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Application of a Traffic Safety Improvement Process: A Case Study of Taichung City in Taiwan

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Abstract— *This study employs the PDCA improvement process, utilizing radar diagrams, cross-tabulation, and contingency analyses to thoroughly investigate the primary causes of traffic accidents. Research findings indicate that Taichung City experienced a significant increase in traffic accidents in 2023, particularly among young adults aged 18-29 and elderly individuals aged 70-79, with a high prevalence of motorcycle-related incidents. The main contributing factors include illegal overtaking, failure to maintain safe distances, and speeding by heavy-duty vehicles, coupled with rapid population growth and increased travel during holiday periods in February and April. Taiwan's Ministry of Transportation and Communications has consistently prioritized road safety issues, implementing measures such as regulatory revisions and increased penalties, while local governments regularly review road safety assessment reports and improvement plans. The study results demonstrate that understanding the root causes of accidents enables effective resource allocation and the development of targeted policies, along with long-term effectiveness evaluations to reduce accident rates. These research findings not only hold practical value but also assist governments in swiftly implementing relevant measures to enhance road safety and effectively reduce the occurrence of traffic accidents.*

Keywords— ***Road Safety; Cross-tabulation Analysis; Correspondence Analysis; PDCA (Plan-Do-Check-Act) framework, key performance indicators (KPIs)***

I. INTRODUCTION

Traffic accidents caused by congested roads have become a problem for governments in Taiwan. Figure 1 illustrates the number of incidents in Taiwan over the years. Although it has moderated somewhat due to the impact of COVID-19 from 2019 to 2022, the overall trend shows that the number of incidents in Taiwan is increasing year by year. Whenever an accident occurs, its seriousness is not limited to the loss of lives and property of passers-by but may also cost more to society.

Historically, the primary indicators of intersection safety were the frequency of traffic accidents and the associated number of casualties. However, the causes of traffic accidents are multifaceted, influenced by a

combination of human behavior, vehicle conditions, roadway design, and other pertinent factors, complicating the accurate assessment of the relationship between accident frequency and injury/fatality rates. Identifying the principal causes of accidents and summarizing the inherent or observable behaviors of these factors is crucial. Only through understanding the true causes can the government allocate appropriate resources to mitigate accidents. Additionally, the government must employ management techniques or traffic engineering solutions to enhance road safety. The PDCA (Plan-Do-Check-Act) methodology is a widely adopted approach that emphasizes planning, execution, checking, and action to ensure reliability objectives are achieved and to foster continuous improvement.

This study chose Taichung City, the largest urban center in central Taiwan, as a case study city for investigation. The research aims to comprehend the prevailing social dynamics within Taichung City, focusing on demographic factors, road infrastructure, and private vehicle usage patterns. Additionally, it collates accident records from the past 15 years, sourced from Taiwan's national database, to serve as the empirical foundation for the study. Through data analysis, the study endeavors to identify the primary causes of accidents, categorize different types of incidents, and analyze the behaviors of those involved. Furthermore, it examines traffic accidents in Taichung City during 2023 to exemplify the comprehensive process of enhancing traffic safety. It is anticipated that the findings of this study will offer valuable insights and serve as a model for other regions in advancing traffic safety initiatives.

