Implementation of The Traffic Conflict Technique Method at Pontianak's unsignalized intersection
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Abstract
The high number of traffic accidents is a problem for the government in realizing traffic security, safety, and smoothness. Intersections are the most common point of conflict, especially unsignalized intersections. The research location of the intersection of Jl. Budi Utomo - Jl. 28 October-Jl. Parit Nenas, Siantan Hulu Village, North Pontianak District, and Pontianak City intersect environmental-type commercial roads with many vehicles and education centers. The research objectives are to identify traffic conflicts, analyze the level of traffic conflicts, and provide alternatives to overcome problems.

Traffic Conflict Technique is an observation method to analyze traffic conflict that illustrates the seriousness of the conflict. The research data used CCTV recording for two days, Saturday and Tuesday. The Traffic Conflict Technique method uses the Time to Accident and Conflicting Speed values to determine the seriousness of the conflict.

Based on the analysis of the Traffic Conflict Technique method, the research location with 34 vehicle conflicts has a severe level of conflict that could potentially cause accident risk. The level of serious conflict is 27 vehicle conflicts, with a percentage of 79.41%. Vehicle speed in the class 15 km / h - 19 km / h is the most severe conflict speed, with 12 vehicle conflicts and a percentage of 44.44%. Accelerating vehicle behavior is the most severe conflict, with 25 vehicle conflicts and a percentage of 83.33% of accidents that have the potential to occur. Alternatives to reduce the causes of accidents are adding traffic signaling devices and traffic signs to improve safety.

1. Introduction
Pontianak is the capital of West Kalimantan Province, which is the center of administrative activities, trade, and services. It is experiencing a relatively rapid increase in economic improvement and population growth. Transportation is the essential means in a country; the development of a country can be measured by the progress of transportation in a country (Transport aims to facilitate human activities in daily life, thus increasing the number of vehicles (Paiva et al., 2021; Kent, 2022). Increased vehicle ownership will certainly affect road congestion, which can lead to traffic jams and accidents. Traffic congestion and accidents are transportation conflicts that are difficult to separate due to the increasing level of vehicle ownership and the number of victims that cannot be said to be small and have a considerable impact (Chalid, 2018), as well as those that occur in Pontianak. Based on accident rate data from Pontianak Police in 2022, it is known that there were 311 cases of traffic accidents recorded in Pontianak, with the number of fatalities increasing by 15% from 32 people in 2021 to 49 people in 2022.

In Law No. 22 of 2009 concerning road traffic and transport, transportation aims to realize traffic and road transport safely, safely, quickly, smoothly, orderly, regularly, comfortably, and efficiently; this indicates that safety is an aspect that needs to be considered. However, the facts show that this goal has yet to be fully achieved because frequent traffic accidents occur.

The driver factor in the form of evil and disorderly driving behavior such as speeding,
Evasion and sudden braking are vulnerable or contribute significantly to causing traffic accidents (Saprollah et al., 2022). An example that often occurs is a vehicle suddenly stopping or cutting lanes, which can cause spontaneous reactions or actions of other road users, resulting in conflicts and even traffic accidents. The location that has the potential for unruly behavior is the intersection; this is because intersections are characteristic of black spot areas, which are locations on the road network where the frequency or number of traffic accidents per year is greater than the minimum number specified (Sabrina et al., 2022). The number of traffic accidents at unsignalled intersections in the Indonesian Road Capacity Manual is estimated at 0.60 accidents per million vehicles (Saprollah et al., 2022).

The intersection of Jl. Budi Utomo - Jl. 28 October-Jl. Parit Nenas in Pontianak is one type of unsignalled intersection close to the center of community activities. As an access that connects between districts/cities in West Kalimantan, traffic conditions at this intersection are quite congested every day and have the potential for conflicts or traffic accidents. Therefore, preventive measures must be taken to reduce accidents at this location. This study aims to (a) identify traffic conflicts at unsignalled intersections, (b) analyze the level of traffic conflicts at unsignalled intersections, and (c) provide alternatives to overcome the problems found at unsignalled intersections to improve the safety and comfort of road users at unsignalled intersections.

2. Materials and Methods

2.1 Theoretical Frame Work

An intersection is a meeting or branching of roads, either on a level or not level. In other words, an intersection can be defined as two or more lanes of roads that intersect and include roadways and roadside facilities (Widyawan, 2019). An intersection (in MKJI 1997 called an unsignalled intersection) is a type of intersection that is a meeting of two or more intersecting roads that are not regulated by traffic signals (APILL) (DPU, 2014).

