

DEVELOPMENT OF TRAFFIC MANAGEMENT BY PUBLIC PARTICIPATORY PROCESS: THE CASE OF TRAFFIC IN FRONT OF MUEANG PHETCHABUN SCHOOLS

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ABSTRACT

This research studies and develops the traffic management on Thai highway No.21 in front of three schools in Phetchabun province, by collecting opinions through the public participation process (PPP). The PPP group comprises thirty-five people of agencies related to traffic and accidents (six responsible traffic police officers, four responsible highway engineers, and twelve community traffic volunteer staff) and thirteen frequent travelers. A structured survey is conducted to learn concerns about traffic problems/management during rush hours as well as opinions on solving traffic problems. The PPP group has multiple in-depth conversations, with a framework for traffic management and solutions to reduce accidents on Thai highway No.21 in front of schools in Mueang district, Phetchabun province, Thailand. From the opinion survey, the most serious is lacking traffic problem resolution, followed by on-street parking, insufficient public transportation, most drivers lacking knowledge of traffic rules, large trucks to stop and deliver goods, and too many motorcycles. The PPP group wants to have more traffic surface to solve traffic jam. The PPP group has been introduced various possible strategies to road safety management including U-turn management. adding bumps/speed tables, using by-pass roads or ring roads, road diet, using information technology, strong road traffic laws enforcement, charging rush hours toll to trucks, providing parking spaces raise awareness through education. The trade-off of traffic management should be considered.

Disciplinary: Civil Engineering (Traffic and Safety Management), Public Administration and Policy.

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1. INTRODUCTION

As for the international image of Thailand of having high road traffic accident rates, England, Australia, and the United States issued a warning to tourists to be aware of travels to Thailand. The situation on road safety in Thailand affects national development because traffic accidents are the number one cause of death among teenagers aged 15-29 years and the second leading cause of premature death of children between 5-14 years of age for deadliest road accidents (WRA, 2004). The World Health Organization and the organization under the supervision of the United Nations jointly announced the intention of calling the 'Moscow Declaration', which is the source for the UN to announce that 2011-2020 is the 'Decade of Road Safety' (Phanthunane et al, 2014).

Thai Ministry of Transport and the Thai government have approved the said declaration and taken safety seriously by announcing the safety policy is a national agenda for society. There are road accident reduction networks such as the Road Safety Academic Center, The National Public Health Foundation, Road Safety Network in the Provincial Level of Thailand, Thai Health Promotion Foundation. Normally various government agencies whether under the Ministry of Transport, Ministry of Interior, and Ministry of Public Health will focus on solving accident problems only during the long holiday seasons, even though in reality, losses in life and property occur every day. The average accident death rate is 60-66 deaths per day during festivals and holidays, while the normal day is around 30 deaths. However, the important festival and holiday durations are no more than 15 days a year, while normal days are more than three hundred days. It is a tremendous number. During 2006-2012, an average of 10,326 road users died each year and 50,988 injured. Studying the damage value of accidents, the Department of Highways in Thailand had estimated the total financial loss caused by the accident in 2008 up to 232 billion baht (7.5 billion USD), representing 2.8% of the Gross Domestic Product (GDP) from that accident, this causes operators to have to bear the higher transportation costs. The problem has become a concern of the government and agencies involved in the road traffic accident that recognizes the need to solve problems using systematic and serious measures and must cooperate at the strategic level to the plan level to maximize benefits, to reduce the loss and damage caused by road traffic accidents.

