# Identifying Driver Behaviours Contributing to Road Safety Among Different Modes at Road Junctions, Peri-Urban Areas, Thailand

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The mismatch between land use and road layout has led to high traffic volumes in unsafe conditions in peri-urban areas. This is also the case in Pathumthai Province, which was selected as a study area, as one of the areas surrounding Bangkok, the megacity of Thailand. For this study, an attempt was made to focus on 4 points of road junctions of multi-lane highways and to observe their longitudinal differences with their speeds. The results showed that traffic volume has a major impact on accident risk, especially at higher traffic volumes and in mixed-traffic situations. The risk is increased by the presence of commercial vehicles mixed with smaller vehicles (e.g. motorcycles), which require sufficient distance between following vehicles. The novelty of this paper is identifying driver behaviours through the use of prototype CCTV technology and distinguishing the role that types of drivers' vehicles play in mitigating risks in different travel patterns, considering the safety aspects of highway design and land use.

## 1. Introduction

Road safety is an issue that Thailand has been researching and solving for a long time. It is generally accepted that a traffic accident is caused by a mistake/fault in at least one of 3 factors, possibly the fault of the passerby or deficiencies in road infrastructure or vehicle defects or two out of three factors or three factors (Iamtrakul et al., 2023c). However, the cause is inevitably caused by the behaviour of the driver. For Thailand, the number of deaths from road accidents is the ninth highest in the world (2018), with an estimated 32.7 fatalities per 100,000 population (WHO, 2018). When considering the report on the main assumptions that cause road accidents from the road accident situation analysis report of the Office of Transport and Traffic Policy and Planning (2020), it pointed out that speeding and speeding in front of the vehicle are still among the top presuppositions of factors attributable to accidents. Nowadays, there are guidelines for urban development based on the concept of smart city development, which is a development approach that integrates innovation and technology in planning and solving urban problems (Iamtrakul et al., 2023b). In terms of road safety management, innovation and technology have been used to help plan and solve the problem known as "Intelligent Transportation System: ITS", including "Artificial Intelligence" that will help in image-processing and video processing, including predicting traffic possible risks from driver behaviour. Integrating innovation and technology to address road safety issues related to driving behaviour focuses on providing information for drivers, including forecasting potential risks from drivers (Winter et al., 2023), accounting for behaviour (Fu et al., 2015) and traffic conflict prediction (Formosa et al., 2020). Therefore, the objective of this study is to understand the driver behaviour that needs to be identified between different modes of travel, which can lead to proposals to solve road safety problems caused by driver behaviour.

## 2. Methodology

### 2.1 Study area

Pathum Thani is one of the metropolitan provinces, an area that supports expansion and development in various fields from the capital area of Thailand. As a result, Pathum Thani Province has a variety of activities that attract settlement and travel in a large number of different forms of travel (Iamtrakul and Chayphong, 2023). In particular, private car travel leads to traffic congestion in the area, including the problem of road accidents (Iamtrakul et al., 2023a). Considering the statistics of road accidents in Pathum Thani province, it was found that in 2019-2021, there was an increase in the number of deaths and injuries when considered together with the number of deaths tending to increase in each year. Considering the data on the number of accidents together with the data on the type of vehicle, it was found that the type of vehicle that caused the most accidents was the four-wheel pick-up truck, followed by passenger cars and motorcycles. Furthermore, in terms of morphological causes, it was found that the most common morphological causes of accidents were speeding, followed by defective vehicle equipment and drowsy driving. These data point to the need for road safety studies to find solutions to the problems that arise, with a particular focus on driver behaviour.