Traffic accidents at unsignalled intersections are estimated at 0.60 per million vehicles (Saprollah et al., 2022); this indicates that the goal of realizing safe and secure transportation still needs to be 100% achieved. One of the main contributing factors to these traffic accidents is the erratic conduct of drivers when turning at crossroads. Therefore, an analysis is needed to determine the level of traffic safety and the cause-and-effect relationship between irregular behavior and accidents so that it can become a reference in realizing zero accidents at intersections, one of which is the Traffic Conflict Technique method used.

2.2 Unsignalled Intersections

Unsignalled intersections are identified as critical locations due to more road crashes at these locations. The primary causes of crashes at unsignalized intersections are (a) limited sight distance, (b) incorrect assessment of gaps by drivers on minor roads, and (c) higher speeds of vehicles on major highways (Rachakonda & Pawar, 2023). Unsignalized intersections are intersections or meetings on a flat plane between two or more lanes of road with each intersection and at points of intersection that are not equipped with lights as intersection signs (Irzadi et al., 2020). At unsignalized intersections, traffic conflicts often risk accidents and impact vehicles' movement through the intersection (Pamungkas et al., 2023).

2.3 Traffic Conflict

A traffic conflict is an observable event that would end in an accident unless one of the involved parties slows down, changes lanes, or accelerates to avoid collision (Arun et al., 2021).

The dimensions of traffic conflicts are determined by the cars' positions in space and time, as well as the time to collision, post-encroachment time, and angle of conflict (Qi et al., 2020). Since it might be difficult, risky, or impractical to observe and monitor individual collisions, traffic conflicts have traditionally been employed in transportation safety studies. (Taylor & Bonsall, 2017).

Under the presumption that the same factors affecting collision rates also affect conflict rates in proportion to the conflict severity, known as the conflict hierarchy, traffic conflicts are employed as surrogates for traffic collisions (Sacchi & Sayed, 2016). All forms of transportation involving vehicles traveling in an unguided medium, such as powered cars, aircraft, boats, and bicycles, are subject to the rules governing traffic conflicts. (Duarte & Firmino, 2017).

Red-light violations, rear-end, left-turn, cross-traffic, and weave problems are the main conflicts at intersections. Conflict counts can rapidly assess environmental modifications, signage, signalization, and road design (Arun et al., 2021). Every point at the intersection is a possible accident location, and the accident's severity depends on the vehicle's relative speed (Jurewicz et al., 2016).
Fig 1. Potential Conflict Points at the Fourth Intersection (Direktorat Jenderal Perhubungan Darat, 1996)

In general, the course of the study is as shown in Figure 1 below.

2.4 Research Location

The research was conducted at the intersection of Jl. Budi Utomo - Jl. 28 Oktober - Jl. Parit Nenas. The geographical location of the junction of Jalan Budi Utomo - Jalan 28 Oktober Jalan Parit Nenas is as follows:
- West direction: connecting access to Jl. Khatulistiwa;
- East direction: connecting access to Jl. Selat Panjang;
- North direction: connecting access to Jl. Abdurrahman and
- South direction: connecting access to Jl. Sultan Hamid II.

2.5 Data

The data used in this study are primary data and secondary data. The primary data for this study are intersection geometric conditions and vehicle conflicts (vehicle distance, vehicle time, vehicle speed, and vehicle behavior) obtained from CCTV recordings installed at the intersection.

Fig 3. Research Location

Fig 4. Location and Placement of CCTV in Research

This research gathered information about road geometry from road geometry surveys at the intersection of Jl. Budi Utomo, Jl. 28 Oktober, and Jl. Parit Nenas, the research location, has the pavement's condition being examined. Observations show it appears good in areas without damage, such as cracks, holes, or other issues obstructing traffic flow.
For this study, secondary data collection is obtained from related agencies, references in the form of books and journals, or the results of research and projects carried out in the intersection area of Jl. Budi Utomo - Jl. 28 October-Jl. Parit Nenas.

2.6 Analysis Method

This study analyzed vehicle speed and distance using The Traffic Conflict Technique Method. Traffic Conflict Technique (TCT) is a method that can be used to describe the seriousness of conflicts at intersections and road sections (Putra et al., 2019). Traffic Conflict Techniques can help detect a place with the potential for accidents without accident rate data (Sugasta et al., 2022).