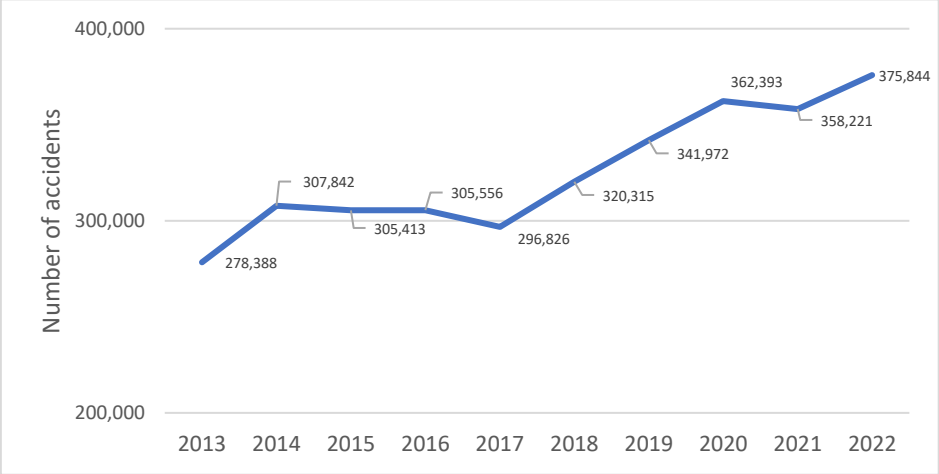


Fig.1. Number of traffic accidents in Taiwan

This study is organized into the following chapters: Chapter 2 provides an introduction to the population and road conditions in Taichung City, along with a detailed description of the current accident scenario within the city. Chapter 3 elaborates on the implementation of a traffic safety process, including the formation of the team, data collection methodologies, identification of key performance indicators by the team, and the analytical techniques employed. Chapter 4 presents the findings from the data analysis, evaluates the government's strategies in response to these findings, and scrutinizes the outcomes of the process. The chapter concludes with recommendations and potential future directions for the process.

II. BACKGROUND ON CASE CITIES

2.1 Population Road Conditions

Taichung City currently has a population exceeding 2.8 million individuals in Taiwan. It ranks as the second-largest city in the central region of Taiwan. The population is experiencing steady growth, with an average

growth rate surpassing that of other counties and cities within the central region. The population distribution predominantly centers on the original jurisdiction of Taichung City, urban planning areas, and rural regions of non-urban land (Figure 2), which provides a schematic diagram of the current population distribution of Taichung City. Regarding the age structure, the juvenile population constitutes 13%, the young and middle-aged population accounts for 71%, and the elderly population represents 16%. Consequently, Taichung City is characterized by a substantial proportion of young and middle-aged residents.

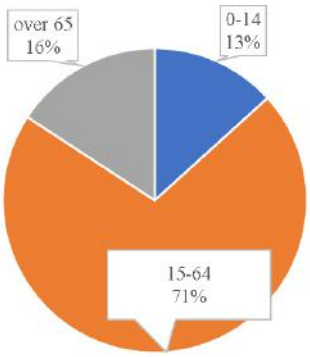


Fig.2 Age Distribution in Taichung City (Source: Taichung city government)

Regarding the road network in the Taichung area, it is characterized by a dense distribution. The road system primarily comprises highways, expressways, provincial highways, and municipal highways. Highways include National Highway No. 1, No. 3, and No. 4. Provincial highways consist of Provincial Highway No. 1 and No. 3, which run north-south. Expressways feature National Freeway No. 61, also running north-south, and National Freeway No. 74, which forms a circular route. Additionally, some local road networks within the area are arranged radially (Figure 3).

Fig.3. Anniversary Sale Period Traffic Flow Frequency Distribution

2.2 Description of characteristics of accidents in Taichung City

According to data from the Taiwan Ministry of Transportation's road safety database, the overview of road traffic accidents in Taichung City reveals that a significant number of incidents occur at intersections. When

categorized by age, it is evident that adults and younger individuals experience higher rates of accidents compared to other age groups (Table 1).

Table 1 Age Group Distribution of the Number of Accidents in Taichung

Rank	Age group	No. of item	Dead	Injured	Dead & injure
1	Adult (25-64)	35,482	87	36,512	36,599
2	Young-man (18-24)	19,519	22	18,422	18,444
3	Elderly (over 65)	7,004	53	6,397	6,450
4	Juveniles (13-17)	891	6	770	776
5	Unknown	23	0	10	10
6	Children (0-12)	6	0	6	6
Total		62,925	168	62,117	62,285

Remarks: "Unknown" refers to the absence of identity card number and date of birth of the subject in the case.

Among the various types of vehicles operated by drivers, the incidence of accidents involving motorcycles exceeds that of other vehicle categories. Consequently, this study focused on identifying the primary causes of motorcycle accidents. Analysis driver behavior revealed that the leading top five factors include: failure to observe the situation in front of the vehicle, non-compliance with yielding regulations, inadequate maintenance of a safe driving distance, disregard for traffic signals or instructions, and violations of specific sign (line) prohibitions. These results are detailed in Table 2.