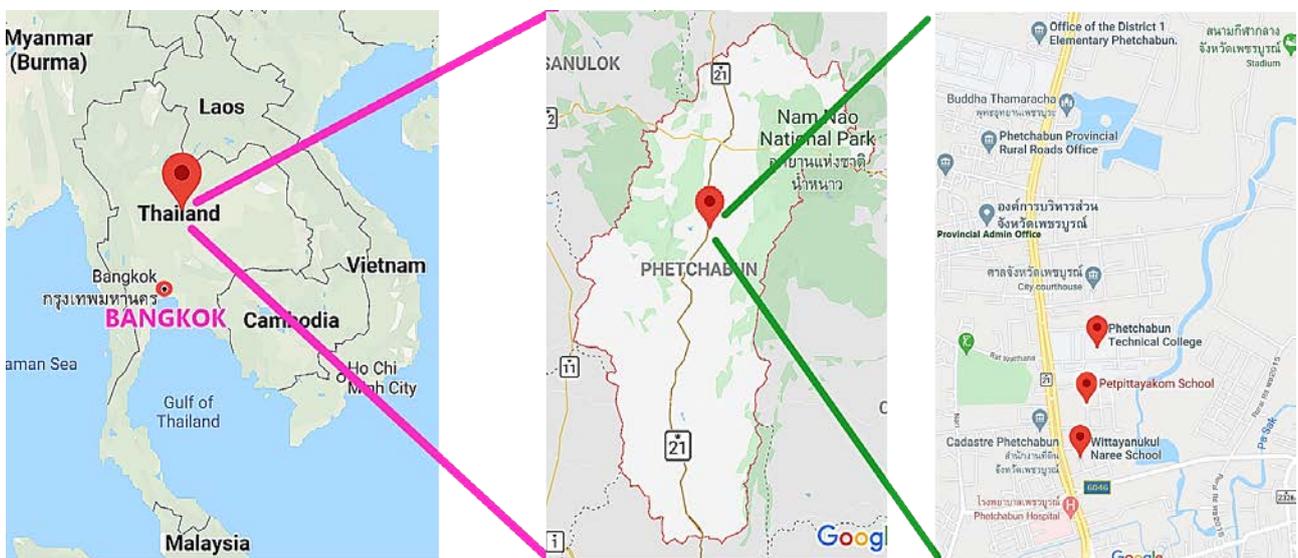


Figure 1: Geo-map of the study area on highway No.21 in front of schools in Phetchabun Province, Thailand (Courtesy of Google).

2. LITERATURE REVIEW

An after-school road-crossing accident was reported by Witchayangkoon and Sirimontree (2016) that a small truck installed a dashboard camera hit three girl scouts on a three-lane road in Trat Province, east of Thailand, and one girl flew ten meters away from the hitting point. The video footage showed how the accident took place.

A three-vehicle smashup in front of a primary school on Friday morning in Guyana was reported and no school children were seriously hurt (Kaieteur News, 2019). The accident took place almost on the pedestrian crossing in front of the school.

Sarasua et al (2003) used an intelligent transportation system (ITS) technology based on radio frequency identification (RFID) technology to enhance after-school traffic management at an elementary school in South Carolina. Giving advanced notification to school making children readied for pickup at the right time as cars are more efficiently loaded. The system enhanced after-school pick-up capacity by 14 percent. This results in shorter vehicle wait times, shorter queue lengths with better efficient uses of the student pick-up area.

Temrungsie et al. (2015) studied road accident factors for the case of Thailand using the Analytic Hierarchy Process (AHP). The prioritization results showed that safety management is the most important factor, followed by engineering factors and environmental and social factors. Law enforcement is the highest prioritized sub-factor, followed by road users' knowledge of road rules sub-factor.

Assi (2013) studied the characteristics of the trip attracted to local boy schools traffic jams on the urban road network of Saudi Arabia. It reported that 60% of students suffered from traffic congestion around schools. Still, 50% of them came to schools by personal cars. Ratrout et al. (2019) predicting traffic attracted to schools in the early planning of neighborhoods' average income and lot area, by taking into account the gross floor area, the number of students, and classrooms.

Studies on traffic management and accident in front of the school are limited and each location will have different characteristics. This work studies and assesses the traffic conditions in the rush hours of the Thai Highway No.21 (THW21) in front of the school in Mueang District, Phetchabun province, Thailand. Suggestions are given for possible improvements in traffic management.

