referred to by road safety experts, including the International Road Assessment Programme (iRAP) who incorporated many of the information in their web-based toolkit for road safety intervention (iRAP, 2010). Nevertheless, the selection and implementation of effective treatments for a road network require a good understanding of the underlying problems affecting the crash risks and it is usually achieved through analyses of the crash history. First, this is important to ensure a positive return on investment for any treatment programmes and second, to avoid putting road users in a more dangerous environment due to the use of inappropriate treatments. This is especially true when the road network under investigation consists of a significant proportion of vulnerable road users such as the motorcyclists. In many instances unfortunately, crash data of sufficient quality is not readily available especially in less advanced countries due to lack of good crash reporting system.

Acknowledging the challenges faced by many countries in the world in conducting road assessment exercises in a holistic way and to identify appropriate treatment programmes based on scientific evidence, iRAP had introduced a new universally accepted methodology for road network safety assessment. It aims to reduce road fatalities and serious injuries by identifying high impact road safety treatments that could improve the safety conditions of high-risk roads. Leveraging on established worldwide evidence-based studies, the iRAP approach offers one advantage in that the models require minimal information on crash history to estimate the number of fatalities and serious injuries that could be prevented. Yet, it can produce a relatively effective source of information on high-impact treatment programmes to assist in justification of fiscal allocation. Many in-country studies have also been worked on the iRAP models to suit assessment protocols relevant to the local experience and nature of safety issues such as the Australian National Risk Assessment Model, or ANRAM (Jurewicz & Excel, 2016).

Using the iRAP star rating and fatality estimation models, we assessed the safety conditions along Persiaran Saujana Impian which had over the recent years seen an increase in the number of crashes. Since 2015, at least x KSIs among motorcyclists are recorded annually (Royal Malaysia Police, 2018), the group of road user which constitutes the largest proportion of road fatalities in Malaysia. One obvious factor is the increasing traffic loading over the years due to more and more housing development providing access along this route. Due to better road connectivity and accessibility, additional use of vehicles is generated or induced, hence the term induced traffic (Hansen & Huang, 1997; Litman, 2001). Furthermore, this bypass provides a high degree of mobility for commuters between Kajang town centre and Semenyih, a fast-rising township located less than 10 km down south. Site observation estimated that this road carries as high as 20,000 vehicles daily, with a composition of 75% passenger cars, 20% motorcycles and 5% heavy vehicles.

This paper proposed a holistic road safety improvement plan based on crash evidence, scientific evaluation and strategic implementation framework. This paper also highlights the importance of localizing road safety intervention programmes which places emphasis on empowering local community to champion road safety. The proposed strategic framework can be replicated for use in other parts of the country as far as improving the safety of road users is concerned.

1.1 Motivation Behind This Study

In order to illustrate the scale of the problem along Persiaran Saujana Impian, firstly imagine that one motorcyclist died each year on average for the past six years. Secondly, note that 384 crashes of all types were recorded in 2020. In addition, this 5 km road observed 3 fatal cases out of a total of 33 fatal cases recorded on the 1,400 km[1] of road network in the district of Kajang in 2020. Other crash information recorded in 2020 revealed that collisions between passenger cars[2] happened to be the major crash types and more than a third of all the crashes occurred between 6 pm and 6 am (Figure 1). Despite crashes involving motorcyclist constituted less than 10% of the total cases, they over-represented the number of fatalities over the years. These statistics indicated that while mitigation measures should focus on the reduction of passenger car-related crashes, interventions to reduce the injury severity of motorcyclists should also be immediately carried out.

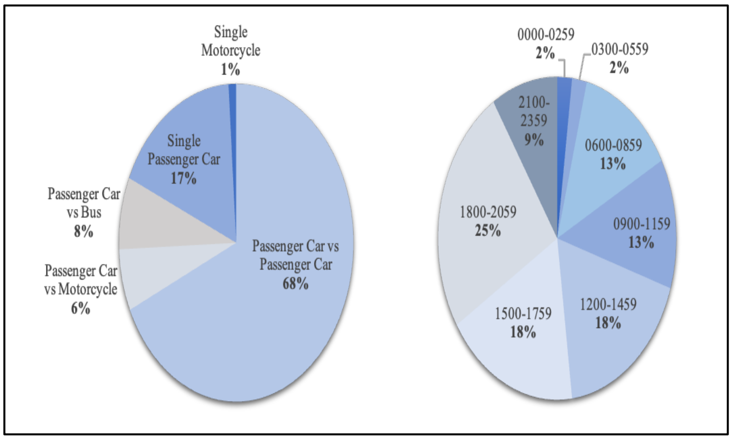

Figure 1: Percentage of all crashes recorded in 2020 by vehicles involved (left) and by hours of the day.

