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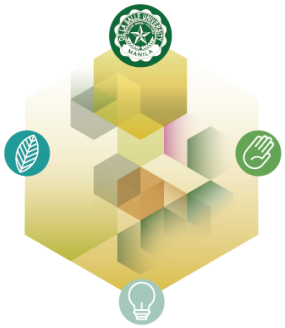

Driver Behavior at an Intersection During Peak Hours: Subic City

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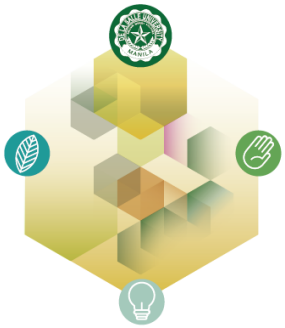
Abstract: Driver behavior is affected by a multitude of external factors that range from the behavior of other fellow drivers on the street to more personal factors such as the driver's mood and how they were trained to drive, and the habits that were developed to be able to drive in a way that they perceive to be the most efficient. Metro Manila is an example of a macrocosm of these behaviors coming into play and has given the city a reputation for having notably aggressive drivers. However, within the Philippines, the Subic Freeport zone is acknowledged by many as an area where their driving experience is considerably more positive than in Metro Manila. However, there has been no statistically sound source of this data to back these claims up so far. This paper serves as a way to prove these statements and as a stepping stone in examining what key differences make the driving experience in the Subic Freeport Zone more pleasant than in Metro Manila. Recordings were taken at the intersection and road segments of Argonaut Highway and Rizal Highway during peak and lean hours and were watched for their vehicle counts as well as specific driving behaviors such as overtaking, stoplight violations, and failure to yield to pedestrians. Within the data collected, there is a notably low amount of negative behaviors from drivers that go through the intersection, with a vehicle count of over 1000 vehicles per hour, which stayed reasonably constant over the course of the day. Stoplight violations only occurred 15 times at most within the span of 1 hour. Given these notable results, the traffic management of the Subic Bay Metropolitan Authority should be examined to see which of their systems may be adopted in larger cities.

Key Words: Behavior, Subic, Traffic, Authority



1. INTRODUCTION

The psychological behavior of individuals varies; each person reacts differently to a specific situation. Many external factors also influence their behavior. A realistic example to illustrate this would be the daily driving environment in the well-known Metro Manila. The situation here can differ from what one may experience in other cities. There are several factors that contribute to this. Firstly, road infrastructure needs to be able to handle the volume of traffic at various times of the day. Since rush hour always leads to a significant increase in traffic demand and thus congestion, this is a common cause of frustration among drivers. As mentioned, people react to situations differently. Many drivers shift to being aggressive drivers just to cut down on time being stuck in traffic; some common reactions seen are honking horns, constantly changing lanes, cutting off drivers, and failing to yield to pedestrians and other vehicles. This signals drivers that there is a sense of urgency. These are more known to the people as “road rage”. Another factor to consider is the lack of proper enforcement of traffic rules and regulations on the government’s side. Drivers tend to be more aggressive on the road since they feel they could get away with violating rules. This can lead to a general disregard for safety, resulting in dangerous driving behaviors. From another lens, the lack of understanding from drivers could also affect their driving behavior. In a survey conducted by Fernandez et al. (2020), 535 drivers from Metro Manila were interviewed on the depth of their understanding of traffic signs they would encounter while driving. The survey results showed that 76.25% of the responses were correct; however, it concluded from this that drivers in the city have a poor understanding of traffic signs. Using these results, a relationship between the results, the socio-economic background, as well as the driving characteristics of the driver is developed. This meant that the carelessness or lack of understanding of drivers could also be a factor in a driver’s behavior on the road.

Because of this, the researchers study the area of Subic City to understand better how the government and authorities handle situations like this. We will be comparing this to the general characteristics of cities in Metro Manila. From the data gathered, the researchers can analyze the significant variables in the study to propose solutions.

Traffic safety culture varies everywhere as it stems from drivers' risk perception and risk culture. That said, driver perception of traffic safety culture varies everywhere as it stems from drivers' risk perception and risk culture. With that being said, driver perception relates to their behavior. In a study conducted by Bathan et al. (2010), countries such as the USA, Germany, Spain, and the Philippines were examined. It was surmised that America would have the lowest risk perception among these countries. When there is a relaxed or absence of road authorities, a less safe driving experience can be observed. However, the absence of authorities should not give drivers a reason to drive dangerously, as lives are still at stake when safe driving is not followed. Another factor that could affect drivers' driving behavior is their background and mentality. This plays a massive part in the overall driving experience as their behavior could be affected by how they learned to drive and their mentality and goals in driving, as shown by the study of PUJ drivers by Dela Cruz et al. (2014). It is essential for drivers to know all the rules and regulations of the road and all the basics of driving. Distractions could also affect the driving experience, as no matter how much a driver is experienced in

driving, distractions can affect the driver's concentration on the road. The driver's concentration will be divided, making them less aware of the road conditions in front of them. Giant billboards, passengers in the vehicle, and the presence of music are a few examples of distractions that can affect the driver. Lastly, implementing policies can affect perceived differences in driving behavior and experience. Poorly thought out government road and traffic policies can lead to increased traffic and frustration from motorists. Not only that, considerable economic loss is experienced due to wasted time, as seen in the study made by Llanto (2016) on the cargo truck ban, which cost billions of pesos in economic losses and increased traffic in the area.

