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Evaluation of Traffic Accidents in the Province of Albay: Basis for Sustainable Traffic Management Framework

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ABSTRACT

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The traffic safety situation around the world is still not optimistic. Accidents occur due to a combination of factors and are rarely caused by a specific reason. Risk factors are a better explanation for why traffic accidents occur. This study determined the traffic accidents in the province of Albay. It identified the number of reported traffic accidents in the Province of Albay covering Calendar Year 2020 to 2022. It also determined the causes and risk factors of traffic accidents regarding driver's behaviors, road conditions, vehicle conditions, traffic signs, and traffic management. Moreover, it inferred a significant agreement among the ranks regarding the causes and risk factors of traffic accidents. It proposed a traffic management framework to prevent traffic accidents in the province of Albay. The respondents of this study are 60 personnel from the three CPS in Albay, 30 from the Local Government

Unit, and 47 community, representing the riders and commuters in the Poblacion area. The study revealed a concerning prevalence of traffic accidents, underscoring a pressing public concern due to the high number of casualties and severity of outcomes. Despite this, road safety has not received sufficient attention, attributed to a lack of awareness regarding the problem's extent, associated costs, and effective interventions. Implementing a comprehensive traffic management framework involving collaboration among stakeholders is crucial for understanding and addressing the multifaceted causes of accidents, emphasizing the importance of community-wide initiatives and cooperation among various entities to enhance public awareness and promote responsible driving behavior. Thus, the traffic management framework will serve as a guide in preventing or lessening traffic accidents.

INTRODUCTION

Road traffic accidents, driven by numerous interconnected risk factors, continue to escalate globally, causing significant injury, death, and disability through collisions involving vehicles, pedestrians, and animals, leading to property damage and fatalities (Rodriguez et al., 2021). Numerous studies have investigated theories surrounding traffic congestion in the Philippines. One such study examines the multifaceted nature of congestion, addressing both public and private transportation. It suggests implementing a system based on Convolutional Neural Networks to accurately count, detect, recognize, and categorize vehicles (Ambata et al., 2019). Another study delves into the factors contributing to congestion, including population growth, urbanization, and industrialization. To mitigate this problem, it suggests embracing environmentally sustainable transportation options, such as diesel-electric vehicles (Estacio et al., 2019).

The current road safety situation in Malaysia, where achieving the objectives of the Road Safety Plan 2014–2020 is uncertain (Darma, 2017), mirrors the challenges faced in the three cities in Albay. Public perception of road traffic accidents in Malaysia and Thailand, known for their high accident rates (Hamid et al., 2022), resonates with the concerns in the present research. Likewise, Insights from studies like Vaziri's (2010) work on road safety in the Asia Pacific region and Niazi's (2018) examination of risk factors for road traffic injuries provide valuable perspectives for addressing similar issues in Albay. Additionally, understanding patterns such as the higher occurrence of accidents on Thursdays and Fridays in Kandahar can inform strategies for accident prevention and management in Albay.

Road traffic deaths in the Philippines rose by 39% from 2011 to 2021, with

road traffic injuries leading as the cause of death among Filipinos aged 15-29 and children; the decrease to 8,746 deaths in 2020 was due to reduced mobility during the COVID-19 pandemic, while the increase to 11,096 deaths in 2021 aligned with the easing of lockdowns, alongside road traffic injuries costing about 2.6% of the country's GDP (Junio, 2023). Likewise, in 2022, car-related road accidents in Metro Manila, Philippines, constituted approximately 52% of all vehicular accidents, with motorcycle accidents closely behind, representing about 23% of the total incidents (Statista Research Department, 2023). Various factors, including weather conditions, road infrastructure issues, and high levels of foot and vehicle traffic influence road accidents. The top five common causes of road accidents include overspeeding, often due to a lack of enforcement and awareness of speed limit laws, driving under the influence of alcohol, exacerbated by the prevalent social culture of alcohol consumption, bad overtaking practices resulting from failure to gauge distances and signal properly, improper turning habits, and jaywalking, with pedestrians opting for convenience over safety by disregarding designated crossings (Kim, 2022).

This study analyzes traffic accidents in the Province of Albay, specifically in Legazpi City, Ligao City, and Tabaco City. These cities exhibit notable traffic accident records, with Legazpi City recording 2,448 accidents from 2020 to 2022, Tabaco City reporting 604, and Ligao City documenting 294 (Albay PPO Crime Statistics, 2022). The rationale behind analyzing traffic accidents lies in identifying causes and contributing factors. This analysis aids policymakers, transportation engineers, and law enforcement agencies devise effective strategies to prevent and reduce accidents. The goal is to gain insights that drive proactive road safety measures, inform decision-making, and ultimately diminish the number of accidents and associated societal costs.

Furthermore, persistent high accident rates can tarnish the reputation of a region, affecting tourism and investment prospects. The consequences of traffic accidents underscore the urgent need for comprehensive measures to enhance road safety and mitigate their wide-ranging impacts. Understanding, analyzing, and evaluating various aspects of traffic issues is crucial to devising effective solutions, prompting the need for this study. The study's significance benefits the community, the Philippine National Police, Local Government Unit, Land Transportation Office, Public Safety Officers, external and internal stakeholders, students, and researchers.

