

Perception of Road Users and Stakeholders Towards Traffic Management Plan at Work Zone Area

Hisam Masry Saedin¹, Mohd Khairul Afzan Mohd Lazi^{2,*}, Aliyu Mani Umar², Sitti Asmah Hassan², Hanini Ilyana Che Hashim³, Mohd Zulfabli Hasan³, Teh Zaharah Yaacob³

¹ Muda Agricultural Development Authority (MADA), 05990 Alor Setar, Kedah, MALAYSIA

² Faculty of Civil Engineering,
Universiti Teknologi Malaysia, Johor Bahru 81310, MALAYSIA

³ Faculty of Management
Universiti Teknologi Malaysia, Johor Bahru 81310, MALAYSIA

*Corresponding Author: mohdkhairulafzan@utm.my
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Abstract

The rapid development of Malaysia today contributes towards an increase in road users. High traffic on the highway and construction of road upgrading and maintenance work have a high risk of accidents. Therefore, a perfect and efficient traffic management plan must be enhanced to avoid road accidents. An efficient traffic management plan can ensure that traffic runs smoothly at an acceptable level while reducing the risk of road accidents. This study aims to evaluate the comprehension and implementation of the parties directly involved in the traffic management plan during road construction, upgrading work, or repairs as well as road users. This will be achieved through a well-structured questionnaire. This study case is carried out along the Projek Menaiktaraf Laluan 7 Persimpangan Lencongan Barat Ke Persimpangan Simpang Tiga Kemboja, Kedah Darul Aman is about 14.3 km long. The study indicates that those responsible for road construction (upgrading and maintenance work) have a good understanding of the Traffic Management Plan and follow the guidelines provided in the *Arahan Teknik Jalan (ATJ) 2C/85 Pindaan 2017* (Manual on Traffic Control Devices). Moreover, the study reveals that road users are satisfied with the Traffic Management Plan carried out during the construction work.

1. Introduction

The management of traffic in work zone areas is a critical component of road safety and efficiency. In Malaysia, the rapid development of infrastructure has necessitated frequent construction and maintenance activities, which often lead to the establishment of work zones. These work zones, while essential for the upkeep and expansion of road networks, pose significant challenges to road users and stakeholders alike (Rashid et al., 2019). The complexities of navigating through or around these areas can lead to increased travel times, elevated stress levels, and heightened risks of accidents (Abdelmohsen & El-Rayes, 2016). An understanding of the perceptions of road users and stakeholders towards traffic management plans (TMPs) in work zones is vital for developing strategies that minimize negative impacts (Abdelmohsen & El-Rayes, 2018). Road users, including drivers, pedestrians, and cyclists, are directly affected by changes in traffic flow, signage, and road conditions.

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Stakeholders, such as local businesses, residents, and government agencies, also have vested interests in how these areas are managed, as disruptions can affect economic activities and community well-being (Bae et al., 2017).

Despite the importance of effective traffic management in work zones, there has been limited research focusing on the perceptions and experiences of those most affected. This gap in the literature is particularly evident in the context of Malaysia, where diverse road users and stakeholders may have unique perspectives influenced by cultural, economic, and infrastructural factors. Addressing this gap is crucial for the development of tailored TMPs that can enhance safety, reduce congestion, and improve overall satisfaction with road infrastructure projects.

This paper aims to explore the perceptions of road users and stakeholders towards TMPs in a work zone area in Malaysia. In the next section, review of relevant literature on traffic management in work zones is presented. Section 3 describes the methodology used in this study. Section 4 presents and analyse the findings, and discuss their implications for practice on policy. Section 5 ends the paper with some conclusions and recommendations.