Table 2 Top Causes of Motorcycle Accidents

Rank	Causes	No. of item	Dead	Injured	Dead and injure
1	Driver Failure to pay attention to the situation in front of the vehicle	5,512	14	4,984	4,998
2	Drivers failing to yield the right-of-way	4,676	11	3,915	3,926
3	Drivers failing to keep a safe distance between vehicles	3,973	3	3,493	3,496
4	Failure of the driver to be safe at the starting their vehicles	1,521	6	1,235	1,241
5	Drivers failing to comply with left turns	1,158	1	966	967

2.3 Research on road safety issues

In the past, intersection safety improvement has emphasized on road sign re-planning, however, the causes of traffic accidents are quite complex and are affected by the simultaneous influence of related factors such as human, vehicles, and roads, resulting in the relationship between the number of accidents, traffic injuries, and fatalities is not easy to be measured accurately, so the Center divides the elements into element intrinsic component: which is defined as the characteristics that the element itself has, and the extrinsic component is the characteristics that through the occurrence of the incident.

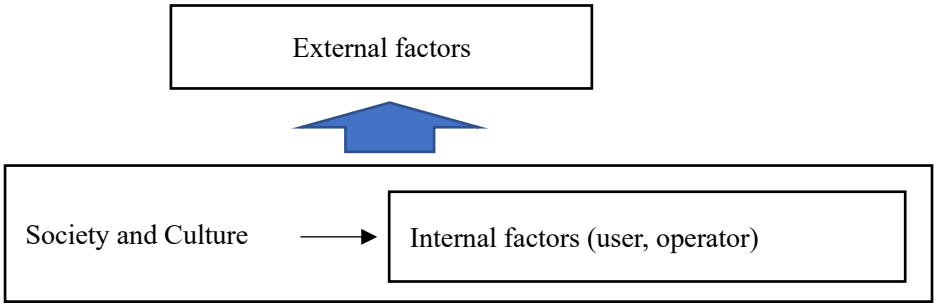


Fig.4 The Safety Framework by Salmon et al.'s (2016)

The study by Salmon et al. (2016) illustrates that current deterministic approaches to addressing this issue do not adequately consider the intrinsic complexity of the transport system or all the factors that influence behavior and suggests that the measurement framework should consider the road transport system more holistically and that, in addition to the factors of the road users' own behaviors and road accidents, the focus should be added to include a focus on factors other than road users' behaviors (e.g., policies, road safety strategies, design standards, and guidelines) (Soja, 2010; Sheller, 2018; Wang et al. 2021). The study proposes a framework for preventing road injuries from the five behaviors (drug driving, distraction, fastening seat belts, speeding, and fatigue) and emphasizes the shared responsibility for road safety among road users, vehicle manufacturers, designers, and policymakers (Fainstein, 2005; Fainstein, 2011).

Firstly, the behavior of the driver: according to the National Safety Council (NSC) research, driving errors are the leading cause of traffic accidents, contributing to about 94% of all accidents in the U.S. (NSC, 2020). WHO predicts that by 2030, road accidents will rise from the 9th to the 7th highest fatality rate, resulting in about 1.8 million deaths annually (WHO, 2018). The study also highlights the importance of the pedestrian element of road safety, which is the most important factor in road safety. Irawan (2022) uses Indonesian youth cycling as a case study to illustrate the two main determinants of disadvantage affecting youth cycling. One is related to the environment and constraints, and the other is the attitude towards cycling. However, the results show that habitual behavior determines the frequency of cycling by adolescents to and from school rather than perceived disadvantage. Many countries and regions have set up road safety courses, and the first of the seven key points of road safety improvement is to start with education. In addition to the bus-to-school program, the 5-stage traffic safety education curriculum module, and the addition of the National Primary School Students' Safe Crossing Lesson Plans (Ho Eui-Ting, 2020) to enhance the public's knowledge of safety and to generate the internal characteristics of the public with the responsibility of traffic safety. In addition, studies in Western countries (mainly the United States) (Piccinini et al., 2017; Seppelt et al., 2017; Gu et al., 2019; Asadianfam et al., 2020) illustrate that driver inattention (e.g., visual distraction and driver fatigue) and driving-related visual scans (e.g., mirrors, A-pillar blind corners) are the main causes of accidents.