FRAMEWORK

The study incorporates three relevant theories: the 4M's Factor Theory, the Evaluation Theory, and the Domino Theory. These theories aim to elucidate the factors contributing to accidents, particularly in the context of road traffic accidents, making them pertinent to the study. The 4M's Factor Theory, also recognized as Multiple Causation Theory by Vernon L. Grose (Ranjan, 2018), identifies contributing factors that converge randomly to cause accidents, emphasizing the need for management to recognize these elements and implement necessary safety measures. This theory supports the Domino Theory, which asserts that accidents result from risky behaviors or circumstances, pinpointing the point of contact. Various countermeasures are employed to mitigate these risks, such as diversion, dispersion, reinforcements, surface functionalization, separation, barricading, shielding, absorption, and others (Ranjan, 2018).

Furthermore, support for this concept can be found in the evaluation theory, as articulated by Smith (1993) and Scriven (2003). Smith characterizes evaluation theory as the contemplation of "our ideas concerning the motives and methodologies involved in conducting evaluations." This framework serves to validate, ensure accountability, monitor, and foster improvement and advancement through evaluation. Theories play a pivotal role in guiding the goals of evaluations and in setting standards for acceptable evidence when making evaluative judgments.

OBJECTIVES OF THE STUDY

This study determined the traffic accidents in the province of Albay, identified the number of reported traffic accidents in the Province of Albay covering the period from CY 2020 to 2022, and determined the causes and risk factors of traffic accidents in terms of driver's behaviors; road conditions; vehicle conditions; traffic signs; and traffic management. Moreover, it proposed a traffic management framework to prevent traffic accidents in the province of Albay.

METHODOLOGY

Research Design

This study utilized the descriptive-evaluative method of research. Descriptive research considers one variable at a time and is typically the entry-level type of research in a new area inquiry. It further describes what appears to be happening and what the important variables seem to be. Incorporating the descriptive-

evaluative method of research into the study involves initially describing the current state of road safety in Albay. This approach allows researcher to not only describe the current scenario but also evaluate the efficiency of interventions, guiding future road safety policies and initiatives. The sources of data came from the Crime Statistics of Albay PPO to identify the number of reported traffic accidents and the primary data came from the responses of the respondents in determining the causes and risk factors of traffic accidents.

Research Site

This study was conducted in the province of Albay. Albay is situated in the southeastern part of the island of Luzon within the Bicol Region of the Philippines, boasting Legazpi as its capital and largest urban center. Nestled amidst the scenic landscapes, Legazpi is the regional hub for the entire Bicol Region. It finds its majestic backdrop in the southern foothills of the iconic Mayon Volcano, adding to the province's allure and charm. Primarily, this study was conducted in the three cities of Albay. Albay has a total land area of 2,575.77 square kilometers (994.51 sq mi), which makes it the 53rd biggest province. In addition, Tabaco, officially known as the City of Tabaco, is a 4th class component city situated in Albay, Philippines, with a population of 140,961 according to the 2020 census. It is one of the three component cities in the province, bordered by various towns and the Lagonoy Gulf, with the iconic Mayon Volcano located to its south, shared by eight nearby towns and cities. Lastly, Ligao City is a 4th class component city situated in the province of Albay, Philippines, with a population of 118,096 according to the 2020 census. The city's economy primarily relies on the agricultural sector. As an emerging site in the province of Albay, daily transport stakeholders pass along the area, which, as years go by, becomes a highly urbanized barangay. Likewise, these cities recorded many traffic accidents from 2020-2022. As a result, these cities have been confronted with various traffic issues, which interestingly become the focus of the researcher.

Respondents

The respondents were composed of 60 PNP personnel, Public Safety Officers with 30 respondents and selected riders and commuters with 47 respondents which are randomly picked and ensure that each member of the population had an equal chance of being chosen to participate in the study. The respondents were chosen based on their knowledge of the problem and availability. The study selected Philippine National Police (PNP) personnel as respondents due to their pivotal role in enforcing traffic regulations and maintaining order on the roads, as lapses in enforcement can contribute to an environment conducive to traffic

accidents. The 18 Public Safety Officers (PSO) were chosen to represent the Local Government Unit (LGU) as they are instrumental in implementing traffic control measures, which if ineffective, could lead to congestion and heightened accident risks. Likewise, the 6 Department of Public Works and Highways (DPWH) personnel were identified as respondents due to their responsibilities in planning, designing, and maintaining road infrastructure, which can impact accident rates and 6 Municipal Disaster Risk Reduction and Management Council (MDRRMC) personnel were considered due to their involvement in managing emergencies related to road safety. Finally, riders and commuters were included as respondents because their behaviors significantly influence overall road safety. These stakeholders collectively provide valuable insights into the multifaceted causes of traffic accidents, making them crucial informants for the research.

Table 1
Respondents

Respondents	PNP	PSO	Community		Total
			Riders	Commuters	
Legazpi City	20	10	9	9	48
Tabaco City	20	10	8	8	46
Ligao City	20	10	7	6	43
TOTAL	60	30	47		137

Instrumentation

To answer the objectives of the study, the survey questionnaire primarily indicates the causes and risk factors of traffic accidents along with human behavior, road conditions, vehicle conditions, traffic signs, and traffic management. The questionnaires enabled the researcher to gather data applicable to the respondents. The questionnaires were created to enable the researcher to clearly gather data applicable to the respondents. To ensure that the instrument comprised the themes and areas that the study was examined, the items included in the questionnaire were subjected to validation by personnel from Legaspi CPS, Tabaco CPS, and Ligao CPS for face and content validation. Face and content validity are questionnaire measurement techniques used to judge and quantify measurements that appear acceptable to the general public and highly qualified experts. The validation reveals that the data collection tools are aligned with the specific research objectives. The study used a Likert-type survey questionnaire that gave the respondents four (4) choices of answers.