2. Literature Review

Traffic management in work zones is crucial for safety, efficiency, and project success (Sabeti et al., 2024). Work zones pose unique risks, such as changes in traffic flow and construction equipment. Effective traffic management prevents accidents and ensures driver safety (Shahin et al., 2023). Strategies reduce worker exposure to traffic, lowering accident and injury risks. Human behaviour is the primary cause of road accidents (Al-Bdairi, 2020). About 81 % of road accidents are caused by human negligence, with situational factors contributing 13 % and vehicles 6 % (Jiao & Tsai, 2018). The figure for the average number of road accident deaths in Malaysia is at an alarming level. With the increasing rate of accidents in Malaysia, Malaysia's Road Safety Council was formed to develop recommendations for preventing and controlling road accidents (Abd Rahman et al., 2023).

Traffic management is an important element in every project to upgrade or construct a road. Compliance with traffic management plans should be implemented to increase drivers' safety levels to avoid accidents on construction site routes (Abdelmohsen & El-Rayes, 2016). Various construction activities are carried out during the project period. The contractor must consider the safety of all parties including the public while reducing disruption to existing traffic conditions. Thus, to reduce disruption to traffic conditions, among them is the design and planning of TMP (Huang et al., 2023).

Road users' perceptions are crucial to the success of TMPs, especially during maintenance work (Shahin et al., 2023). To ensure a positive perception, it is essential to understand the concerns of road users and improve overall acceptance (Valdes et al., 2020). Clear and timely communication is key to informing road users about maintenance work and associated TMPs. The effectiveness of communication strategies often determines the perception of road users (Papamichail et al., 2018). Shakouri et al. (2016) suggest that road users' satisfaction levels increase when they have positive experiences, such as minimal disruptions and well-managed detours. Additionally, addressing safety concerns, such as adequate signage and visibility of construction zones, positively impacts road users' perceptions (Ahmed et al., 2017).

3. Methodology

3.1 Study design

This study employed a cross-sectional survey design to gather data on the perceptions of road users and stakeholders towards TMPs in a work zone area in Malaysia. The survey was conducted using a structured questionnaire designed with a Likert scale to quantify the perceptions and attitudes of the respondents (Tables 1, 2 & 3). The questionnaire was meticulously designed to capture various dimensions of traffic management perceptions. It included sections on demographic information, general perceptions of work zone traffic management, specific concerns related to safety, convenience, and communication, and suggestions for improvement. Each item on the questionnaire used a three-point Likert scale ranging from 1 (Not sure) to 3 (Yes), allowing respondents to express their agreement or disagreement with each statement.

Table 1 Questionnaire on perception of project management personnel towards TMP.

No	Question
1	Is your party involved in road widening upgrading construction works?
2	Have you ever received a disclosure regarding a traffic management plan?
3	Have you ever attended a seminar or course on traffic management plans from a certified Traffic Management Officer (TMO)?
4	Has your party appointed a certified consultant to design a traffic management plan?
5	Did you apply for a work approval permit from the Public Works Department (JKR) or Local Authority (PBT) before completing the construction work?
6	Is a verified traffic management plan by a certified TMO necessary for work permit applications with JKR or PBT?
7	Does your party implement an approved traffic management plan?
8	In your opinion, a good traffic management plan can reduce accidents in road construction areas?
9	Have you read the traffic management plan book based on the Road Technical Directive (ATJ) 2C/85 Amendment 2017 (Manual On Traffic Control Devices)?
10	Do you agree to appoint a full-time or part-time Traffic Management Officer (TMO) at the construction site to monitor the implementation and conduct periodic audits of the Traffic Management Plan that has been prepared?

Table 1 shows the questionnaire administered to project management personnel. It assesses the awareness and understanding of TMPs, including how familiar personnel are with the plan and how frequently they utilize it. The perceived effectiveness of the TMP is also evaluated, particularly its impact on traffic flow, safety for workers and the public, and its ability to minimize project delays. Similar information is obtained on construction workers and road users' perception of TMP using the questionnaire shown in Tables 2 and 3 respectively.

Table 2 Questionnaire on perception of construction site workers towards traffic management plan.