Secondly, concerning vehicles, advancements in information technology have enabled automobile manufacturers to enhance vehicle model designs and propose intelligent transportation systems, such as Advanced Driver Assistance Systems (ADAS). These improvements aim to eliminate or minimize driver errors, assist in decision-making, correct mistakes, and reduce

collisions, thereby enhancing the inherent functionality of vehicles.

Thirdly, regarding road design, historically, it focused on facilitating vehicle movement, prioritizing smooth traffic flow. However, Bystrov and Kozak's (2018) research proposes that road traffic structures should address safety across all lifecycle stages—design, construction, operation, and reconstruction. Similarly, Mohan et al. (2017) found that urban road and street layouts significantly impact traffic fatality rates. Cities with wider roads and larger blocks typically experience higher fatality rates, necessitating enhanced police enforcement and additional road safety measures (Martens, 2016; Reece, 2018; Krumholz and Hexter, 2019).

III. RESEARCH METHOD

3.1 The Process of the Study

This study investigated the process of road safety; it had five steps:

1. Organizing an action team: The school collaborates closely with the Taichung City Government. The school meticulously provides comprehensive data analysis results and proposes well-thought-out plans, while the government efficiently implements these suggested plans and diligently reports relevant Key Performance Indicators (KPI) data, ensuring transparency and continuous improvement.

2. Data analysis: We focused on accident data collection and statistics to understand the occurrence and location of A1 accidents in the region; therefore, this study utilizes the Taiwan Ministry of Transportation and Communications (MOTC) Road Safety Information Platform (RSIP) to compile accident data of Taichung City in the past 15 years (2008-2022), aiming to comprehend the city's accident profile.

3. Selecting the key performance indicators (KPIs): To provide a consistent and fair benchmark for comparison among counties and municipalities and to serve as a reference for improving the performance of various policies, this study selects 14 indicators as a reference basis. These indicators were selected as the focus of this study, and they are also the long-term concerns of the Ministry of Transportation and Communications (MOTC) in Taiwan.

4. Conducting an in-depth analysis of KPIs: since the scope of KPIs consists of roads, people, and vehicles (conveyances), this study organizes the data and analyzes the results based on Salmon et al.'s (2016) road safety system framework and proposes corresponding improvement strategies for Taichung City.

5. The action team continuously observes changes in KPI values: the government implements the recommended strategies in real situations and liaises with the schools to propose improvement measures to address the lagging indicators.

3.2 Data Collection and Analysis

Historically, road safety was primarily assessed through the number of traffic accidents and related fatalities and injuries. However, due to the complexity of accident causes—encompassing human, vehicle, and road factors—it is challenging to accurately measure these metrics, making them unsuitable indicators of road safety performance. To establish a reliable indicator, it is essential to comprehend the accident occurrence process and how driver behavior influences both the likelihood and severity of accidents. This data analysis flow is depicted in Figure 5.