Sampling Technique

The study employed a purposive sampling methods to select respondents. Purposive sampling, utilized for Philippine National Police (PNP) and Local Government Unit (LGU) personnel, including Public Safety Officers (PSO), Department of Public Works and Highways (DPWH) personnel, and City Disaster Risk Reduction and Management Council (CDRRM) personnel and for the community, including riders and commuters that aimed to capture insights from individuals with specialized knowledge pertinent to law enforcement, public safety, disaster management, and road infrastructure. This method enabled selecting participants based on specific characteristics relevant to the research questions, ensuring a depth of understanding from experts in relevant fields.

Data Analysis

This study used the documentary analysis to answer the objective number 1. The document review is the process of checking a document to make sure it's ready to be used or published. This usually involves reading the document, checking the sources, and making sure any data points are accurate. Further, the statistical tool that was used in this study is the weighted mean. This was the method by which the number of respondents, responses, and occurrences of the subject were determined.

Research Ethics Protocol

To ensure ethical standards in this study, participation is entirely voluntary, and participants have been provided with a consent letter to freely engage with the questionnaire. Moreover, respondent anonymity has been upheld. Ensuring the dignity of participants through careful phrasing in the questions was a top priority in this research. Ultimately, the researcher is dedicated to upholding the study's independence and impartiality in presenting all the gathered data.

RESULTS AND DISCUSSION

This part of the study presents the analysis and interpretation of the data gathered on the causes and risk factors of traffic accidents in the province of Albay. They were analyzed and interpreted in the light of the insights from reading and statistical outputs for the relationship.

Reported Traffic Accidents in the Province of Albay covering the period from CY 2020 to 2022

A road traffic accident is any accident involving at least one road vehicle in motion on a public or private road to which the public has the right to access. In this study, the reported Traffic Accidents in the Province of Albay covering the period from CY 2020 to 2022 include the frequency, severity, and type of road accidents.

Severity. On the severity of traffic accident fatalities, Ligao City had the highest number of fatalities in 2021 (13), while Tabaco City had the lowest in 2020 and 2022. Ligao City showed an increase in 2022 compared to 2021. On the other hand, in serious injuries, Tabaco City consistently reported serious injuries each year, with a slight decrease in 2022. No data was provided for Ligao City. In minor injuries, Legazpi City consistently reported the highest number of minor injuries each year. Ligao City showed an increase from 2020 to 2022, while Tabaco City had a significant increase in 2022 compared to the previous years. Lastly, regarding property damage, Ligao City consistently reported higher damage to property than the other cities. All cities showed an increase in this category in 2022 (Albay PPO Crime Statistics, 2022).

Legazpi City consistently reported the highest total number of accidents each year. Ligao City had the lowest total accidents in 2020 but showed an increase in 2022. Tabaco City had an increase in total accidents in 2022 compared to the previous years. Overall, it can be seen that the three cities in the province of Albay have an increasing number of traffic accidents from 2020 to 2022. Though there is no recorded serious injury in Legazpi City and Ligao City, Tabaco City has a total of 31 cases with a serious injury (Albay PPO Crime Statistics, 2022).

In a related study, Hyodo and Hasegawa (2021) investigated the impact of traffic, road, and environmental conditions on accident severity levels. They find that less severe accidents are linked to icy and snowy road surfaces for single- and multi-vehicle accidents. The study suggests that temperature and visibility conditions may increase the likelihood of severe and fatal multi-vehicle accidents. Additionally, Makarova et al. (2020) review methods for identifying factors affecting the severity of traffic accidents. The study emphasizes that different accident types lead to varying levels of severity, with collisions involving pedestrians and cyclists common contributors to severe consequences.

Number of Casualties. In fatalities, Ligao City had the highest number of fatalities in 2021 but showed a slight decrease in 2022. Tabaco City consistently reported lower fatalities. In serious injury, Legazpi City reported a significant increase in serious injuries in 2021, while no data was provided for Ligao and Tabaco City. The absence of serious injury data in 2022 for Legazpi City and

Ligao City suggests a need for more comprehensive reporting. Furthermore, in minor injury, all cities experienced an increase in minor injuries. Ligao City decreased in 2022, while Legazpi City and Tabaco City recorded notable increases. Overall, Legazpi City consistently reported the highest total casualties, with a decrease from 2021 to 2022. Ligao City had fluctuations, and Tabaco City witnessed a substantial increase in total casualties in 2022 (Albay PPO Crime Statistics, 2022).

Minor injury is the most common cause of traffic accidents. Though minor injuries are not nearly as dangerous as serious ones, they still require medical attention and treatment. The classification of the accident's cause and the point of impact on the vehicle will significantly influence the injuries sustained by individuals involved in the accident (WHO, 2023). In the study of Ahmed et al. (2023), road accidents represent a significant cause of fatalities and severe injuries. Road traffic injuries are a substantial yet overlooked global public health concern, demanding urgent attention. Implementing conservative preventive measures is crucial for long-term accident prevention, aiming to reduce collisions and foster a safer road environment.