The TCT method requires data in the form of speed (V) and distance (D); both data produce a time to accident (TA) value. TA is the time remaining from the avoidance action when a collision occurs, provided that the vehicle user does not change the speed of the vehicle and does not change the direction of the vehicle. Parameters that affect the time of the accident are the distance between cars (distance) and speed (speed). The definition of distance is the approximate distance to the potential collision point between one vehicle and another. At the same time, speed is the car's speed when avoidance action is taken. The equation can calculate the equation for finding time for accidents:

\[ TA = \frac{D}{V} \]  

where TA is the time remaining before the accident (s), D is conflict distance (m), and v is vehicle speed (m/s) (Romadhona et al., 2017).

Time to Accident (TA) is the time remaining from when evasive action is taken to the time of collision if the road user does not change the vehicle's speed or direction. Parameters that affect the time of the accident are the distance between vehicles (distance) and speed (speed).

Distance is the approximate distance to the potential collision point between one vehicle and another, while speed is the vehicle's speed when avoidance action is taken.

Conflicting Speed is the speed of the relevant road user when taking evasive action before the conflict occurs. The measurement of the speed value is calculated using the average result obtained from different speeds.

Based on the conflict point, several vehicle behaviors are obtained when experiencing conflicts, including:

1. Avoiding or slamming the steering wheel (Swerving) is the behavior of vehicles avoiding dangerous things.
2. Braking or deceleration (breaking) is the behavior of the vehicle to slow down and reduce the vehicle's speed to stop the movement.
3. Acceleration runs faster than the vehicle's initial speed to avoid dangerous things.

The Traffic Conflict Technique method uses the average distance to get the Time to Accident value. The following is the formula for determining the average distance of vehicles.
∑S = \frac{S_1 + S_2}{n} \quad \text{..............................................(2)}

\text{Sum the} \sum S : \text{Average vehicle distance (m)}
S_1 : \text{Vehicle Distance 1 (m)}
S_2 : \text{Vehicle Distance 2 (m)}
n : \text{amount of data}

The Traffic Conflict Technique method uses the average speed of each vehicle involved in the conflict. The following is the formula for calculating the average speed of vehicles involved in the conflict.

\sum V = \frac{V_1 + V_2}{n} \quad \text{..............................................(3)}

\text{Sum the} \sum V : \text{Average vehicle speed (m/s)}
V_1 : \text{Vehicle Speed 1 (m/s)}
V_2 : \text{Vehicle Speed 2 (m/s)}
n : \text{amount of data}

Determining the percentage of severe conflict events is as follows.

f(x) = \frac{\Delta \text{Serious Conflict}}{\Sigma \text{Conflict}} \times 100\% \quad \text{........(4)}

f(x) : \text{Percentage of conflict events involved.}
\Delta \text{Serious Conflict} : \text{Number of vehicles involved in traffic conflict}
\Sigma \text{Conflict} : \text{Total number of vehicles involved in traffic conflict}

3. Result and Discussion

The results of recording vehicle conflict events are used to analyze vehicle conflict data to obtain conflict Speed and Time to Accident, which can determine the seriousness of conflicts that occur at the research intersection location. The following is one example of a vehicle conflict determining time and speed data to calculate the average speed of vehicles involved in vehicle conflicts on Saturday at 07:37:21 WIB.

3.1. Time

Data on the vehicle time of conflict is obtained from observations of vehicle recording results. Time is calculated based on the recorded observations of each vehicle when heading for a vehicle conflict. The Traffic Conflict Technique method uses the average time to obtain the speed and Time to Accident value.

In Figure 7, the red line explains the conflict between Vehicle 1, with a time of 2 seconds, and Vehicle 2, with a time of 1 second. The data is used to get the average time to the vehicle conflict to obtain the time to the vehicle conflict.

3.2. Distance

Vehicle distance data for conflicts is obtained from observations of vehicle recording results. The distance is calculated based on the recording observations of each vehicle when heading for a vehicle conflict. The Traffic Conflict Technique method uses the average distance to obtain the speed and Time to Accident value.

In Figure 7, the red line explains the conflict between Vehicle 1, with a distance of 8 meters,
and Vehicle 2, with a distance of 5 meters. The data is used to get the average distance to the vehicle conflict to obtain the speed to the vehicle conflict.