3. CHARACTERISTIC OF STUDY AREA OF HIGHWAY #21 IN PHETCHABUN

Phetchabun Province is geographically located in the lower Northern part of Thailand, 346km away from Bangkok. In Phetchabun, THW21 is the main route lining in the South-North direction, passing the Mueang district, which is central to Phetchabun Province. Along this highway includes the areas of business centers, government centers, and schools.

3.1 CAUSES OF TRAFFIC JAM: THREE CONSECUTIVE SCHOOLS AND OFFICES

Phetphitthayakhom school, a provincial boys school, is responsible for teaching and learning in upper and lower secondary levels. The school has twenty-five hundred students with more than 120 teachers and staff.

Wittayanukulnaree school, a provincial girls school, is responsible for teaching at the lower and upper secondary levels, with more than twenty-seven hundred students with 160 teachers and staff.

Phetchabun Technical College, the only vocational school in Phetchabun Province, is responsible for vocational teaching and training, with more than four thousand students and 162 teachers and staff.

All these three school sites in consecutive locations, while the City Courthouse is located next to the Phetchabun Technical College. On the opposite are the Phetchabun Provincial Administrative Office, Phetchabun Juvenile and Family Court, Phetchabun Highway District Office, and Phetchabun General Hospital. Having many offices and schools make traffic jam especially during rush hours, see Figure 1.

The THW21 in front of Mueang Phetchabun schools are eight-lane with separates and u-turns. Mix traffic can be found including personal cars, motorbikes, bicycles, lorries, mini-truck, and others. Since many schools and offices are built along the THW21, the studied area becomes a busy town.

3.2 RECORD OF ACCIDENTS

From the accident statistics in this area, Phetchabun Provincial Health Office and Phetchabun Highway District Office show the number of accidents on THW21 in front of Witthayanukulnaree school. The average accident record occurred in front of Petchittayakhom School is eleven times a day, with fourteen deaths in 2015, twenty-two deaths in 2016, and 219 injuries in 2015 and 251 in 2016, and most are students between the ages of 1-16 years (DLT, 2018).

3.3 VEHICULAR SPEED MONITORING

From the survey of traffic volume information on THW21 in front of these schools in Phetchabun province found that important government agencies locate on this road. The average traffic volume is 1,200 cars/hr (in the morning rush hour in both directions). In the evening, the average traffic volume is 1,500 cars/hr (in both directions). For off-peak traffic, the speed of cars in the study area equals 52 km/hr. In rush hours, morning and evening, the average speeds are 30 km/hr and 25 km/hr, respectively, cause of heavy traffic volume especially during rush hours that parents pick up and deliver their children in the morning (07.00-08.00 hrs.) and evening (16.30-18.00 hrs.), because the study area is the location of important government agencies in the province with an important traffic origin which is PhetPhitthayakhom school, WittayaNukulnaree school, Phetchabun Kindergarten, Phetchabun Technical College and the origin of traffic in nearby areas is Phetchabun Rajabhat University, the mall, and many other important places.

Not only all accidents result in loss of lives, injuries, and disabilities, but also loss of property economics and societies, especially the important strength of the nation that these youths will grow into the important force of the nation. Thus, it is very important and necessary for all sectors to cooperate in solving problems, prevent, and alleviate future losses from traffic management and accidents, in this case, on the traffic route THW21.

4. METHOD

This study is qualitative and quantitative research, explaining phenomena in response to research questions via relevant documents and data collection through the participated process of in-depth conversations. The non-structural conversations and discussions have been conducted to brainstorm for solutions to alleviate traffic jams, address safety issues, and decrease accidents for THW21 in

front of schools in Mueang Phetchabun. The structured perception survey was also carried out to systematically collect opinions for this.

This study developed traffic management based on concepts and theories of traffic management for rush hours, and vehicle crash accidents.

4.1 PARTICIPATORY PROCESSES

Public Participatory Process (PPP) is used to take active participation of all members of a group to reach decision-making. With PPP, every member has opportunities to be involved in solving issues and problems. PPP includes participation, conversations, empowerment, linking with community culture.