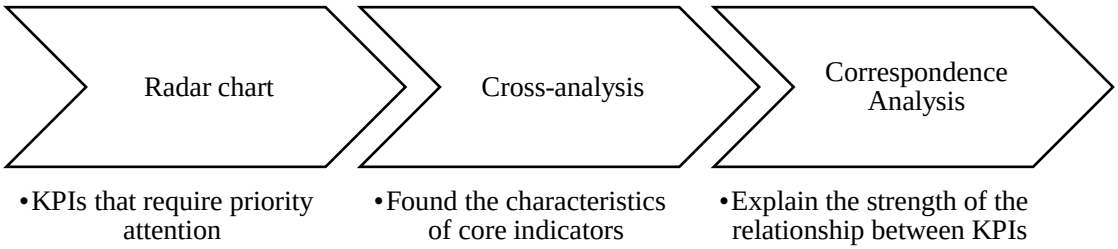


Fig.5. Data Analysis Process

Firstly, the study used a radar chart; the performance of multiple items in different dimensions can be quickly compared by observing the shape of the radar chart. Thus, the radar diagram is a useful data science visualization technique for finding and showing the strength of relationships between categories. Cross-tabulation, which is a practical analytical tool often used to compare initially, the study employed a radar chart, a sophisticated visual data science technique that facilitates the rapid and compelling comparison of multiple items across various dimensions. By analyzing the shape, symmetry, and characteristics of the radar chart, researchers can discern the strengths and weaknesses of relationships among different categories and the relative performance of each item comprehensively. This method is particularly advantageous in contexts where multiple variables must be assessed simultaneously, as it allows for a holistic view of performance metrics, enabling stakeholders to make informed decisions based on visual insights. The primary advantage of utilizing a radar chart lies in its intuitive nature. It empowers researchers and decision-makers to swiftly identify data patterns, trends, and anomalies, thereby elucidating the intricate interconnections among diverse categories. Consequently, the radar chart emerges as a valuable tool for data visualization, especially in multivariate analysis, where the complexity of relationships can be challenging to convey through traditional methods. Its ability to present data visually engagingly enhances the interpretability of the findings, making it easier to communicate insights to a broader audience.

Subsequently, cross-tabulation was utilized as a robust analytical tool designed to compare the outcomes of one or more variables systematically. This methodology is particularly effective for analyzing data measured on a nominal scale, allowing for examining categorical data in a structured format that highlights the relationships between different variables. Although the process can be intricate and requires careful consideration of variable interactions, it mitigates biases associated with univariate analyses. It prevents the oversight of relationships among specific demographic groups, such as the nuanced interactions between age, gender, ethnicity, and other socio-economic factors. Through cross-tabulation, researchers can comprehensively understand the interrelations between different variables, thereby enabling more nuanced explorations based on these insights. This approach enhances the interpretability of the data and provides a solid foundation for informed decision-making, allowing organizations to tailor their strategies based on empirical evidence.

Lastly, correspondence analysis was incorporated into the study as a complementary analytical technique that further enriches the understanding of the data. While cross-tabulation results provide clear illustrations of the relationships between categorical variables, correspondence analysis offers a deeper examination of the distances between points on a variable, with shorter distances indicating stronger associations. This analytical framework is beneficial for visualizing complex

relationships in a multi-dimensional space, allowing researchers to observe how different categories relate to one another in a nuanced manner. Thus, correspondence analysis illustrates the distribution of variables across categories meaningfully, providing insights into the underlying structure of the data. In this analytical framework, the data from the cross-tabulation table undergoes a series of transformations based on its associations with surrounding data, yielding correlation data that can be plotted to assess the results quantitatively. This methodological approach provides specific insights and aids researchers in uncovering latent trends and patterns within the data, ultimately contributing to a more profound understanding of the underlying dynamics at play. By integrating these analytical techniques, the study enhances the robustness of its findings and sets the stage for future research that can build upon these insights.

1. Research Method

4.1 The Results of Data Analysis

The study first analysed the core indicator radar chart of Taichung City from 2021 to September 2023 (Figure 6). It revealed that side impacts were the most common accident type on road sections, followed by same-direction rubbing. At intersections, pursuing crashes were more frequent than other types, with side impacts following. The age group with the highest incidents was 16 to 24 years old. Additionally, motorcycle users were more affected than other types of road users.