**Table 3. Conflict Percentage in Research Location**

<table>
<thead>
<tr>
<th>Time to Accident (s)</th>
<th>Amount Conflict</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.50 - 0.60</td>
<td>7</td>
<td>21%</td>
</tr>
<tr>
<td>0.70 - 0.80</td>
<td>17</td>
<td>50%</td>
</tr>
<tr>
<td>0.90 - 1.00</td>
<td>10</td>
<td>29%</td>
</tr>
<tr>
<td>Total</td>
<td>34</td>
<td>100%</td>
</tr>
</tbody>
</table>

**3.3. Speed**

The Traffic Conflict Technique (TCT) method requires speed data, which is used to determine the seriousness of the conflict. Vehicle speed is calculated manually, without using a speed measuring device (Speedgun), which compares the distance traveled and the travel time of the vehicle at the time of the conflict.

**Table 4. Recapitulation of Average Speed**

<table>
<thead>
<tr>
<th>Average Speed (Km/Jam)</th>
<th>Amount Conflict</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 - 14</td>
<td>7</td>
<td>21%</td>
</tr>
<tr>
<td>15 - 19</td>
<td>17</td>
<td>50%</td>
</tr>
<tr>
<td>20 - 25</td>
<td>10</td>
<td>29%</td>
</tr>
<tr>
<td>Total conflict</td>
<td>34</td>
<td>100%</td>
</tr>
</tbody>
</table>

**3.4. Time to Accident**

The Traffic Conflict Technique (TCT) method requires Time to Accident data to determine the seriousness of the conflict. The data used to obtain the Time to Accident (TA) value is the vehicle's average distance and average speed at the time of the conflict so that the Time to Accident (TA) value is obtained. The following is the Time to Accident (TA) calculation involved in the conflict on Saturday at 07.37.21 WIB.

Answer: \[ TA = \frac{D}{V} = \frac{6 \text{ m}}{6 \text{ m/s}} = 1.0 \text{ s} \]

**Fig 8. Speed Percentage Radar Chart**

Figure 8 shows that the average speed of vehicles during the most significant conflict is 15 -19 km/hour, with 17 vehicle conflicts and a percentage of 50%. The lowest is at an average speed of 10 -14 km/hour with seven vehicle conflicts and a percentage of 21%.

**3.5. Vehicle Behavior**

Driving behavior is defined as the behavior of vehicle owners or users in driving and maintaining their vehicles (Gouribhatla & Pulugurtha, 2022). In this research, vehicle behavior data is taken from observations recorded at each conflict point of the intersection.

**Table 5. Recapitulation of Vehicle Behavior**

<table>
<thead>
<tr>
<th>Vehicle Behavior</th>
<th>Intersection</th>
<th>West</th>
<th>South</th>
<th>East</th>
<th>North</th>
<th>Amount Conflict</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evasive</td>
<td></td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Brakes</td>
<td></td>
<td>9</td>
<td>18</td>
<td>3</td>
<td>1</td>
<td>31</td>
</tr>
<tr>
<td>Accelerate</td>
<td></td>
<td>14</td>
<td>10</td>
<td>2</td>
<td>4</td>
<td>28</td>
</tr>
<tr>
<td>Total Conflict</td>
<td></td>
<td>27</td>
<td>30</td>
<td>5</td>
<td>6</td>
<td>68</td>
</tr>
</tbody>
</table>
From Figure 10, the graph of vehicle behavior analysis results shows that when a conflict occurs, 83.33% of the conflict occurs due to braking (braking behavior), and the avoidance of 14.70%.

3.6. Conflict Categories

The level of seriousness of the conflict requires the speed of the vehicles involved in the conflict and the Time to Accident (TA) value, plotted in a boundary graph between serious conflict and non-serious conflict so that the level of seriousness of the traffic conflict is known as severe conflict or non-serious conflict.

Figure 11 shows a graphical plot of vehicle conflicts, 27 serious conflicts, and seven non-serious conflicts in Table 5, described based on four sections where each vehicle conflicts.