Causes of Accidents. Drunk driving contributed to accidents in all cities, and efforts to address this issue should continue. The decrease in Legazpi City and the increase in Ligao City warrant attention. Meanwhile, over speeding emerged as a significant cause in all cities, with a notable increase in Ligao City and Tabaco City. Speed management measures may be crucial for accident prevention. In addition, hit-and-run incidents decreased in Legazpi and Tabaco City, while in Ligao City, there were no reported cases from 2020 to 2022. Enforcement and public awareness campaigns may contribute to further reductions (Albay PPO Crime Statistics, 2022).

Bad overtaking incidents varied; targeted education and enforcement efforts may be necessary to address this behavior. It can be seen that there is also an increasing number of traffic accidents as to the causes of accidents. In Ligao City, there is no recorded hit-and-run case, while from 2020 to 2022, Legazpi City and Ligao City also have zero recorded cases of collision as to the cause of traffic accidents. It is not worth taking that Tabaco City has the least number of other causes of accidents among the three cities in Albay. However, other causes of traffic accidents were a common and predominant category in all cities, suggesting a diverse range of factors contributing to accidents (Albay PPO Crime Statistics, 2022).

In investigations on road traffic accidents in African countries, a significant consensus among researchers highlights that human-related factors, including speeding, reckless driving, fatigue, drunk driving, drug use, seat belt neglect, and

cell phone usage, contribute to over 75% of accidents. Particularly in densely populated African nations like Nigeria, Ethiopia, and Egypt, more than 80% of road traffic accidents are attributed to these human-related factors (Deme, 2019). Cai's 2020 study emphasizes that traffic accidents on urban roads stem from collaborative influences involving human, vehicle, road, and environmental aspects. Identifying primary accidents requires extracting association rules between relevant risk factors based on accident statistics. Furthermore, according to Harantová et al. (2020), traffic accidents primarily result from three factors: the driver, the vehicle, and the road infrastructure. Although the causes of traffic accidents vary, inappropriate driver behavior is the predominant factor in most cases.

Causes and Risk Factors of Road Traffic Accidents. Road traffic accidents arise from a blend of factors involving the elements of the road system, environmental conditions, vehicles, and road users, as well as their interactions. Certain factors contribute to collision incidence and are thus integral to crash causation.

Drivers Behavior. Driver behavior refers to the intentional and unintentional traits and actions exhibited by a driver while operating a motor vehicle. It is a pivotal aspect of fleet management due to its significant impact on driver safety, potentially increasing the likelihood of collisions, injuries, or fatalities. Table 1 presents the driver's behavior, which includes five indicators.

Table 1

Drivers Behavior

	Indicators	Legazpi	Ligao	Tabaco	TWM	AI
1.	Inexperience, lack of skill and risk taking behaviors.	2.70	1.65	2.27	2.21	H
2.	The vehicle speed factor or the driver exceeding the speed limit and the absolute vehicle velocity contributed to crash causation.	2.72	1.66	2.52	2.30	H
3.	Driving fast, poor visibility.	2.62	1.57	2.47	2.22	H
4.	Driving while impaired by alcohol and driver inattention or lack of focus in driving.	2.68	1.71	2.63	2.34	H

5.	Incapacitation or drivers who feel asleep or experienced a seizure/heart attack/blackout.	2.53	1.69	2.21	2.14	H
	Total Weighted Mean	2.65	1.66	2.42	2.24	H

Legend: 3.26 – 4.00 Very High (VH), 2.51 – 3.25 High (A), 1.76 – 2.50 Low (L), 1.00 – 1.75 Very Low (VL)

Based on the results of the study, the respondents from Legazpi City perceived that vehicle speed factor or the driver exceeding the speed limit and the absolute vehicle velocity contributed to crash causation is the most common cause and risk factor of traffic accidents with a weighted mean of 2.72 or Moderately Agree. Acknowledging the vehicle speed factor, particularly the driver exceeding speed limits and the absolute velocity of the vehicle, as a significant cause and risk factor for traffic accidents highlights the importance of prioritizing speed management measures in traffic safety initiatives. The shared perception among respondents indicates a potential foundation for collaborative efforts to reduce the impact of excessive speed on road safety.

In Ligao City and Tabaco City, driving while impaired by alcohol and driver inattention or lack of focus have the highest weighted mean of 1.71 and 2.63, respectively. The recognition of these factors as the factors with the highest weighted mean emphasizes their critical role in contributing to traffic accidents. Implementing evidence-based interventions and fostering a culture of responsible driving are key components in addressing these significant road safety challenges.

Generally, driving while impaired by alcohol and driver inattention or lack of focus in driving have the highest weight of 2.34 or Agree. The fact that this factor has the highest weighted mean indicates that survey participants or respondents consider them the most critical elements contributing to traffic accidents. Driving while impaired by alcohol is a well-established risk factor due to its impact on coordination and decision-making. Simultaneously, driver inattention or lack of focus can arise from various causes, including distractions, fatigue, or cognitive overload.

The environment heavily influences human behavior. Actions reached by a deliberative process can be mistaken if it fails to consider all relevant information or processes it incorrectly. Since risk assessment is a self-responsibility, people are not always rational. People tend to underestimate the likelihood of accidents happening to them personally while overestimating the risks associated with others.