5. TRAFFIC MANAGEMENT VIA PARTICIPATORY PROCESS

Normally, in Thailand, traffic management is performed by traffic polices under normal duties and in some cases under executive orders of chief police officers. Thus, the public has no chance to give opinions on traffic management. On the other hand, the public participatory process (PPP) provides room for all stakeholders to share their perceptions and ideas that may give better ways for traffic management.

A discussion group of involved stakeholders was created to develop a traffic management strategy. The PPP starts with open brainstorm conversations. Total thirty-five people participated in this discussion group, consisting of personnel from agencies related to traffic and accidents (six responsible traffic police officers, four responsible highway engineers, and twelve community traffic volunteer staff) and thirteen people who frequently travel on the THW21 (Figure 2). The participated discussion group provided multiple in-depth conversations during May-July 2018, with a framework for traffic management and solutions to reduce accidents on THW21 in front of schools in Mueang district, Phetchabun province.

6. RESULTS AND DISCUSSION

From the PPP, both non-structural discussions and structural surveys give important outcomes for traffic management and solutions to reduce accidents on THW21 in front of schools in Mueang district, Phetchabun province.

6.1 TRAFFIC JAMS

Like other places, traffic jams problems occurred on the THW21 in front of schools in Phetchabun province, in the morning and evening rush hours. The study found that the main causes of traffic jams due to high traffic volume (1,200 and 1,500 cars/hour for morning and afternoon rush hours). In this area, there are thirteen local roads connected to THW21 causing thirteen conflict points due to the entrance-exit of cars on local roads in the study area without control. Also, this is due to many factors such as lack of discipline, do not know traffic rules, unlawful parking in prohibited areas or at prohibited times, unlawful double parking, etc.

6.2 ROAD SAFETY

For 2017 accidents in the study area, there were 32 accidents (12 were very injured, 21 were moderate injuries and nine were minor injuries). These accidents involve 45 motorcycles

(66.17%), followed by eighteen cars (26.47%) and five pedestrians (7.35%). The PPP discussion group identified many dangerous points in the study area, especially at road junctions. The concerns go to pedestrian safety particularly in front of Petchpittayakhom school, as there is a U-turn.

6.3 TRAFFIC PROBLEMS

Figure 2 gives results from the structured perception survey of a four-point scale, during rush hours on THW21 in front of schools in Mueang Phetchabun. From the average of results, the most serious is lacking traffic problem resolution, followed by on-street parking, insufficient public transportation, most drivers lacking knowledge of traffic rules, large trucks to stop and deliver goods, and too many motorcycles.