### 2.2 Data collection and analysis

In this study, the CCTV technology prototype was applied as a tool for collecting traffic data in the pilot area, namely, rural road 3004, Pathum Thani Province, which collected data from June 29 – July 13, 2021. This study accordingly attempted to focus on 4 points of road junctions of multi-lane highways and observe their longitudinal differences with their speeds. Once the data collection is complete, it will be taken into the process of analysing a sample of the traffic data obtained from the technology prototype (Figure 1).
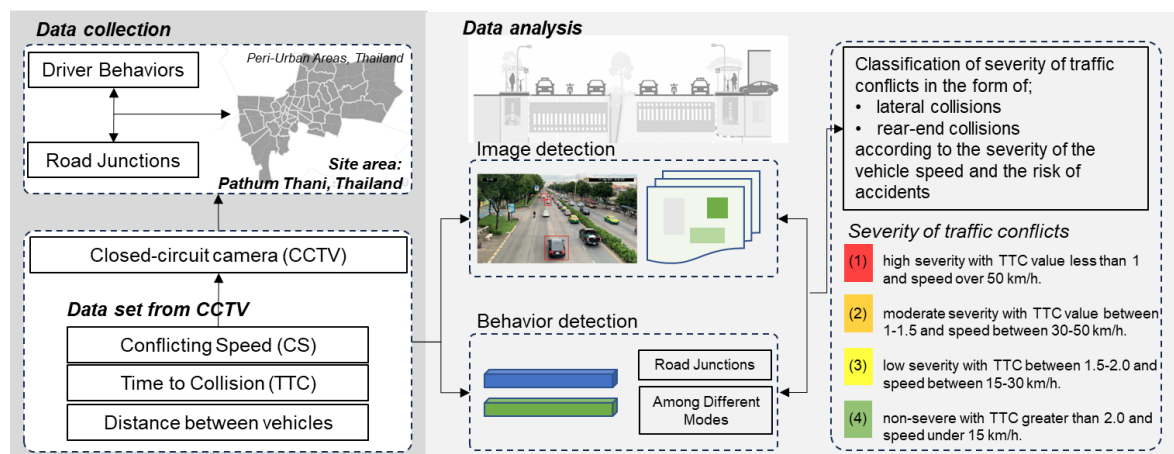


Figure 1: Framework

The data was analysed in terms of creating safety to be used in the assessment of the road safety information management index. In this study, data analysis was applied to intersections using the road safety indices Time-to-Collision (TTC) and Speed. Time-to-Collision (TTC) index is the most commonly used measurement and evaluation to assess collision risk for road safety (Li et al., 2020) and consider surrogate models (Mahmud et al., 2017). It is an analysis that can be categorised according to the severity of the risk based on the crash pattern. The level of risk of a crash varies depending on the type of road. The review found that the TTC can indicate the degree of severity of a crash compared to the collision speed of the vehicle. in the form of a 4-level colour-coded graph: (1) high severity with TTC less than 1 and vehicle speed over 50 km/h, (2) moderate severity with TTC between 1-1.5 and vehicle speed between 30-50 km/h, (3) low severity with TTC between 1.5-2.0 and vehicle speed between 15-30 km/h, and (4) non-severe with TTC greater than 2.0 and vehicle speed below 15 km/h.

## 3. Result

### 3.1 Characteristics of the location

When analysing data in terms of safety, it is necessary to understand the context of the area as an urban area with a large number of private vehicles. Suburban areas with high traffic of goods and services trucks. or community areas with a variety of traffic on foot, motorcycles, bicycles, etc. The context of the area around