The Kajang District Police Headquarters (IPD Kajang) had identified three hotspots (marked with a red circle in Figure 2) along the road with high frequency of crashes in 2020. These locations were at merging and diverging areas where speed differential is believed to contribute to increased risk of collisions during lane change manoeuvres. However, a fatal head-on collision was reported at Location 1 involving a passenger car and a van. Investigation into the case conducted by MIROS revealed that the van was driven above the speed limit, and that both drivers were not buckled up. In this case, one of the possible explanations for the van to lose control could have been that it tried to avoid vehicles merging from the left. It then ran-off the narrow kerbed median and encroached onto the opposite direction before colliding with the passenger car.

[1] Road length obtained from Road Statistics Book published by the Public Works Department, Malaysia 2018.

[2] Passenger cars include multi-purpose vehicle, 4-wheel drive, sports-utility vehicle and van.

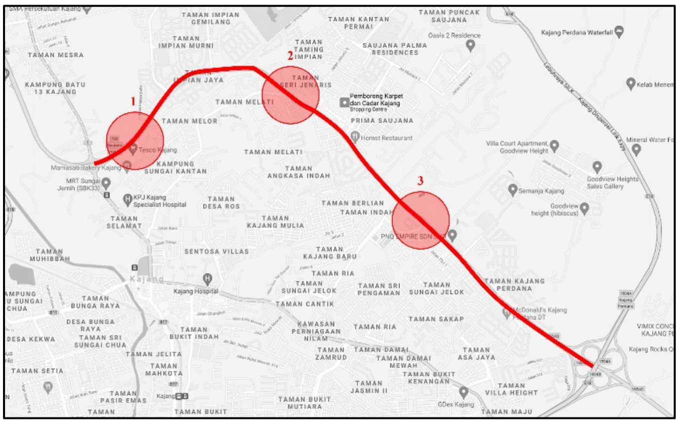

Figure 2: Locations with high frequency of crashes in 2020 (*Source:* Google Maps Data, 2021)

All the above information would not suffice to call for immediate risk assessment along this road if not for engagement with the local community in which more accounts of crashes were reported and which triggered a sense of urgency within MIROS. A team was setup who sought for information and contacts of community leaders in the areas in addition to close contacts and referrals. The efforts paid off when connection was made with the head of community committee and other non-governmental organisations (NGO) as well as local council representatives. The engagement was successful in gathering documents and facts of road safety issues endured by the community. Among the issues raised were road ownership and road maintenance responsibilities.

The engagement process led to calls for immediate improvement to the road and infrastructure system, albeit temporary, before permanent solutions are implemented. Among the proposed measures include setting up temporary median concrete barrier, enhancement of the existing transverse bars as well as installation of warning lights and signboards. Within a short period of time, the proposed measures were implemented, and the number of crashes had seen a drastic drop. This effort showed that public pressure indeed worked for immediate safety improvement which otherwise would only be carried out when the issues deteriorate further. Such effort motivated the present study to conduct an extensive assessment to identify a long term and a more sustainable intervention programme.

2. Method

The variation in the level of risk for the entire road length was obtained by estimating the risk for each 100 m road segment for each direction. In total, there were 112 road segments inspected for more than 50 road attributes covering roadside elements, cross-section elements, the horizontal and vertical alignment, intersection layout, delineation, road surface condition, facilities for the vulnerable road users, traffic flows and speeds, and several other built environment characteristics. Images used in the inspection were taken from Google Street View captured in April 2019, supplemented with information obtained through site visits conducted in November 2020. All inspected data were uploaded onto the iRAP Vida web-based processing software for analysis.