2. METHODOLOGY

2.1 Description of Road Network

The road network for the intersection chosen, as shown in Figure 1, has the following characteristics: 3 lanes, traffic islands, presence of traffic enforcers, pedestrian lanes, ramps from road to sidewalk, and stop lights. The intersection connects to the residential areas, schools, warehouses and Subic's government offices in the West-hand side. In the South, The Subic Bay FreePort, Subic Power Plant, and other undeveloped areas closed for Subic Bay Metropolitan Authority use. The North-hand side connects Subic City to Zambales, another area that is quite developed as well. Going East, one will be able to see the Subic-Tipo Expressway; the exit from Subic that connects it to the North Luzon Expressway.

Fig. 1. Top View of Argonaut Highway Intersecting Rizal Highway

2.2 Gathering of Data

Data was obtained through on-site recording or documentation of the chosen intersection, including its road segments. This is due to the lack of previous data on driver behavior in Subic available online. The factors involving the selection criteria for this study area include the number of lanes, traffic lights, traffic enforcers, and being one of the largest intersections within the Freeport Zone.

The length of the four recordings was around an hour each; morning peak hour (6 AM - 7 AM), morning lean hour (10 AM - 11 AM), afternoon lean hour (3 PM - 4 PM), and afternoon peak hour (6 PM - 7 PM). Figure 1 shows this in a graph. Additional minutes are in the recording for allowance to ensure that the traffic behavior during these hours is as consistent as possible. The hours were chosen based on the reported peak and lean hours of the traffic enforcers and the security officers of SBMA. A regular working day, Wednesday, was chosen so that the data would revolve mainly around the people in the area. Choosing a Monday or a Friday could alter the result as tourists or road users enter and exit the city. Therefore, Wednesday was chosen to lessen the variability.

Additionally, the researchers also considered the perspective of traffic enforcers in the area. Subic is currently managed by the Subic Bay Metropolitan Authority for its traffic situation and concerns.

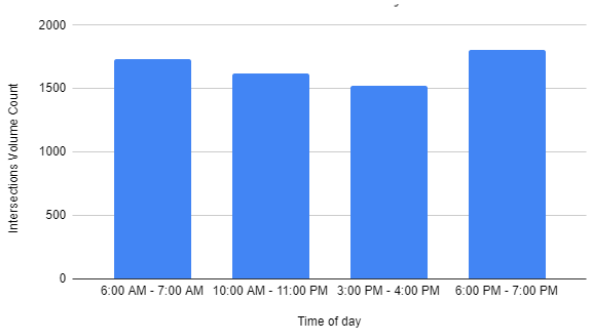


Fig. 1. Time of Day versus Intersection Volume Count

2.3 Processing of Data

Since Subic City is the study area being observed, the researchers quantified the data and chose specific variables that could be important in pointing out what this city has that other areas, such as cities in Metro Manila, do not have. Hence, aggressiveness factors were measured. The variables were as follows: time of day, volume count at intersections, volume count at road segments, volume count at island turns, stoplight violations, blocking of the pedestrian lane, driving in the wrong lane, unnecessary lane change, failure to yield, reactions to emergency counterflowing vehicles, and overtaking.

To summarize, each data was compared to see the trends. For the time of day, there is evidence that peak hours are true in the area. Figure 1 can prove that the morning peak hour runs from 6:00 AM to 7:00 AM. In this case, the morning peak hour had a value of 2521 vehicles passing through the intersection. The peak hour for afternoon traffic runs from 6:00 PM to 7:00 PM and has a value of 2870 vehicles passing through the intersection. The off-peak hour volume count for the morning and afternoon are 2178 and 2522 vehicles, respectively. This may be seen in Table 1.

Moreover, violations tend to be done more during peak hours than off-peak hours. This could be mainly due to the fact that drivers want to get back to their areas as soon as possible and not get stuck in traffic. Some ways the aggression of drivers may be seen are as follows: their resisting attempts by other road users to change lanes, emotions, stress, and cognitive behaviors. This, in turn, would reflect a decreased compliance with traffic rules since they prioritize going to their destinations quickly. Although Subic City is less congested, the authorities and traffic engineers have their way of making the travel of vehicles very efficient.

3. RESULTS AND DISCUSSION

Subic City is able to manage the flow of traffic reasonably well. Traffic flow always runs smoothly with its authorities on shifts to check on prominent intersections and communicate with the office. From the data source, the researchers recorded the road segment along Rizal Avenue and another along Argonaut Highway. Vehicles did not speed up drastically unless overtaking, which added to aggressive behavior. When put in an environment like cities in Metro Manila—which are denser, the driving environment varies; more aggressive characteristics show a higher volume of traffic and a more disorganized public transport system. Subic City is really able to manage its traffic well.