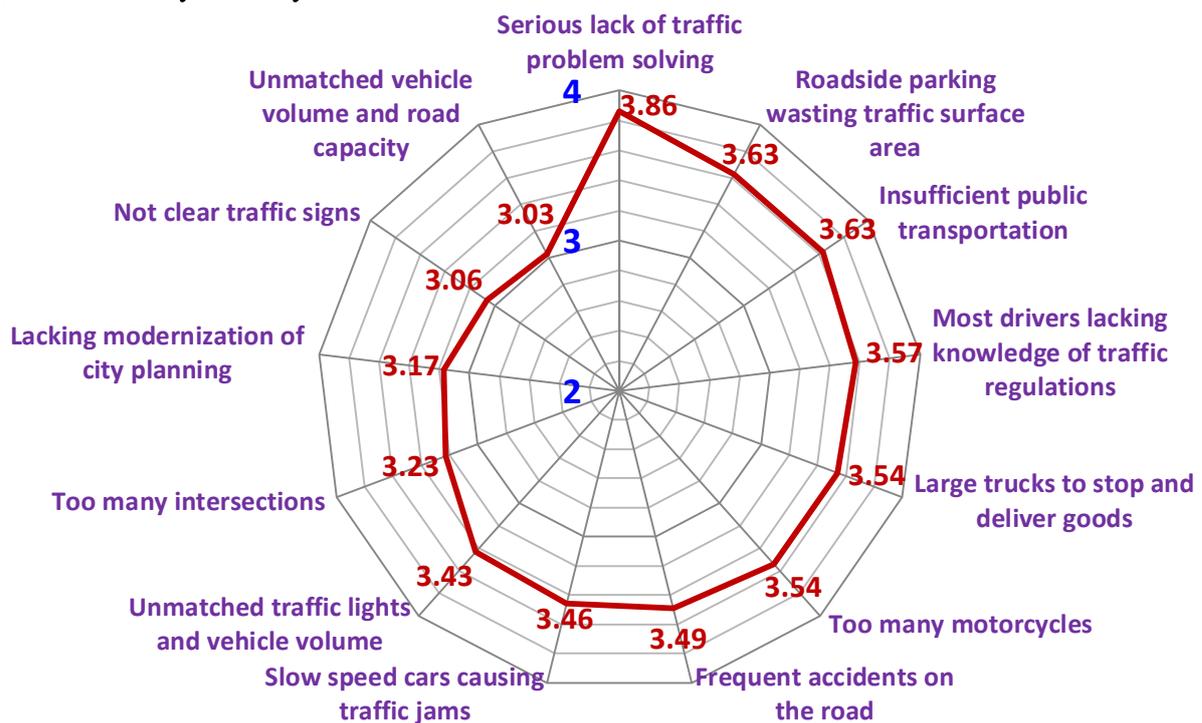


Figure 2: A structured survey on concerns about traffic problems/management during rush hours.

The PPP discussion group wants to have systematical traffic management including the prohibition of parking along the THW21 road, strong traffic law enforcement, and prohibition of the truck from entering the traffic jam during rush hours. Besides, the school does not have a parking space and other measures to support fast student transfer, causing most parents to vie for the parking space. The schools also have a lot of traffic in and out, especially in rush hours, lack of regulations, causing traffic problems to occur. Another issue is that Mueang Phetchabun lacks efficient public transportation systems.

6.4 SOLVING TRAFFIC PROBLEMS DURING THE RUSH HOURS

From the structured survey, Figure 3 shows the results of opinion on how to solve traffic problems during the rush hours on the THW21 segment in front of schools in Mueang Phetchabun. From the average result, most opinions want to increase the traffic surface and to reduce the number of u-turn points as these seem to cause more traffic jams.

To alleviate traffic during the peak hours, the PPP group wants to have parking spaces for parents sending and picking their kids from school. All involved traffic management agencies should

encourage private areas to arrange parking by requesting a reasonable parking fee creating the safety of public transportation through the schools.

The least agreed issue is to organize one-way traffic. The PPP group also seems to concern about the problem of lack of traffic discipline either private or public cars, obstructed roadside parking, and driving without consideration for pedestrians, being selfish driving by overtaking, disorderly lane-changing. Another problem includes not following the road rules of public vehicles such as buses do not stop at the stop. Moreover, street-shops on the pedestrian area force people to walk on the road, which is very dangerous.