Table 6. Recapitulation of conflict categories

<table>
<thead>
<tr>
<th>Vehicle Behavior</th>
<th>Intersection</th>
<th>West</th>
<th>South</th>
<th>East</th>
<th>North</th>
<th>Total Conflict</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serious Conflict</td>
<td>21</td>
<td>23</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>46</td>
</tr>
<tr>
<td>Non Serious Conflict</td>
<td>6</td>
<td>7</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>22</td>
</tr>
<tr>
<td>Amount Conflict</td>
<td>27</td>
<td>30</td>
<td>5</td>
<td>6</td>
<td>6</td>
<td>68</td>
</tr>
</tbody>
</table>

Figure 12. Conflict Category Chart

Figure 12. shows that the seriousness of the conflict level is greatest at the southern intersection point with 30 conflicts, while the smallest is the eastern intersection point with five conflicts.

3.7. Speed to Severity of Conflict

Based on the identification and analysis, the dominating conflict speed is the speed with a class of 15 km/h - 19 km/h with 17 vehicle conflicts, and the percentage of conflicts that occur is 50%. This means that the speed with this class is a speed that has the potential for accidents.

Table 7. Recapitulation of Speed to Severity of Conflict

<table>
<thead>
<tr>
<th>Speed (Km/h)</th>
<th>Serious Conflict</th>
<th>Non Serious Conflict</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-14</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>15 - 19</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>20 - 25</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Amount Conflict</td>
<td>27</td>
<td>7</td>
</tr>
<tr>
<td>Total Conflict</td>
<td>34</td>
<td></td>
</tr>
</tbody>
</table>

Figure 13. Diagram of Speed to Severity of Conflict
Figure 13 shows how the speed with a class of 15 km/h - 19 km/h, with 12 vehicle conflicts and a percentage of 44.44% affecting the seriousness of vehicle conflicts, dominates the level of seriousness of the severe conflict category. In contrast, the 10 km/h speed class -14 km/h reduces the seriousness of vehicle conflicts. If the percentage of conflict events involved is determined using the incidence of major conflict, it would look like this:

\[ f(x) = \frac{\Delta \text{Serious Conflict}}{\Sigma \text{Conflict}} \times 100\% \]

\[ f(x) = \frac{27}{34} \times 100\% \]

\[ f(x) = 79.41\% \]

Based on the calculation of the percentage of severe conflict events with 27 vehicle conflicts, a percentage value of 79.41% is obtained, which has the potential for accident risk.

3.8. Vehicle Behavior on Conflict Seriousness

Based on the identification and analysis of the vehicle behavior of each intersection section, the dominant vehicle conflict is the behavior of braking vehicles. Vehicle behavior affects the seriousness of severe conflict and non-serious conflict.

<table>
<thead>
<tr>
<th>Conflict Category</th>
<th>Evasive</th>
<th>Brakes</th>
<th>Accelerate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serious Conflict</td>
<td>6</td>
<td>23</td>
<td>25</td>
</tr>
<tr>
<td>Non Serious Conflict</td>
<td>1</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Amount of Conflict</td>
<td>7</td>
<td>31</td>
<td>30</td>
</tr>
<tr>
<td>Total Conflict</td>
<td>68</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 8. Recapitulation of Vehicle Behavior on Conflict Severity

Figure 14 shows that the number of behaviors that experience more severe conflicts is accelerating as many as 25 vehicle conflicts and a percentage of 83.33%. Based on the vehicle’s behavior, accelerating causes a high level of seriousness that has the potential for accidents, while with evasive behavior, the level of seriousness is low.

3.9. Speed to Vehicle Behavior

Based on the identification and analysis, the dominating conflict speed is the speed with a class of 15 km/h - 19 km/h. The behavior of vehicles that experience the most severe conflict is accelerating behavior; this means that speed with accelerating vehicle behavior is the most potential for accidents with accelerating behavior affecting vehicle speed.

<table>
<thead>
<tr>
<th>Speed (Km/h)</th>
<th>Vehicle Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-14</td>
<td>1</td>
</tr>
<tr>
<td>15 - 19</td>
<td>7</td>
</tr>
<tr>
<td>20 - 25</td>
<td>14</td>
</tr>
<tr>
<td>Amount of Conflict</td>
<td>7</td>
</tr>
<tr>
<td>Total Conflict</td>
<td>68</td>
</tr>
</tbody>
</table>

Table 9. Speed on Vehicle Behavior

![Figure 15. Diagram of Speed to Vehicle Behavior](image)