Pathum Thani Road 3004 is in the area of Pathum Thani Province, which is connected to Bangkok by a 4-lane road surrounded by community and industrial areas, thus making the diversity of road users. The road is located in the connecting area between Rangsit-Nakhon Nayok Road and Lam Luk Ka Road, which is the main road in Pathum Thani Province. Therefore, Road 3004 is classified as a secondary road connecting the community together (Figure 2). In terms of building density, it was found that buildings are concentrated around roads with medium to high density. Most of the buildings are used as warehouses, dwellings, housing estates and commercial premises.
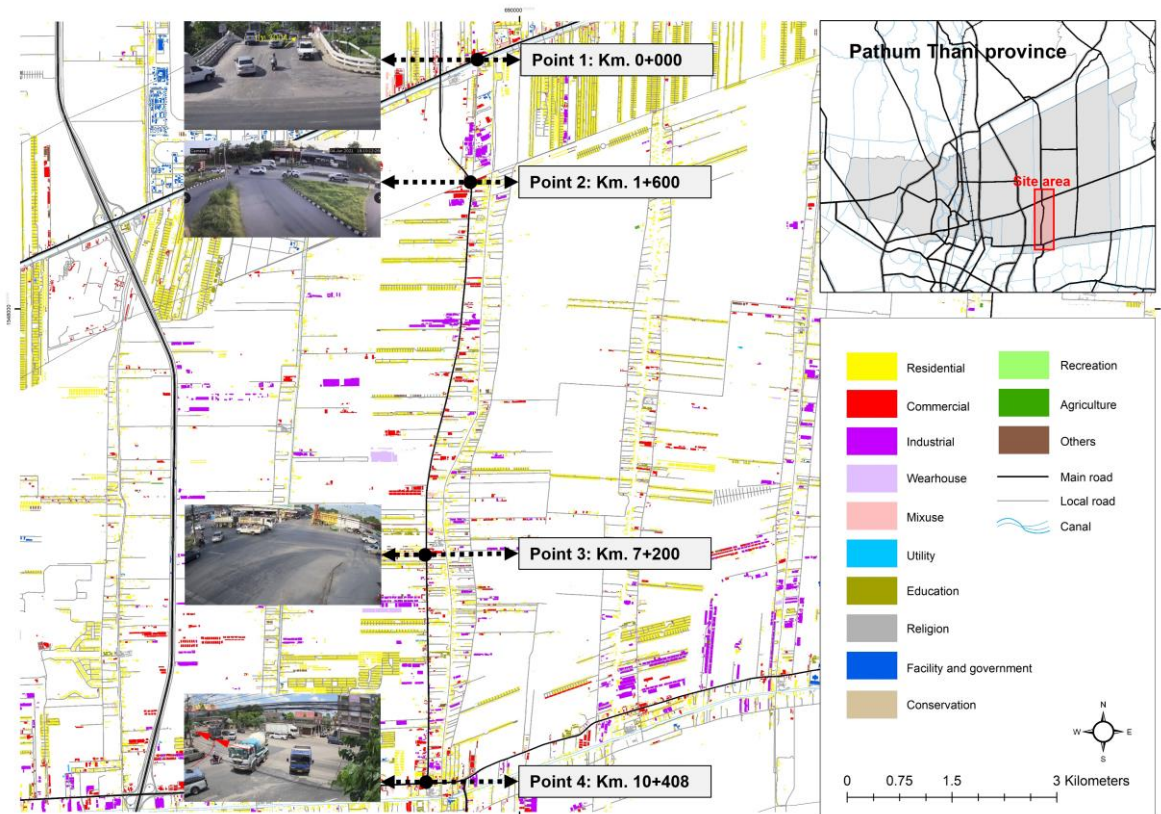


*Figure 2: Characteristics of the study area*

### 3.2 Identifying risk driver behaviours

In this study, the CCTV camera technology prototype was installed on PTT 3004 Road, at the intersection of a total of 4 points, namely (1) KM. 0+000, (2) KM. 1+600, (3) KM. 7+200 and (4) KM. 10+408, as shown in Figure 3.

The data to be transcribed from the CCTV data and fed into the analysis consisted of 3 main components: conflict speed (CS), distance between vehicles (S) and time to collision (TTC). This information is used to classify the severity of traffic conflicts in the form of side and rear-end collisions according to the severity of the vehicle speed and the risk of an accident.

The analysis results show that there are only 3 data points from all 4 areas that can be collected and used for safety index analysis. Due to the KM. 0+000 that the camera angle may obscure the vehicle, and it may be difficult to measure various indices. The results of the 3-point analysis are as follows.

1) AT KM. 1+600 CCTV cameras are installed in 3 sub-corner areas, namely sub-points 2A1, 2A2 and 2A3. From the data, it was found that points 2A1 and 2A2 had a proportional severity ranging from low severity to no severity. Most of the data collected was of low severity, while point 2A3 had a proportional severity ranging from moderate to no severity, and most of the information collected is at a low severity level, as illustrated in Figure 4.