No	Question
1	Do you know what a Traffic Management Plan is?
2	Do you understand the arrangement of warning signs and the correct spacing of each warning sign according to the Traffic Management Plan that the Traffic Management Officer has approved?
3	Are the Traffic Management Plan equipment and equipment sufficient and according to the specified specifications such as a set of warning signs, blinkers, light buttons and others?
4	Before the construction works are carried out, will your party install warning signs following the traffic management layout plan?
5	Does your upper management emphasize the implementation of the Traffic Management Plan?
6	The implementation of the perfect layout of the Traffic Management Plan can reduce the risk of accidents for road users during the construction work of upgrading/repairing the road.
7	Do you feel safe working when you have a Traffic Management Plan?

The study targeted two main groups: road users and stakeholders. Road users included drivers, pedestrians, and cyclists who regularly navigated through the work zone area. Stakeholders comprise of two parties, namely the project management and the full-time employees at the construction site. Project managers, engineers and site security officers represent the project management, while project supervisors, site security supervisors, quality control officers, on-site general workers, and other full-time employees represent the construction site workers. A total of 400 questionnaires were distributed, with 300 allocated to road users and 100 to stakeholders, ensuring a comprehensive understanding of diverse perspectives.

Table 3 Questionnaire on perception of road users towards TMP.

No	Question
1	Have you ever passed through a construction area upgrading or repairing a road?
2	Do you often pass through construction areas upgrading or repairing roads?
3	Are the number of directional signs or warning signs sufficient?
4	Is the position of direction signs/warning signs readable while you are driving
5	Are directional signs or warning signs bright and clear (not Blurry)?
6	When driving in the construction area of road upgrading or repair work, do you slow down to the speed limit set?
7	The implementation of a perfect traffic management plan can reduce the risk of accidents when passing through construction areas for upgrading or road repair work.
8	Do you feel confident and safe while passing through the construction area of road upgrading or repair work?
9	Are you satisfied when going through a temporary detour while going through the construction area of road upgrading or repair work?

3.2 Data collection

Data collection was carried out along the Laluan 7 Persimpangan Lencongan Barat Ke Persimpangan Simpang Tiga Kemboja. Questionnaires were distributed at various points around the work zone area to capture a representative sample of road users. Stakeholders were approached at the construction site and through their respective companies. Participation was voluntary, and respondents were assured of the confidentiality of their responses. A total of 143 responses were recorded as shown in Table 4.

Table 4 Number of respondents by category.

No.	Respondent Category	Total Respondents
1	Client	21
2	Main Contractor	22
3	Sub Contractor	19
4	Road User	81
	TOTAL	143

3.3 Data analysis

Responses are evaluated using an index range calculated using Equation (1).

$$\text{INDEX RANGE} = \frac{\text{MEAN HIGHEST SCORE (A)} - \text{MEAN LOWEST SCORE (B)}}{\text{NUBER OF SCALES USED (C)}} \quad (1)$$

Where, A = 2.89, B = 1.00 and C = 3. Hence,
Index range = 0.63

Table 5 Summary of index ranges for each response scale.

Scale	Response	Index range
1	Not Sure	1.00 – 1.63
2	No	1.63 – 2.26
3	Yes	2.26 – 2.89

4. Methodology

This section outlines the results of analysis done on the data obtained from respondents. Fig. 1 displays the average score of management's comprehension of the TMP for construction work on the road shoulder. The data indicates that management has a clear understanding of the plan, which demonstrates their adherence to the Arahan Teknik Jalan (ATJ) 2C/85 Amendment 2017 (Manual on Traffic Control Devices) guidelines for a comprehensive TMP. The analysis shows that management has a good understanding of the TMP during road

upgrading construction work, with an average score of 2.67. The parties directly involved in traffic management have a high level of understanding and implementation, with an average score index ranging from 2.33 to 2.78.