Driver motivation and personality traits, particularly factors like driving anxiety and anger, are identified by Karimi et al. (2022) as pivotal in shaping driving behavior and influencing the likelihood of being involved in traffic

accidents. An insightful study conducted in Tabuk city, Saudi Arabia, examined the impact of drivers' characteristics on traffic accidents. The research indicated significant relationships between various variables and accidents in the city, particularly highlighting drivers' age and educational level as significant factors. Younger drivers tended to be more involved in accidents with less responsibility, while accidents were less likely to be attributed to higher-educated drivers. Additionally, Le (2009) emphasizes in his study on Risk Analysis, Driver Behavior, and Traffic Safety at Intersections in Motorcycle-Dominated Traffic Flow that human behavior stands out as the primary cause of traffic accidents.

Road Condition. Road surface conditions and structural integrity greatly impact vehicles, drivers, and the community. Road conditions that affect drivers also inherently affect the surrounding area. Poorly maintained roads can directly and indirectly affect many areas of daily life by causing traffic disturbances. Table 2 presents the road conditions that Driver motivation and personality traits, particularly factors like driving anxiety and anger, ascribe the causes and risk factors of traffic accidents.

Table 2

Road Condition

	Indicators	Legazpi	Ligao	Tabaco	TWM	AI
1.	There is no roadway and intersection design/markings and control.	2.30	1.91	2.44	2.22	H
2.	Inadequate Street Capacity (crowded to capacity).	2.23	2.10	2.38	2.24	H
3.	Poor drainage and standing water on freeways.	2.56	1.90	2.40	2.29	H
4.	Faded centerlines and lack of reflective markers.	2.39	2.19	2.50	2.36	H
5.	Inadequate lighting and or failure to install traffic signals	2.62	2.12	2.30	2.35	H
	TOTAL WEIGHTED MEAN	2.42	2.04	2.40	2.20	H

Legend: 3.26 – 4.00 Very High (VH), 2.51 – 3.25 High (A), 1.76 – 2.50 Low (L),1.00 – 1.75 Very Low (VL)

Based on the results of the study, inadequate lighting and or failure to install traffic signals have the highest weighted mean of 2.62 or Agree as perceived by the respondents in Legazpi City. The statement suggests that inadequate lighting and/or failure to install traffic signals have the highest weighted mean, indicating agreement among respondents. The agreement on inadequate lighting

and traffic signal failure underscores the importance of investing in infrastructure improvements. This may include upgrading existing lighting systems and ensuring the proper installation and maintenance of traffic signals. Furthermore, recognizing the significance of inadequate lighting and the failure to install traffic signals suggests a need for proactive measures in infrastructure improvement and urban planning. Addressing these issues can create safer road environments and reduce the risk of accidents, especially at critical points such as intersections.

On the other hand, faded centrelines and lack of reflective markers are the highest weighted among the five indicators, with 2.19 and 2.50 or Agree in Ligao City and Tabaco City, respectively. The agreement on the significance of faded centrelines and the lack of reflective markers underscores the need for ongoing infrastructure maintenance and improvement efforts to enhance road safety, particularly in conditions with reduced visibility.

Commonly, faded centrelines and lack of reflective markers have the highest weighted of 2.36 or Agree as perceived by the three groups of respondents. This was followed by inadequate lighting and or failure to install traffic signals with a weighted mean of 2.35 or Agree. Meanwhile, no roadway intersection design/ markings, and control have the lowest weighted mean of 2.22 or Agree. Overall, the causes and risk factors of road traffic accidents in terms of road conditions have a total weight of 2.20 with an adjectival interpretation of Agree.

This study evaluated driver behaviors by examining the driving and visual habits of users, taking into account the influence of various configurations of pedestrian crossings and road signs to mitigate accidents. This highlights the issue of faded centerlines and the absence of reflective markers as key concerns. Roadway design emerges as a crucial determinant impacting driving behavior and the perception of safety. Moreover, amidst increasing globalization, roads have become indispensable infrastructure facilitating the movement of goods and people making the better and sustainable development of roads very important. Thus, it will prevent even lessening traffic accidents. Furthermore, driving behavior is a complex and multidisciplinary research domain, and bad driving behaviors that threaten the safety of road users should be refrained.

One of the important difficulties on roads is that they often do not have reliable and typical designs. Roadway design is among the most important issues affecting driving behavior and alleged safety. Additionally, with increasing globalization, roads have developed a vital infrastructure that allows the allocation of freight and people, making the enhanced and workable development of roads very significant. Therefore, it will avoid traffic congestion.

The referenced studies, Agustin et al.'s (2023) research, identify key factors contributing to road traffic accidents, including driver demographics, weather

conditions, and road infrastructure. These insights offer valuable guidance for devising effective preventive measures on MacArthur Highway.

Sun et al. 2022) observations reveal that influential factors for heavy and serious traffic accidents are equivalent when using universal traffic accidents as a reference. Factors such as highways, accident-prone roadsides, intersections, crosswalks, traffic signals, and stop signs consistently impact heavy and serious traffic accidents irrespective of the time of day. Alkhadour et al. (2021) anticipated statistical analysis of serious accidents and traffic volume in specific locations in Ahmedabad aims to assess the prevalence of such accidents over six years.

Additionally, Athiappan et al. (2022) identifies the top 10 causes of accidents, including volume-to-capacity ratio, lack of sight distance, uncontrolled intersections and bridge approaches, absence of footpaths, skid resistance, male drivers, driving under the influence, speeding, and passenger vehicles. Levin and Nalbandyan (2022) underscore that many car accidents stem from poor and hazardous roadway conditions, potentially resulting in severe and fatal injuries (Gilman & Bedigian, 2023).