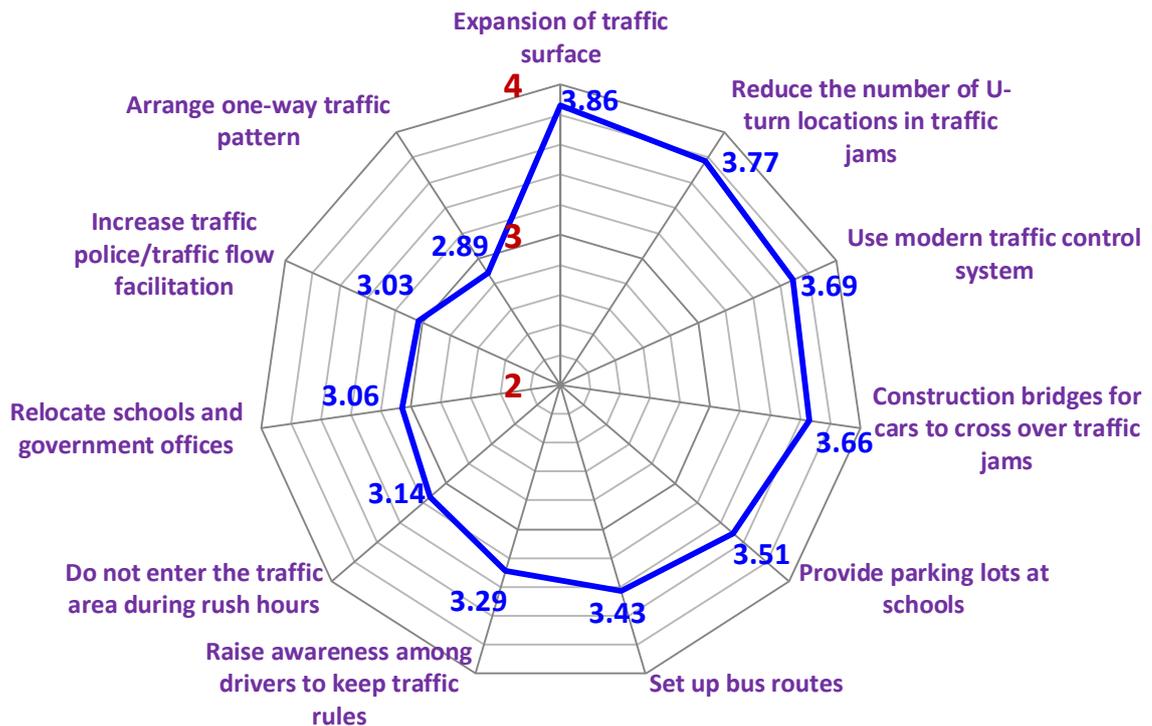


Figure 3: Opinion from a structured survey on solving traffic problems during rush hours.

7. POSSIBLE SOLUTIONS TO SAFETY MANAGEMENT

For safety management measures, the PPP group has been introduced with various strategies to enhance traffic safety in the area.

7.1 U-TURN MANAGEMENT

From the PPP discussion group to increase road safety, it is important to do u-turn management by decrease the number of U-turn points and add traffic cones to divide the traffic lane. The flow arrangement is mandatory, by controlling traffic flow to be in line that will increase the capacity of the junction making more convenient traffic flow and reduces the likelihood of incidents caused by channel flow arrangements. After the implementation of a reduction of the number of U-turn points from five to one, it found even though many cars concentrated at the U-turn point, but the amount of road accidents has decreased significantly from 16 in 2017 to three in 2018.

7.2 ADDING BUMPS/SPEED TABLES

Bumps, humps, and speed tables are self-control speed equipment that can be installed on the road to reduce vehicular speeds (Witchayangkoon et al., 2011). To reduce speeds on THW21 on the

study portion, it is possible to install the equipment at the exact point that low speeds are needed. Speed tables seem to be more suitable for highway roads. Besides, speed tables can be installed every 50 meters. Additional small bumps may be installed such as those made from used pneumatic rubber tires (Witchayangkoon et al., 2019).

7.3 BY-PASS ROADS OR RING ROADS

By-pass roads are a good option for vehicles to go around the town to get through without having to go through the crowded traffic, to reduce town traffic congestion (Intapiw et al., 2017). Improvement of the existing roads to be by-pass roads is a good alternative to keep the budget while vehicles can get through faster.

7.4 ROAD DIET

When thinking the opposite, the Road Diet concept (FHWA, 2015) will need to gain public supports. Instead of expanding the road, many US towns enjoy making roads smaller, the number of lanes is reduced which is the concept of Road Diet. Thus, the Road Diet becomes safer for communities, and the numbers of accidents decrease (FHWA, 2015).



Figure 4: Implementation of Road Diet on Ninth Avenue, Manhattan, New York, USA (courtesy of Google and FHWA (2015)).