The iRAP International Star Rating Model Version 3.02 quantify the risk score for each individual 100 m segment as an aggregate of the risks for six crash types under the model for vehicle occupant and seven crash types for motorcyclist. The risk of each crash type was calculated based on the crash modification factors of the relevant road attributes embedded within the model. In addition, the model also calculates the average risk for every 1 km road section to reflect the quality of travel over a longer distance, besides allowing for better representation in maps. The risk score for each individual 100 m segment was calculated as follow (iRAP, 2014a):

Risk score for each 100 m segment (vehicle occupant) = Run-off LOC[3] driver side + Run-off LOC passenger side + Head-on LOC + Head-on overtaking + Intersection + Property access (1)

Risk score for each 100 m segment (motorcyclist) = Run-off LOC driver side + Run-off LOC passenger side + Head-on LOC + Head-on overtaking + Intersection + Property access + Along (2)

In order to evaluate whether safety benefits gained from a countermeasure programme would justify the costs of implementation, the benefit-to-cost ratio (BCR) for each programme was calculated. A BCR value of one means that the total value of safety benefits equals the total cost of countermeasure. The calculation of BCR involved comparison between the monetary benefits of the number of lives saved and the costs of a particular countermeasure programme. Therefore, a programme with BCR of more than one indicates that the programme generates a positive return on investment. The iRAP provides a rule-of-thumb to quantify safety benefits using the value of a statistical life (VSL) and the value of a statistical injury (VSI) as a function of the per capita gross domestic product (per capita GDP, current price) expressed in local currency. The iRAP rule-of-thumb defines that (Dahdah & McMahon, 2008):

$$VSL = 70 \ x \ per \ capita \ GDP \quad (3)$$

$$VSI = 17 \ x \ per \ capita \ GDP \quad (4)$$

Thus, the safety benefits or the savings in crash costs generated by a countermeasure was calculated by multiplying the VSL and VSI with the respective expected number of fatalities and serious injuries reduced over a 20-year period into the implementation. The value of safety benefits accrued over the 20-year period was converted to present value by applying a discount rate of 12%. On the other hand, the average costs for all potential countermeasures were estimated based on information provided by the Public Works Department (JKR Malaysia), taken into consideration of the service life for each countermeasure. In other words, the cost of a particular countermeasure was doubled if its service life is 10 years and quadrupled if it is expected to last 5 years over the analysis period.

As part of the process of quantifying the safety benefits, the iRAP model uses the total reported annual fatalities to make estimates of the number of fatalities and serious injuries that occur on each individual 100 m based on the calculated risk score as in Eq. 1 and Eq. 2. This estimation also considers traffic flows and the underlying trend in fatalities in a non-linear relationship (iRAP, 2014b). In this paper, the actual number of fatalities used in the calibration process was 1.4 fatalities per year with vehicle occupant and motorcyclist making up 30% and 70% of the total fatalities, respectively. Based on the available crash statistics, no pedestrian or bicyclist fatalities were reported.

3. Results

The road environment along Persiaran Saujana Impian varies in terms of land use, access point density and vertical alignment. The section between Kajang Perdana Interchange and Prima Saujana consists of mostly commercial areas, less access points (presence of service roads) and with rolling terrain of not more than 6% gradient. The section between Prima Saujana and Saujana Impian Interchange on the other hand consists of mostly residential areas, more access points and a flat terrain. The latter section is relatively more built-up as it is closer to the Kajang town centre. Speed studies along this road

[3] LOC – Loss of Control

estimated that the operating speed was between 80 km/h and 90 km/h, far exceeding the speed limit of 60 km/h.

Inspection on the road characteristics for every 100 m segment revealed several critical road attributes which contribute to increased risk of crashes and which are directly associated with high injury severity outcome (Table 1). For example, the presence of trees and poles less than 5 m from the travel lane leave inadequate space for errant drivers to recover back onto the travel lane. In the event of a high-speed collision, these rigid objects pose a severe impact on vehicle occupants whose survival chance is greatly reduced. More than 60% of the road length has kerbed median to separate the opposing traffic, but the narrow width is considered insufficient to prevent cross-bound crashes. Despite having channelisation at intersection areas, the layout of some of the intersections were hardly noticeable from driver's view.