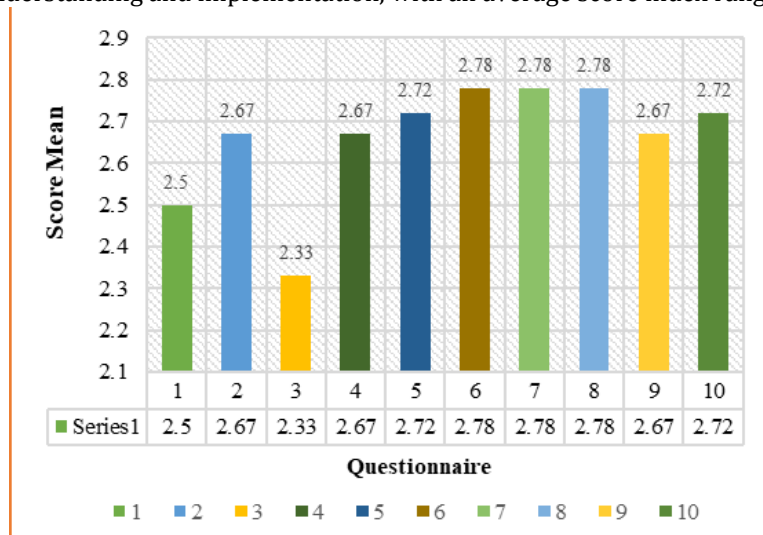


Fig. 1 Mean score of responses on project management personnel's perception of TMP.

In Fig. 2, the average score of workers who were implementing the TMP during construction work on the road is shown. It was found that most of the workers at the construction site understood and implemented the TMP. The score values obtained were 2.52, 2.66, 2.70, 2.84, and 2.89. Construction workers who are well-trained in traffic management techniques are better able to ensure safety, increase awareness, and facilitate smooth coordination with both vehicle and pedestrian traffic. Site supervisors must ensure that employees understand and adhere to traffic control procedures, set a good example, monitor compliance, and act quickly to resolve any problems.

Fig. 1, Fig. 2 and Fig. 3, display the mean score values and index scale for each question in a questionnaire that aims to assess the understanding and implementation of TMPs during the construction work on road upgrading. The majority of respondents have indicated that they possess the necessary information and have implemented TMPs during construction work on the road. However, there is room for improvement in the management team's approach. One such improvement would be to make TMP seminars mandatory. From data obtained found that most of the workers at the construction site understand the implementation of the TMP. Efficient communication and thorough training are the primary factors that help construction site workers comprehend traffic management. Employees who are knowledgeable about and properly trained in traffic management techniques are better able to maintain safety, increase awareness and facilitate smooth coordination with both vehicle and pedestrian traffic. Site supervisors must make sure employees comprehend and adhere to traffic control procedures. They ought to set a good example, keep an eye on compliance and act quickly to resolve any problems.

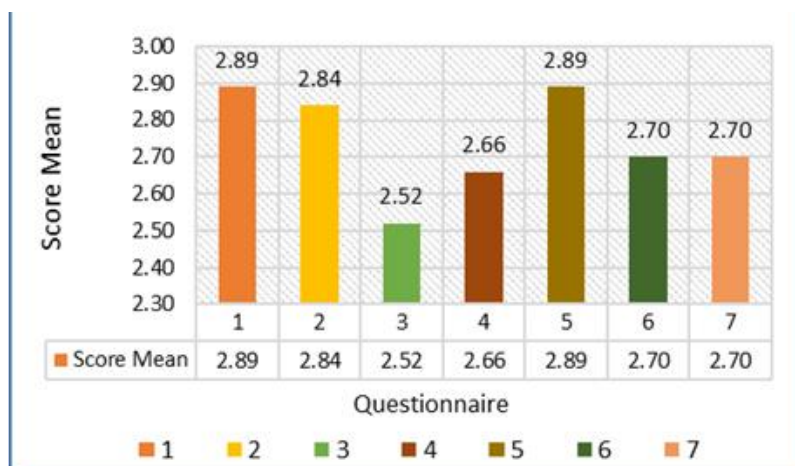


Fig. 2 Mean score of responses on construction workers' perception of TMP.

The survey results show that road users gave positive scores for construction and maintenance works on roads, indicating satisfaction with the implementation of TMPs. Efficient communication, education, and clear

signage are crucial for ensuring safety and smoother traffic flow. Directional and warning signs were found to be easily readable and bright. The road users also feel safe when through the construction area, they have given value score of 2.15 to the party that has done a good TMP and the score value of 2.23 shows the confidence of road users through the construction area.