Vehicle Condition. A lack of preventive maintenance for vehicles leads to inefficiencies as subsequent breakdowns often incur significantly higher costs and longer repair times. Some breakdowns can compromise vehicle reliability, posing safety risks to users. Therefore, maintaining vehicles in good condition is essential for effective fleet management, safely achieving operational objectives, optimizing resource utilization, and adhering to national laws and regulations. Ensuring good vehicle condition is accomplished through proper vehicle use and maintenance practices. Table 3 presents the vehicle condition that describes the causes and risk factors of traffic accidents.

Table 3

Vehicle Condition

	Indicators	Legazpi	Ligao	Tabaco	TWM	AI
1.	Inexperience, lack of skill, and risk-taking behaviors.	2.70	1.65	2.27	2.21	H
2.	The Vehicle speed factor or the driver exceeding the speed limit and the absolute vehicle velocity contributed to crash causation.	2.72	1.66	2.52	2.30	H
3.	Driving fast, poor visibility.	2.62	1.57	2.47	2.22	H
4.	Driving while impaired by alcohol and driver inattention or lack of focus in driving.	2.68	1.71	2.63	2.34	H

5.	Incapacitation or drivers who fell asleep or experienced seizure/ heart attack/blackout.	2.53	1.69	2.21	2.14	H
	TOTAL WEIGHTED MEAN	2.65	1.66	2.42	2.24	H

Legend: 3.26 – 4.00 Very High (VH), 2.51 – 3.25 High (A), 1.76 – 2.50 Low (L), 1.00 – 1.75 Very Low (VL)

In general, as perceived by the three groups of respondents, frequent vehicle breakdowns have the highest weighted mean of 2.30 or Agree, which was followed by a lack of modern safety features (such as lane assist, brake assist, electronic stability control (ESC), ABS brakes) with a weighted mean of 2.28. Frequent breakdowns can lead to operational disruptions on the road, posing safety risks as vehicles may stall unexpectedly, leading to potential accidents. Vehicles experiencing breakdowns can disrupt the flow of traffic, causing congestion and increasing the likelihood of rear-end collisions or other accidents as other drivers adjust to the sudden disruption. On the other hand, the mention of "lack" indicates that respondents may perceive the absence of modern safety features as a significant concern in the context of traffic safety. The mention of this concern suggests a need for increased awareness among consumers regarding the availability and importance of modern safety features when purchasing or using vehicles.

The result of results revealed that improper care of vehicles was the major cause of vehicular breakdowns and accidents, as many drivers do not check their vehicles daily before use. Thus, vehicle breakdowns can lead to fatal accidents, increase costs, and reduce productivity. The lack of modern safety features such as lane assist, brake assist, electronic stability control (ESC), and ABS brakes is linked to vehicle performance and design improvements that technological advancements in the automotive industry have accelerated along. However, some technologies must be considered to effectively monitor the vehicle status and predict the likelihood of car accidents.

Traffic signs. Traffic signs offer drivers and other road users essential information, representing rules established to ensure safety and facilitate effective communication. They are vital in conveying messages to drivers and pedestrians, promoting order, and minimizing accidents. Additionally, traffic signs are indispensable for providing directions, routes, and warnings to drivers, all of which should be clear and easily comprehensible to convey the intended message to road users. Table 4 presents the traffic signs and describes their causes and risk factors.

Table 4
Traffic Signs

	Indicators	Legazpi	Ligao	Tabaco	TWM	AI
1.	The supervision and maintenance of the application of traffic control devices such as traffic light signals, pavement markings, and traffic signs is low.	2.34	1.57	2.52	2.14	H
2.	There is no dedicated designation for the loading and unloading area.	2.33	1.74	2.41	2.16	H
3.	There are no traffic signs or markings.	2.27	1.77	2.46	2.17	H
4.	Confusing traffic signs and markings.	2.15	1.77	2.39	2.10	H
5.	Disobeying Traffic Signals/ disregarding traffic signs.	2.65	1.80	2.43	2.29	H
	TOTAL WEIGHTED MEAN	2.35	1.73	2.44	2.17	H

Legend: 3.26 – 4.00 Very High (VH), 2.51 – 3.25 High (A), 1.76 – 2.50 Low (L), 1.00 – 1.75 Very Low (VL)

Disobeying Traffic Signals/ disregarding traffic signs is the most common cause and risk factor of traffic accidents. Disobeying a sign increases the risk of any of these common accidents. Ignoring a traffic sign is not worth ruining or ending personal life or the life of another. However, having no traffic signs and markings can lead to improper use of roads and eventually increase the risk of accidents, injury, or even death.

Poor and improper road signage also play a role in road accidents. Lack of signage may confuse intersections, inadequate signage may put a pedestrian or cyclist at risk of injury, improper placement of signage at construction sites may obstruct a driver's view or not allow drivers enough time to react during times of congestion, and failure to properly clean up a construction site or warn of hazards may lead to severe injury or even death are other causes of traffic accidents.