2) KM. 7+200, CCTV installation in 1 sub-corner is sub-point 3B1. From the data it was found that the proportional severity ranged from moderate to no severity and for the most part the information collected is at a mild level as illustrated in Figure 5.
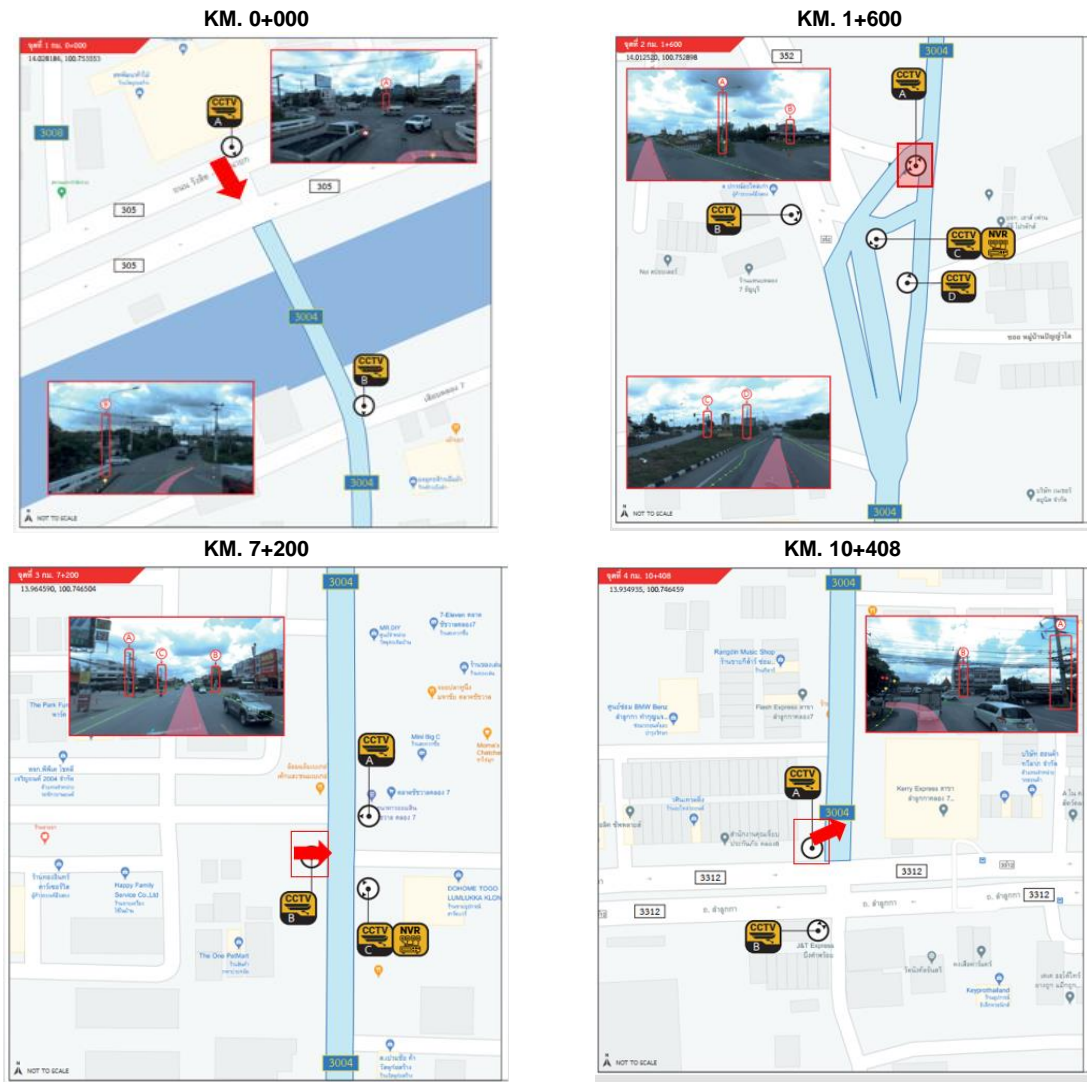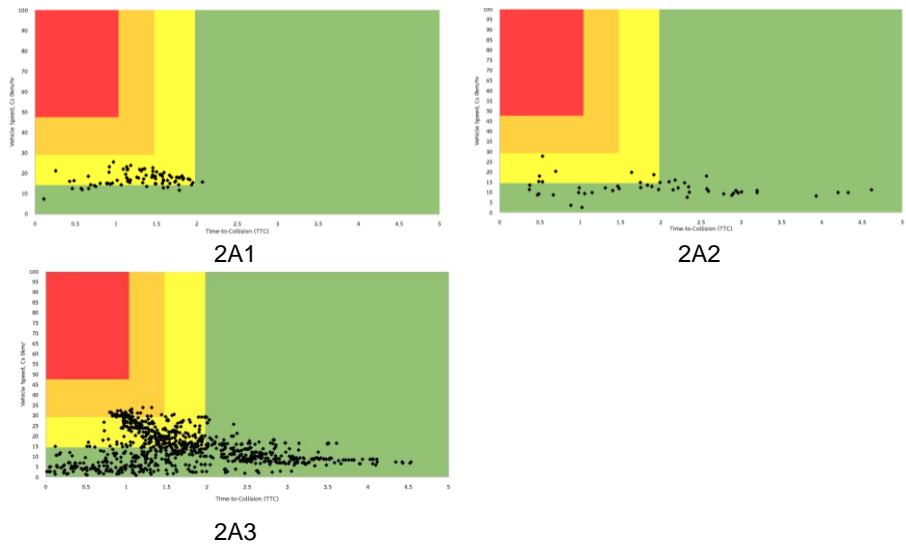
Figure 3: Study area