Table 1: Critical road attributes

Road attributes	Categories	Length (km) / Number
Presence of roadside objects (left side)	Trees >10cm diameter	3.3 km
	Sign, post or pole > 10cm diameter	2.1 km
	Crash barrier	1.8 km
	Rigid/semi-rigid structure or building	1.0 km
	Deep embankment / drainage ditch	0.5 km
	Low rigid object > 20cm high	0.4 km
	Unprotected crash barrier end	19 sites
Presence of roadside objects (median)	Sign, post or pole > 10cm diameter	7.1 km
	Crash barrier	3.1 km
	Rigid/semi-rigid structure or building	0.1 km
	Unprotected crash barrier end	8 sites
Distance between roadside objects and travel lane (left side)	0 to <1m	2.9 km
	1 to <5m	7.8 km
	5 to <10m	0.2 km
	>=10m	0.2 km
Distance between roadside objects and travel lane (median)	0 to <1m	9.2 km
	1 to <5m	1.7 km
	5 to <10m	0.2 km
Paved shoulder	Narrow (< 1m)	7.4 km
	Medium (1m to < 2.4m)	3.4 km
	Wide (> 2.4m)	0.3 km
Median type	Crash barrier (semi-rigid)	3.2 km
	Crash barrier (concrete)	0.3 km
	Kerbed median (width 5m to < 10m)	0.8 km
	Kerbed median (width 1m to < 5m)	3.9 km
	Kerbed median (< 1m)	2.9 km
Intersection type	Merge lane (left in-left out)	14 sites*
	3-leg signalised with protected turn lane	2 sites*
	Median U-turn	4 sites*

*Counted for both directions

Based on the inspected road attributes, the risks of the six crash types were estimated for every 100 m. The analysis was generated using the iRAP International Star Rating Model Version 3.02 in the Vida web-based software for both directions of travel. The results revealed that the road section between Saujana Impian and Prima Saujana is averagely a high-risk section[4] for vehicle occupant (2-star) and motorcyclist (1-star) whereas the section between Prima Saujana and Kajang Perdana is considered satisfactory for vehicle occupant (3-star) but high-risk for motorcyclist (Figure 3). These results reflect the characteristics between the two sections which differ in terms of the density of roadside hazards, number of intersections, number of property access points as well as median type. While the crash risk for vehicle occupant was acceptable between Prima Saujana and Kajang Perdana, the condition along the entire stretch of the road was found not satisfactory for motorcycle use. Figure 4 and Figure 5 show the breakdown of the individual 100 m risk by crash types for vehicle occupant and motorcyclist respectively.

Figure 3: Star rating map for vehicle occupant (left) and motorcyclist based on average risk

The breakdown shows that vehicle occupant risk for 36 individual 100 m segments (65%) for the direction from Saujana Impian to Kajang Perdana and 33 segments for the other direction exceeded the high-risk category threshold score of 12.5. In contrast, close to 90% of all the segments in both the directions were rated as high-risk for motorcyclist. The risk profiles clearly show that run-off crashes were dominant over the other crash types for both vehicle occupant and motorcyclist, indicating that high priority should be given to countermeasures that could reduce the likelihood and severity of these crashes. This is followed by intersection crashes which make up 8% of the total risks for vehicle occupant and 7% for motorcyclist. The analysis also revealed that 25% of the total crash risk among motorcyclist was influenced by road attributes that increased the risk of collisions with other vehicles at the midblock (see Motorcyclist SRS Along).

A total of eight countermeasure programmes were identified that have the potential to reduce the number of fatalities and serious injuries among vehicle occupant and motorcyclist along Persiaran Saujana Impian. These programmes were shortlisted out of more than 150 options based on the amount of safety benefits that outweigh or at least equal the cost of their implementation (BCR exceeding one). Table 2 lists the eight programmes sorted in the ascending order of BCR, in which higher value means a programme is more worthy to be implemented. Going by this context, constructing median crash barrier and improving the road delineation at midblock are the least recommended as the safety benefits gained are equal to the costs, while removing roadside hazards is the best option in the list. Note that some countermeasures require expanding the right of way (ROW) which may not be feasible due to site constraints. Site investigation is therefore recommended to ascertain the practicality of any countermeasures.