Some reasons other cities should model Subic City are as follows: it follows the rules of the road, actively seeks to improve its system, and constantly updates its system depending on the volume shift in an area.

Rules of the road are taken seriously in Subic City. Although some tourist vehicles or ones that may seldom visit this area, Subic Bay Metropolitan Authority lets its drivers know that rules are strictly enforced. One significant rule in Subic that is not found in Metro Manila is: first stop, first go, especially when blinking red stop lights exist. Blinking indicates that no enforcer is currently in the area, and it trusts the road users to drive responsibly. This usually happens during off-peak hours. First stop, first go applies in intersections; whichever vehicle stops first has the right of way to proceed first. With this in mind, proactive enforcers make drivers more aware and conscious on the road.

Subic City actively seeks to improve its system. In an interview done by the researchers during data gathering, some critical technological advancements are being made in the Subic Bay Freeport Zone. Camera systems are very beneficial to the enforcers and the higher officers to be able to see the situation at hand constantly. 360-degree cameras are slowly being placed in subdivisions and could be

remotely accessed and moved through the government office.

Through this, officers could easily relay messages to the one on duty.

They are constantly updating their system depending on the volume shift in an area. As stated earlier, technological advancements are being made in the Subic Bay Freeport Zone. One way to constantly update its system is by changing the duration of the traffic light. The researchers were able to see that intersections that started to bottleneck were checked on by enforcers. Usually, the duration changes at the time of the day rather than not changing it at all and letting bottlenecks become bound to happen. Some intersections are blinking red as well. This happens when fewer vehicles are using a particular road. If this is seen in Subic, it usually means first stop, first go. Another benefit of technological advancement is emergencies. Through the use of cameras that are consistently placed in every intersection, the officers can contact enforcers of a particular area to inform them that an emergency vehicle is approaching; what the enforcers would do is enter the intersection and signal drivers of the emergency and that they would have to give way. This makes the drive more efficient and safe.

The formula for Intersection Volume Count may be seen through Equation 1. This was done to ensure that the count is as accurate as possible since there is the limitation of manually tallying through viewing the intersection's video.

Provided in Table 2 is the total number of vehicular accidents for 2018 to 2022. Since the pandemic, the trend has continued to rise, averaging 439 accidents from 2021 to 2022. It is expected to rise in the next few years since people will be out more.

Table 3 shows the number of vehicles going in and out of Subic from January 30 to February 5. Since the data collected by the researchers were for February 1, it can be divided into 7 to get the total number per day as a rough estimate. When divided by 7, it could be said that the amount of vehicles going in and out of the city is 6208.

Table 1. Data Collected From Intersection Chosen

Time	Intersection Volume Count	Stoplight Violations	Blocking Pedestrian Lane	Driving in the Wrong Lane	Unnecessary Lane Change	Failure to Yield	Reactions to Emergency Counterflowing Vehicles	Overtaking
6:00 AM - 7:00 AM	2521	15	0	1	4	1	0	1
10:00 AM - 11:00 PM	2178	6	0	0	8	2	0	1
3:00 PM - 4:00 PM	2522	6	0	0	22	8	0	4
6:00 PM - 7:00 PM	2870	8	0	0	14	4	0	2

(Eq.1)

$$\textit{Volume Count 1} + \textit{Volume Count 2} + \textit{Traffic Island Turning Volume Count} = \textit{Intersection Volume Count}$$

where:

Volume Count 1 = Rizal Highway Road Segment Volume Count

Volume Count 2 = Argonaut Highway Road Segment Volume Count

Table 2. Total No. of Vehicular Accidents for 2018-2022

DATA SETS FOR INTELLIGENCE AND INVESTIGATION OFFICE, SBMA (YEAR 2018-2022)
Traffic Management & Investigation Branch

Motor Vehicle Mishap	2018	2019	2020	2021	2022
A. Total No. of Vehicular Accident	735	1040	316	444	434

Table 3. Vehicle Volume Count from TIPO Plaza

Tipo Plaza	Class 1	Class 2	Class 3	Total
Jan 30 to Feb 05, 2023	37,703	1,690	4,061	**43,454**

4. CONCLUSIONS

The study data show that few violations are being done in the selected intersection of Rizal Highway and Argonaut Highway relative to the volume count. Given that the vehicle count in each 1-hour segment ranges between 2500-2800, the number of violations that are done relative to the volume count might be considered negligible as only 1.6% of the vehicles that pass through the intersection commit any violation that was considered in the study. These results heavily contrast with the accident rates that can be found in different parts of Metro Manila which had

64 000 accidents throughout the year 2022. This difference in the way drivers behave may be attributed to the driving behavior as well as the road management that the SBMA does in the area, although this would need to be further studied. While Subic and Metro Manila may have differences in their population sizes and density, practices in Subic may be examined to determine if they are fit for trial and application in Metro Manila in the hopes of improving road safety.

5. ACKNOWLEDGMENTS

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