The TMP implemented during construction has garnered positive feedback from road users. They feel secure while navigating through the construction area on the road shoulder. The party responsible for the plan has earned a commendable value score of 2.15 from road users (Fig. 3), indicating their significant satisfaction. Moreover, the score value of 2.23 is a showing the trust of road users in the safety measures implemented (Figure 3). For successful traffic management in work zones, a comprehensive strategy with a focus on safety, communication, efficiency, and public satisfaction is essential. Regular evaluation and user feedback are critical for ongoing improvement and building community trust and support for upcoming projects. Real-time feedback enables effective decision making. Clear communication through signs, information distribution, and early warnings is critical to success.

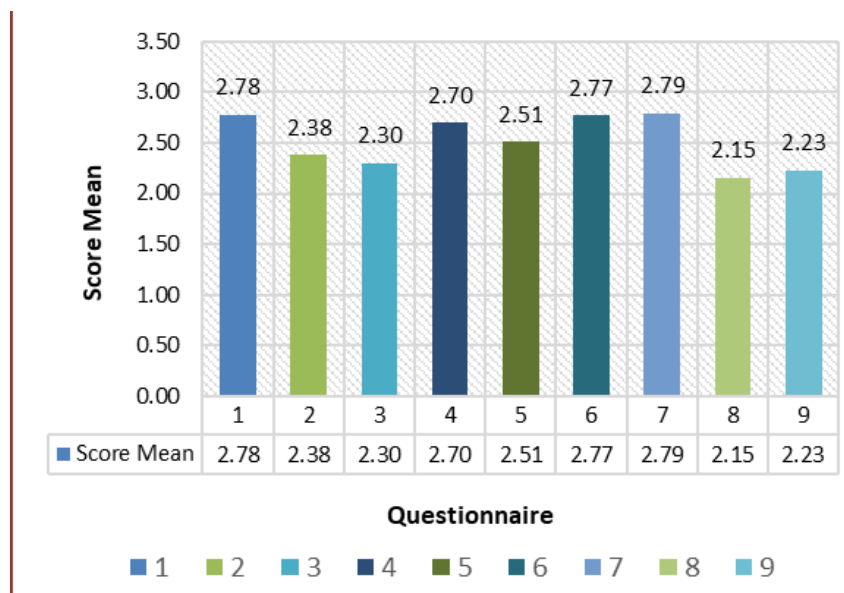


Fig. 3 Mean score of responses on road users' perception of TMP.

5. Results and discussion

By According to the study, it is evident that the entity accountable for managing traffic during the construction of the Laluan 7 Persimpangan Lencongan Barat Ke Persimpangan Simpang Tiga Kemboja project comprehended the necessities and significance of the TMP. However, the management can further improve the skills, capabilities, and knowledge of employees involved by conducting seminars or refresher pieces of training on the TMP. This can benefit project managers, engineers, site safety supervisors, quality control supervisors, and construction workers.

The contractor has provided the necessary tools for the TMP, such as bright and clear warning signs, sufficient plastic barriers, cones, and other equipment. However, both parties need to ensure that periodic audits are conducted to ensure that the TMP equipment is always in good condition and can be used. If there is any damage to the plan tools for traffic management, it should be necessary to replace them with new ones. According to the findings, individuals who have passed through the construction zone of road upgrading work have given positive feedback. This means that every question that has been answered has received an 80% or higher approval rating. It appears that road users are content with the TMP that has been implemented during the construction process.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: **study conception and design:** Hisam Masry Saedin, Mohd Khairul Afzan Mohd Lazi; **data collection:** Hisam Masry Saedin; **analysis and interpretation of results:** Hisam Masry Saedin, Aliyu Mani Umar, Sitti Asmah Hassan; **draft manuscript preparation:** Hanini Ilyana Che Hashim, Mohd Zulfabli Hasan, Teh Zaharah Binti Yaacob. All authors reviewed the results and approved the final version of the manuscript.

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