This proposed investment plan is expected to reduce the number of high-risk segments for vehicle occupant by more than 80% for the Kajang Perdana bound carriageway and more than 90% for the Saujana Impian bound carriageway. In relation to motorcyclist, the number of high-risk segments for both the carriageways is expected to constitute less than 25% of the total length. The plan, if fully implemented now, could on average yield a safety return three times of the cost. In other words, the country would generate RM3 for every RM1 spent on the eight programmes in the next 20 years.

[4] High-risk section refers to road rated as 1-star (coded black) or 2-star (coded red) whereas acceptable-risk section refers to 3-star road (coded orange).

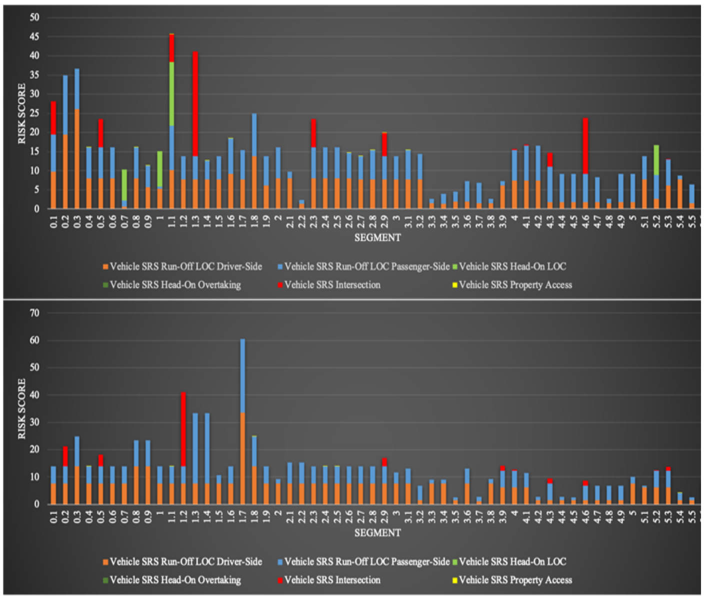

Figure 4: Crash risk profile for vehicle occupant from Saujana Impian to Kajang Perdana (top) and Kajang Perdana to Saujana Impian (bottom)

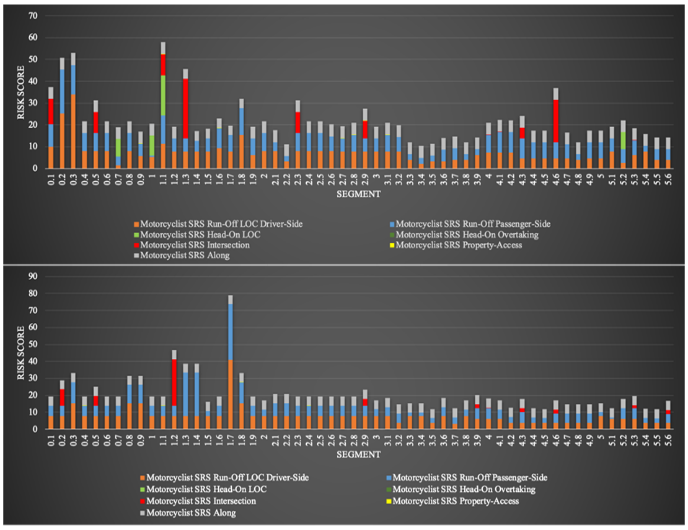

Figure 5: Crash risk profile for motorcyclist from Saujana Impian to Kajang Perdana (top) and Kajang Perdana to Saujana Impian (bottom)

Table 2: High-impact countermeasure programmes

Countermeasure	Length/ Sites	FSIs saved	Present value of safety benefit (RM)	Estimated cost (RM)	Cost per FSI saved (RM)	BCR
Crash barrier (median)	1.10 km	2	885,690	926,933	403,643	1
Midblock delineation	1.00 km	1	503,462	484,871	371,442	1
Crash barrier (left side)	8.50 km	46	17,850,684	10,270,845	221,913	2
Paved shoulder > 1 m (median)	7.70 km	5	1,869,553	1,204,125	248,408	2
Curve delineation	0.20 km	2	623,397	212,131	131,241	3
Road surface rehabilitation	0.30 km	1	419,986	162,404	149,140	3
Intersection delineation	2 sites	1	314,645	121,218	148,585	3
Shoulder rumble strips	11.00 km	49	18,917,339	567,127	11,562	33
Total			**41,384,756**	**13,949,654**		**3**