For example, one-way Ninth Avenue, Manhattan, New York City (NYC), used to have four lanes with parking on both sides. With Road Diet implementation, this Ninth Avenue was redesigned to be three through lanes, with a separated bicycle path on the left located between the parking lane and sidewalk, and pedestrian refuge islands (Figure 4). NYC Department of Transport (DOT) reported a 58 percent decrease in injuries to all road users (FHWA, 2015).

After applying road diet to Division Street (1 mile long) of Grand Rapids, Michigan, the apparent results are slower speeds, thus increased travel times, while improving safety and livability, see Table 3 (FHWA, 2015).

Table 3: Results of the implementation of the road diet in Grand Rapids, Michigan (FHWA, 2015).

Positive Outcomes	Trade-offs
Increased parking spaces	Increased delay
Decreased vehicle speeds (-1.6 to -6.5 km/h)	Longer queues
Improved bicycle facilities (bike lanes/shared lanes)	Longer vehicle travel times
Crashes reduction in a right turn, angle, and sideswipe	Rear-end crashes nearly tripled after installation.
Increased pedestrian/bicycle flow	Increased emissions
Decreased volumes	Diversion from the corridor

Since the THW21 road portion in this study has a distance of less than 2 km, it is possible to

implement the road diet concept.

7.5 USING INFORMATION TECHNOLOGY

From the PPP discussion group, it is possible to use technology such as GPS, RFID, or Internet of Things (IoT) to provide advanced information whereabouts students. This is of particular importance for picking-up students in the afternoon as parents can pick their students faster with reduced parking waiting time. GPS, RFID, or IoT helps to pinpoint students and telling parents if their students are already waiting for picking-up.

7.6 INSTALLATION OF CCTV

From the PPP discussion group, CCTV can be used to effectively monitor traffic conditions and accidents/collisions, and other causes of traffic congestion. To support legal enforcement for traffic management, the installation of warning signs of CCTV will inform road users to aware of illegal actions, thus the traffic may better flow. Footages from the dashboard camera installed in the vehicle are also useful to traffic and accident investigations (Witchayangkoon, and Sirimontree, 2016).

7.7 STRONG ROAD TRAFFIC LAWS ENFORCEMENT

From the PPP discussion group, local authorities and traffic police need to use law enforcement to support responsible motorists. Enforcement should focus on illegal parking, waiting, loading/unloading obstructs traffic flow, reduces capacity at junctions, and increases the danger of walking or cycling people (SCT, 2016).

7.8 CHARGING RUSH HOURS TOLL TO TRUCKS

From the PPP discussion group, moderate to high charges may be imposed on vehicles with six-wheel and more for entering traffic jam zone during rush hours. This is to discourage big vehicles from entering the area during peak traffic. This strategy has been proven in some countries that can reduce the number of vehicles entering specific areas. Logically, the higher the charging toll, the lower the number of big vehicles entering the traffic jam area.

7.9 PROVIDING PARKING SPACES

From the PPP discussion group, arrangements to make parking spaces available to parents for sending and picking up their kids can make the congestion situation better. The parking space should be close to their schools for the sake of safety concerns.

7.10 RAISE AWARENESS THROUGH EDUCATION

From the PPP discussion group, not only child but also all drivers should attend a road safety class regularly to rivet the safety standard. Driving is not a right, it is a privilege. With a driver's license indicating a person having driving skills, permitted drivers must follow the road rules and safely operate the vehicle. Traffic education will re-emphasize the road rules and road safety.

8. CONCLUSION

From this study on learning the traffic problem on the Highway No.21 in front of the schools in Phetchabun province, Thailand, it found serious traffic problems related to traffic congestion and accidents. The reduction in the number of U-turn locations can help traffic jams as well as decrease possible accidents thus increase road safety. Other factors and possible solutions as obtained from the participatory process are important in giving opinions to local authorities to alleviate the

problems. The participatory process also improves public awareness on the concerning road safety, as many measures have been discussed. The trade-off of traffic and safety management should be considered.

9. AVAILABILITY OF DATA AND MATERIAL

Data can be made available by contacting the corresponding author.

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