Moreover, according to Robielos and Lin (2022), the utilization of graphic symbols in traffic signs is recommended. These symbols can efficiently convey complex information with limited resources, are more easily recognizable than words from a greater distance, and aid in memory tasks compared to text. Since

symbols provide a language-free means of communication, they have the potential to be understood by diverse groups with varying life experiences and reading abilities. Additionally, Robielos and Lin (2022) noted that the combination of symbols and verbal codes enhances retention quality. In the context of traffic signs, it also found that adding text to symbols increases driver understanding and reduces the time needed to comprehend traffic signs.

Furthermore, human factors experts assess the impact of roadway environment design and condition on a driver's performance. This involves determining the visibility, consistency with driver expectations, influence on driver actions, and adequacy in preventing accidents of traffic control strategies, roadway markings, and signage. Additionally, traffic engineering addresses the practical aspects of road geometry, including traffic signs, signals, intersection management, and road surface markings. It also encompasses the design and construction of transportation infrastructures, as highlighted by WSP (2022).

Traffic Management. Traffic management is the organization, management, direction, and regulation of both stationary and moving traffic, encompassing pedestrians, bicyclists, and various types of vehicles, which are aimed at ensuring the safe, organized, and efficient flow of individuals and goods. The overarching goal is to safeguard and, whenever feasible, enhance the well-being of all road users and enhance the quality of the local environment on and adjacent to traffic facilities. Table 5 presents traffic management that describes the causes and risk factors of traffic accidents.

Table 5

Traffic Management

	Indicators	Legazpi	Ligao	Tabaco	TWM	AI
1.	Less effective management of traffic laws, rules, regulations and ordinances.	2.49	1.59	2.15	2.08	H
2.	There is a lack of proper or appropriate guidelines and direction for road users.	2.30	1.67	2.38	2.12	H
3.	Limited directing and controlling of traffic movement.	2.32	1.70	2.27	2.10	H
4.	There are no appropriate citations, tickets, or apprehension of traffic violators.	2.35	1.68	2.18	2.07	H

5.	Lack of intervention programs that educate and instill Traffic discipline.	2.47	1.71	2.39	2.19	H
	Total Weighted Mean	2.39	1.67	2.27	2.11	H

Legend: 3.26 – 4.00 Very High (VH), 2.51 – 3.25 High (A), 1.76 – 2.50 Low (L), 1.00 – 1.75 Very Low (VL)

In general, as perceived by the three groups of respondents, the lack of intervention programs that educate and instill Traffic discipline has the highest weighted mean of 2.19 or Agree, which was followed by a lack of proper or appropriate guidelines and directions to road users with a weighted mean of 2.12 or Agree. Lack of intervention programs suggests a potential need for comprehensive initiatives that go beyond traditional driver's education, encompassing a broader audience and focusing on cultivating a culture of responsible road behavior. Addressing the lack of intervention programs for traffic discipline requires a concerted effort from various stakeholders. Initiatives should be designed to educate, engage, and instill long-term behavioral changes, contributing to safer and more disciplined road environments. Meanwhile, the lack of proper or appropriate guidelines and direction to road users shows a perceived deficiency in providing clear and suitable guidance to those using the road. The lack of proper guidelines for road users requires a comprehensive approach involving infrastructure planning, education, technology integration, and collaboration among various stakeholders. Clear and effective guidance is essential for creating a safer and more organized road environment.

A lack of driving discipline or consideration for others, in fact, reduces the capacity of the road network to a fraction of its potential. Driver and pedestrian behavior absolutely must improve. That is why it is so very important to educate the entire population on traffic rules. Likewise, there is a lack of proper or appropriate guidelines and directions for road users and limited directing and controlling of traffic movement.

In a related study, Chang (2019) underscores the expectation that traffic enforcement enhances accident prevention efficiency, prompting an investigation into the correlation between traffic violation records and accidents. The research utilizes Taiwan's national databases for traffic accidents, violation records, and driver-car registrations, categorizing drivers into car drivers and motorcyclists. Descriptive statistical analysis initially examines the accident connection rate for drivers with prior violation records, followed by the application of association rules to unveil the relationship between accidents and these drivers.

Furthermore, Aljaban (2021) highlights traffic as the primary cause of auto

accidents, particularly during rush hours when individuals are commuting to or from work, school, or home. The goal of traffic enforcement is to reduce crashes and injuries while promoting safe driving practices. This is accomplished by ensuring the smooth flow of vehicular and pedestrian traffic through voluntary adherence to traffic regulations by the general public (Saint Paul, Minnesota, 2019).

Propose a Traffic Management Framework That Will Prevent Traffic Accidents in the Province of Albay. The safe system approach to road safety strives to establish a secure transport system for all road users. This method acknowledges people's susceptibility to severe injuries in road traffic accidents and underscores the necessity for a system designed to be forgiving of human error. The fundamental principles of this approach encompass ensuring safe roads and roadsides, maintaining safe speeds, utilizing safe vehicles, and promoting safe road user behavior. Addressing these components is essential for eliminating fatal crashes and reducing serious injuries.

Despite ongoing efforts, the global traffic safety situation remains challenging. Numerous factors impact traffic conditions, including driver and pedestrian awareness, adherence to laws, types of vehicles on the roads, traffic flow and routes, and various other features. It is acknowledged that traffic regulations alone do not solely determine the traffic situation; other crucial factors include the discipline of the populace, road dimensions, and the efficacy of traffic law implementation by responsible offices and officers.