Information used in the analyses:
i. GDP/capita (2019): RM46,366 (www.imf.org)
ii. VSL (2019): RM3.25mil
iii. VSI (2019): RM0.81mil
iv. Death to serious injury ratio: 1 to 10
v. Analyses period: 20 years
vi. Discount rate: 12%

FSI – Fatal and serious injury

4. Discussion

The road environment along Persiaran Saujana Impian was found to be very risky for motorcyclists as there were no means of segregation provided. This explains the high number of fatalities among motorcyclists who over-represented the total number of casualties since 2015. They could not even ride on the paved shoulder most of the time as about 67% of the paved shoulder length was less than 1 m wide. No segregation increased the risk of fatal collision between motorcycles and other vehicles especially on such high volume and high-speed road as proven through a comprehensive study on motorcycle fatal crashes in Malaysia (Abdul Manan et al., 2018). Another study on motorcycle crashes on Malaysian primary roads had evidently demonstrated the effective use of the non-exclusive motorcycle lane in reducing the number of motorcycle crashes in urban areas (Alvin Poi et al., 2019) but it comes with a challenge in terms of funding. The most critical issue for vehicle occupant was presence of roadside hazards such as the street lighting poles and trees. Based on the BCR analysis, the best solution is to install crash barrier.

Despite findings indicating that roadside crash barrier might increase the frequency of run-off crashes, it is an effective measure to reduce the injury severity of those crashes (Park et al., 2016). On the median, the severity of collision with crash barrier or with other vehicles upon redirection were much lower compared to the severity of hitting other hazards or in the event of cross-bound crashes, head-on collision with opposing vehicles (Zou & Tarko, 2018). Data obtained from a benefit-cost analysis in Italy showed significant safety benefits in terms of reduction in fatal and severe injury run-off crashes at sites retrofitted with crash barriers (Cafiso & D'Agostino, 2017). Retrofitting existing roads with crash barriers however is a costly option owing to the fact that underground utilities may have to be relocated.

The most cost-effective countermeasure for Persiaran Saujana Impian was found to be the shoulder rumble strip which was estimated to cost the least per FSI saved. This low-cost treatment can be in several different forms from grooves to plastic ribs placed on the road surface. Depending on the types used, the generated vibration and the level of noise varies, and it could be a concern to nearby residents (Horne et al., 2019). Nevertheless, it was reported in several studies that it could reduce run-off road and head-on crashes by up to 25% (iRAP, 2010). Several studies had demonstrated the effectiveness of rumble strip in reducing run-off road crashes (Khan et al., 2015). Although proven effective in reducing the number of crashes, the use of rumble strip alone is not sufficient to reduce the severity of injury (Wu et al., 2014), especially if roadside hazards are present. Better safety outcome is obtained therefore if rumble strips are used at locations without roadside hazards. However, due to noise concerns the use of this treatment should be discussed at the local level with the affected community to mitigate any potential negative effects in the longer term.

The proposed investment plan provides an ideal list of countermeasures that cost as much as RM14mil but could potentially save more than 100 FSIs over a 20-year period, generating more than RM40mil savings in return. Given that cost is a constraint, it is recommended to prioritize countermeasure programmes that save more FSIs, in this case the shoulder rumble strip. By spending less than a million ringgit, over the next 20 years, the government could expect to get safety returns in a scale more than 30 times the initial investment. No doubt this type of road treatment is still new in Malaysia, but its benefits have been proven in many other countries. A study in Japan found that rumble strips is not only safe for motorcycles but could also prevent run-off and head-on crashes (Hirasawa et al., 2005). The only concern relates to disturbance from the noise, but certain designs produce very minimal noise that could affect adjacent community.