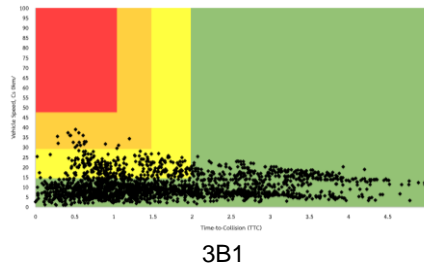Figure 4: TTC severity level of KM. 1+600

3B1

*Figure 5: TTC severity level of KM. 7+200*

3) KM. 10+408, CCTV cameras were installed in 3 sub-corners, namely 4A1, 4A2 and 4A3. From the data, 4A1 and 4A3 have a proportional severity ranging from low severity to non-severe and for the most part, the information collected is at a mild level. While 4A2 had a proportional severity ranging from moderate severity to no severity, and for the most part the information collected is at a mild level, as illustrated in Figure 6.
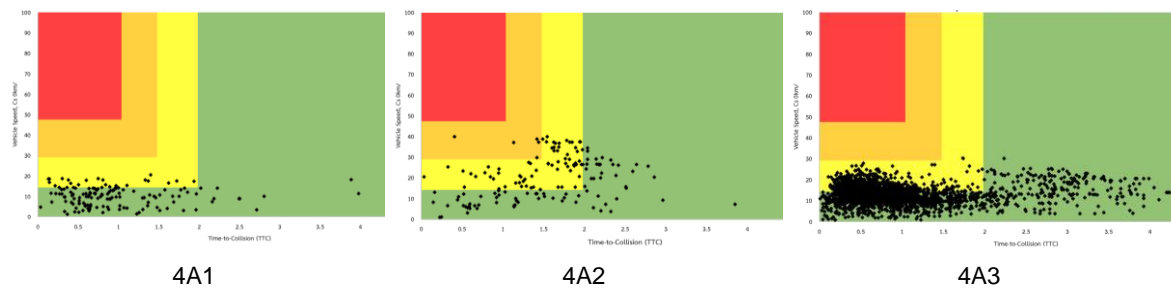


4A1                                4A2                                4A3

*Figure 6: TTC severity level of KM. 10+408*

From considering the overall picture of route 3004 in terms of safety with traffic conflict information by using collision time (TTC) and vehicle speed (Speed) for the analysis of road junctions, it was found that the proportional severity ranges from moderate severity to no severity and most of the information collected is at a mild level. According to the data, the severity of road traffic risks in the study area is relatively low, probably due to the fact that the area is an area of mixed industrial and residential commercial activities, resulting in relatively high traffic in the area, so the speed is not very high, so there are no cases of high severity. However, even if there is not a high level of violence in the area, road accidents can still occur. Especially in areas of moderate severity, it is necessary to find measures to solve problems and deal with risks that may occur at other times. This study highlights the integration of innovation and technology to address road crashes, which previous studies have shown to have benefits and limitations (Pradana, 2023). In this study, time-to-collision (TTC) is used for analysis, which considers the condition to be classified as a traffic conflict (Li et al., 2020). However, road accidents are other factors that influence traffic conflicts (Formosa et al., 2020). In addition, the diversity of local contexts is also limited because Thailand has a variety of road characteristics in each neighbourhood, including road connection characteristics that influence behaviour and use of different speeds. This is an interesting topic for further study in the future.

## 4. Conclusions

This study focuses on identifying driver behaviours that contribute to road safety through the use of prototype CCTV technology. Road junctions of Rural Road 3004 in Pathum Thani Province of Bangkok Metropolitan Area were selected as the study area, a total of 4 points, namely (1) KM. 0+000, (2) KM. 1+600, (3) KM. 7+200, and (4) KM. 10+408. The data was collected from 29 June to 13 July 2021, using time to collision (TTC) and speed as a road safety index to assess risk severity. The results showed that most drivers tended to speed, although there were overtaking collisions on the motorway during local journeys. Overall, the pilot site had a range of severity from moderate to none, and most of the information collected was at a mild level. In conclusion, the differentiation of drivers' vehicles plays a vital role as a critical issue that should be understood for effective risk mitigation in different travel patterns, along with the need to consider the safety aspects of highway design due to the different contexts of not only road infrastructure but also land use that induces a different traffic mix for safe highway planning and design.

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