The impact of traffic regulations and legislation extends beyond legal aspects, influencing broader societal dynamics. Transportation is a fundamental aspect of civilization, and improvements in traffic regulations contribute to refining daily traffic conditions and enhancing the lives of citizens. Conversely, inadequate traffic regulation and enforcement can be likened to a calamity or disaster that individuals would prefer to avoid.

The primary point of this proposed traffic management framework is to lessen traffic congestion while keeping people safe and orderly. Following traffic laws is one of the most essential aspects of driving and can increase safety. Knowing and applying traffic rules can prevent people from getting involved in traffic congestion, even in traffic violations and accidents.

To prevent traffic congestion, this study presents a traffic management framework to develop discipline in the community, lessen negative behaviors like overspeeding, disobeying traffic signs, and getting along with local enforcement, and improve the infrastructure for the safe passage of vehicles. Also, the educational activities, including teaching traffic safety and creating awareness among the people, provide training for personnel who are required to enforce

traffic laws and regulations.

Under the establishment of these strategies to prevent traffic congestion, the education or awareness in the community, including traffic safety campaigns and propaganda, shall be promoted systematically and constantly through cooperation among the national and local government agencies, traffic police and private organizations for the purpose of raising people's traffic awareness and encourage them to observe traffic rules and appropriate traffic behavior in their daily life.

This comprehensive strategy reflects a holistic approach, incorporating community engagement, education, and technological advancements to create a safer and more efficient road environment. The emphasis on transparency and recognition aims to foster public trust and cooperation in the pursuit of enhanced road safety.

In information dissemination and awareness campaign aims to reach drivers and motorists through various channels, including physical materials, educational partnerships, and online platforms. The distribution of pamphlets and posters in key locations provides direct access to important traffic safety information. Collaborating with educational institutions ensures that road safety is integrated into formal education, reaching a broad audience and embedding safety awareness early on. The use of various media, particularly social media, leverages the widespread reach and engagement potential to communicate essential traffic safety messages effectively. Overall, this multifaceted approach seeks to create a well-informed and safety-conscious community.

Furthermore, on the rehabilitation and improvement of road and traffic signs through the adoption of advanced technologies, regular safety audits, and collaboration with traffic engineering experts. The real-time traffic monitoring system aims to enhance responsiveness to emerging issues, while comprehensive safety audits contribute to identifying and addressing potential hazards. The routine maintenance program ensures the optimal functioning of traffic signs and signals, promoting overall road safety. Engaging traffic engineering experts during planning stages and standardizing traffic control devices are measures to enhance the effectiveness and consistency of traffic management. The modernization of signals with advanced technologies further contributes to improved traffic efficiency and safety.

CONCLUSIONS

The data reveals a significant incidence of traffic accidents, marking a substantial public issue due to the considerable number of victims involved

and the severity of the consequences they face. Despite the increasing burden of road traffic accidents, road safety has not received adequate attention. This is attributed to a lack of overall awareness and specific information regarding the extent of the problem, the health, social, and economic costs associated with road traffic accidents, and effective interventions to prevent or mitigate their impact.

The primary causes and risk factors contributing to traffic accidents include driving under the influence of alcohol, driver inattention or distraction, faded center lines, and the absence of reflective markers. Other factors involve frequent vehicle breakdowns, disregarding traffic signals or signs, and the absence of educational programs promoting traffic discipline. Human error stands out as the leading cause of road accidents, while mechanical failures like brake malfunctions or tire blowouts can also play a role. Environmental factors such as poor road conditions, adverse weather, and inadequate signage contribute to accidents. Given the significant threat posed to public safety and economic stability, it is imperative to implement comprehensive preventive measures and foster a culture of responsible driving.

The implementation of a traffic management framework is essential to facilitate collaboration among stakeholders in understanding the real factors contributing to traffic accidents. This framework will serve as a comprehensive guide for preventing traffic accidents. Within the framework, specific activities within the community, such as traffic safety campaigns and propaganda, will be systematically and consistently promoted. This will be achieved through cooperation among entities such as the local government unit, PNP, LTO, DPWH, and other stakeholders. The primary objective is to enhance public awareness of traffic issues and encourage adherence to traffic rules and appropriate behavior.

The data presented highlights the significant incidence of traffic accidents, indicating a pressing public issue due to the large number of victims and severity of consequences. Despite this, road safety has not received adequate attention, attributed to a lack of awareness, information, and effective interventions. These findings are relevant to theories such as the 4M's Factor Theory, which emphasizes human, mechanical, environmental, and management factors contributing to accidents, as well as the Evaluation Theory, which underscores the importance of assessing and improving road safety measures. Additionally, the Domino Theory, which shows that accidents result from a chain of events, aligns with the need for a comprehensive traffic management framework to address the multifaceted causes of accidents and prevent their occurrence through collaborative efforts among stakeholders.

TRANSLATIONAL RESEARCH

The findings of this study could be translated into a plan that aims to analyze the causes, patterns, and consequences of traffic accidents in Albay, providing a basis for implementing a sustainable traffic management framework. Utilizing a translational research approach, data will be collected from various sources including police reports, hospital records, and interviews with stakeholders. Statistical analysis and qualitative methods will be employed to identify trends, risk factors, and underlying issues contributing to accidents. The findings will inform the development of evidence-based policies and interventions aimed at reducing traffic accidents and promoting safer road conditions in Albay. By integrating research findings with practical applications, this study seeks to contribute to the enhancement of traffic safety and the overall well-being of Albay's residents.

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