In order to realise a successful implementation of the proposed investment plan and reaping the safety benefits as forecasted, the first and the most crucial step is empowerment of the existing taskforce to formulate a strategic plan. The task force shall consist of relevant stakeholders who are able to facilitate among others sourcing of fund, setting of programme milestones, setting of implementation plan, tracking of implementation progress and evaluation of safety outcomes. This taskforce could be formalised under the relevant local government regulations or under the Ministry of Transport as a special committee to ensure the goals of the strategic plan are achieved. It is also important for each stakeholder to have a clear understanding on their roles so that no single party is left doing nothing or doing something that is redundant. Table 3 shows a simple RACI matrix of the potential stakeholders in the task force and their respective roles within the strategic plan.

	R.A	NGOs	RMP	MIROS	MPKj	PWD	Ministries
Assess risk and identify countermeasure programmes	I	I	I	R	C	C	I
Seek for programme funding	I	I	I	C	C	R	A
Establish programme milestones and targets	I	I	I	C	C	R	A
Formulate strategic plan and identify potential issues	C	C	C	C	C	R	A
Formulate implementation plan and identify potential issues	C	C	C	C	C	R	A
Execute implementation plan and report progress	I	I	I	I	C	R	A
Monitor implementation progress and identify corrective actions	I	I	C	I	C	R	A
Evaluate outcomes for continuous improvement	C	C	I	R	C	I	I

Note:
R – Responsible; A – Accountable; C – Consulted; I – Informed
R.A – Resident Associations; RMP – Royal Malaysia Police; MPKj – Kajang Municipal Council; PWD – Public Works Department; Ministries – Ministry of Transport, Ministry of Works, Ministry of Housing & Local Government

Aside from engineering modification works carried out by the road authorities, managing traffic speed is equally important to reduce the likelihood of crashes. Although not being shortlisted in the proposed investment plan, speed management strategies such as police enforcement is critical in reducing the rate of speed violations especially during the wee hours. However, participation of the community in advocating for speed compliance could help scale up the effects among the local traffic as such initiative is usually more frequent than police enforcement activity.

5. Conclusion and Recommendations

Persiaran Saujana Impian observed increased rate of crashes for the last five years as more housing and commercial developments induced additional traffic to the already high through-traffic between Kajang town and Semenyih. Despite some minor maintenance works over the years, the road environment was found to be risky to road users especially motorcyclists who over-represented the number of fatalities. Besides crash information from the police, engagement with the local community had shed light on several other issues which explain the lack of safety initiatives being carried out ever since the road was built. One major issue brought to MIROS attention was that the ownership of the road remains unclear among the various road authorities. In the interest of public safety, this study was initiated to assess the level of safety conditions along this road, to identify high-impact countermeasure programmes and to propose a strategic framework to ‘localise’ road safety improvement programmes. Using the iRAP assessment methodology, this 5 km dual carriageway road was assessed for six types of vehicle occupant crash risk and seven for motorcyclists.

The assessment revealed that close to 90% of the road length was indeed high-risk to motorcyclists and more than 60% for vehicle occupants. The likelihood and severity of run-off crashes were found to be the main risk factors for both road users, followed by intersection and head-on crashes. These were due to the presence of roadside hazards, poor intersection design and narrow physical median. In addition, the narrow paved shoulder do not provide a safe riding space for motorcyclists which contributed to the high degree of exposure between motorcyclists and other vehicles. A total of eight countermeasure programmes were proposed in an investment plan that costs approximately RM14mil and which were predicted to save more than 100 FSIs over a 20-year period. The shoulder rumble strips appeared to be the most cost-effective countermeasure due to its high effectiveness in reducing FSIs and its low cost of implementation. The overall programme was forecasted to generate three times the investment amount in the same period, indicating a promising sustainable investment plan.

This paper also proposed setting up of a formal taskforce comprising of local stakeholders to realise a successful implementation of the investment plan. A strategic framework should be formulated to outline the roles and responsibilities of each stakeholder to optimise the available resources and maximise the returns. The spirit behind the proposed taskforce is to uphold a high level of good programme governance through effective coordination among the stakeholders. In this regard, public pressure plays a vital role in the strategic plan to take road safety effort to a higher level. This paper concludes that ‘proven vaccines’ for roads exist and should be put to good use by those in the governing institutions and should be leveraged by those who use the roads.

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