Figure 15 shows that each vehicle’s behavior has a speed difference. Speeds with a class of 15 km / h - 19 km / h are the highest in accelerating vehicle behavior. It can be seen that if the vehicle behavior begins by accelerating, it causes the speed to increase and potentially cause an accident. Meanwhile, if the vehicle behavior begins with braking, the speed and the potential for accidents will decrease.
3.10. Alternatives to Reduce Conflict and Accident Risk

Vehicle speed and driver ignorance are the root causes of vehicle collisions on Jl. Budi Utomo - Jl. 28 Oktober - Jl. Parit Nenas, according to the analysis and debate, this is a result of the driver's failure to slow down when approaching a junction and maintain a low speed when moving through it, as well as his disregard for other drivers' rights to priority when they are already in the lane. The following alternate solutions are derived from these problems:

A. Road Signs

Additional signs are needed, among others: (a) signs prohibiting speeds greater than 15 km / h, (b) warning signs of intersections with priority, (c) fulfillment of the criteria for handling aspects of Regulation Road that must be fulfilled on safe road factors such as; (i) placement and installation of traffic signs that are placed on the left following the flow of traffic at a certain distance from the outermost edge of the road shoulder, (ii) traffic signs are placed at a distance of min 0.6 m measured from the outermost part of the sign leaf to the outermost edge of the road shoulder, (iii) signs must be visible to motorists without any interference from plants or those that can block the sign, (iv) min sign height of 1.75 m measured from the highest surface of the road and placement of warning signs at a distance of min 50 m for roads with a speed of 60 km / h or less.

B. Traffic Signaling Device

It provides lights that signal when vehicles should stop running or walk alternately from various directions. This change is intended to prevent them from interfering with each other between the traffic flows. The use of traffic lights at road intersections is intended to be able to regulate the movement of vehicles on each side so that vehicles can move alternately, so as not to interfere with each other between the traffic flows formed, provide opportunities for pedestrians to cross, then most importantly to reduce the accident rate caused by collisions due to differences in road flow to signal a stop given the color red, caution with yellow, then green which means can walk.

Fig 16. Sketch of Road Sign Placement

Fig 17. Sketch of traffic signaling device placement

4. Conclusion

Based on the analysis of 34 vehicle conflicts within two days, it was obtained that the level of serious conflict was 27 vehicle conflicts with a percentage of accidents obtained of 79.41%, which had the potential for accidents, while non-serious conflicts were seven vehicle conflicts with a percentage of 20.59%. Vehicle speed in the class 15 km /h - 19 km/h is the most severe conflict speed with 12 vehicle conflicts and a percentage of 44.44% of traffic conflicts. The behavior of vehicles that experience the most severe conflicts is accelerating, with 25 vehicle conflicts and a percentage of 83.33% accidents. Traffic conflicts have the potential for accidents to occur. Vehicle behavior begins with accelerating, causing speed increases, and accelerating behavior increases serious conflict. While the vehicle behavior begins with braking, the speed will decrease, and the level of serious conflict will decrease.

Alternatives are given to improve the safety of vehicle users at four unsignalized intersections by recommending adding traffic signal devices on each arm of the intersection before entering the intersection and improving traffic safety by providing warning signs and prohibition signs.

5. Acknowledgement

First and foremost, I would like to thank my parents for their unwavering support, which enabled me to complete this study successfully.
I am very grateful to Mrs. Elsa Tri Mukti, Mrs. Sumiyattinah, Mr. Said, and Mr. Heri Azwansyah for their invaluable guidance, advice, and expertise, which have contributed to the creation of a valuable reference for traffic conflict analysis in West Kalimantan. In addition, I would also like to express appreciation to my friends, who have shown unwavering trust and encouragement throughout this journey so that I could complete this work successfully. Finally, I would like to thank the Jurnal Teknik Sipil (JTS) team for agreeing to publish the results of this research so that it becomes a valuable reference. The results of this research become a valuable reference for everyone, especially in the traffic conflict analysis of West Kalimantan.

6. Author's Note
All content written in this article is original because it summarizes the results of my study with Mrs. Elsa Tri Mukti and Mrs. Sumiyattinah. The content of this article has been reviewed during my thesis at the Department of Civil Engineering, Faculty of Engineering, Tanjungpura University. Civil Engineering Department, Faculty of Engineering, Universitas Tanjungpura, on July 23, 2023, by Mr. Said and Mr. Heri Azwansyah.

7. References