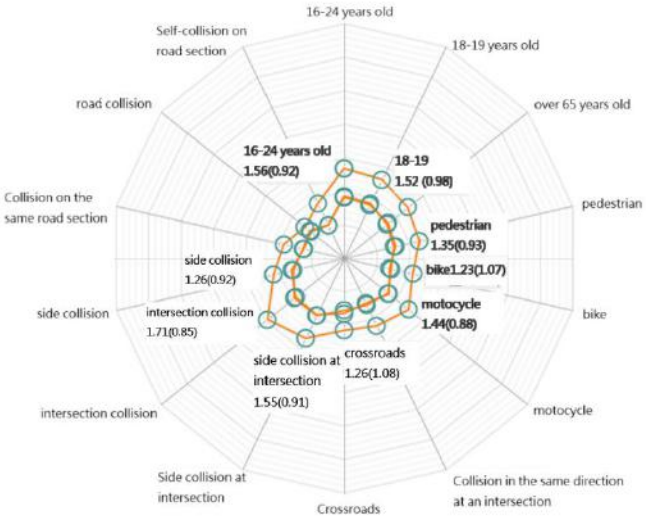
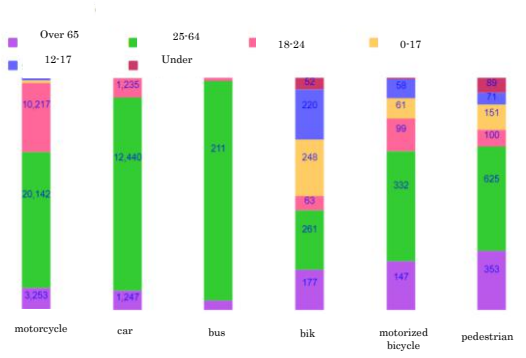


Fig.6. Radar Diagram of KPI for Taichung City during 2021 to September 2023 (Proportion of Taiwan in parentheses)

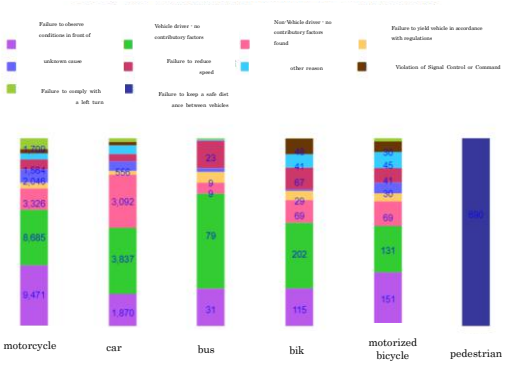
Secondly, this study analysed the relationship between age, roads, and vehicles in Taichung City in 2023 and drew a cross-analysis diagram as illustrated in Figure 7.

1. The number of persons aged 25-64 involved in accidents was higher than that of other age groups for all types of vehicles.
2. Vehicle-to-vehicle side impacts were the primary cause of crashes, except for vehicle-to-vehicle rear-end collisions caused by failing to keep a safe distance between vehicles.
3. The number of vehicle-vehicle side crashes was higher for all age groups than for other crash types.
4. The causes of side impacts were higher for all modes of transportation than for other modes, and pedestrians were more likely to be involved in collisions while crossing the sidewalk.

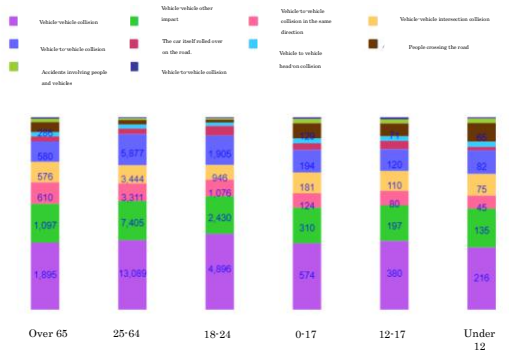
5. Failure to pay attention to the conditions in front of the vehicle was the most common cause of crashes for all vehicles, and "no cause found" was found to account for a portion of the total number of crashes for all vehicles.



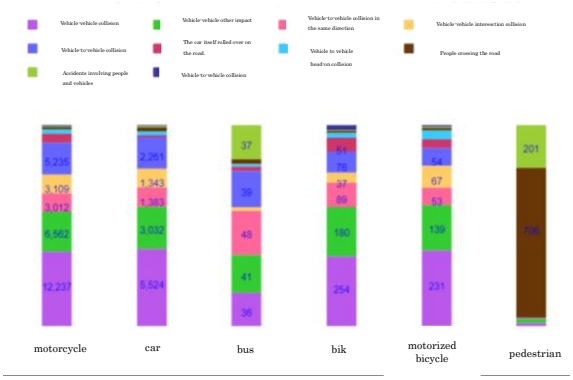
(a) Comparative analysis of age and number of vehicles



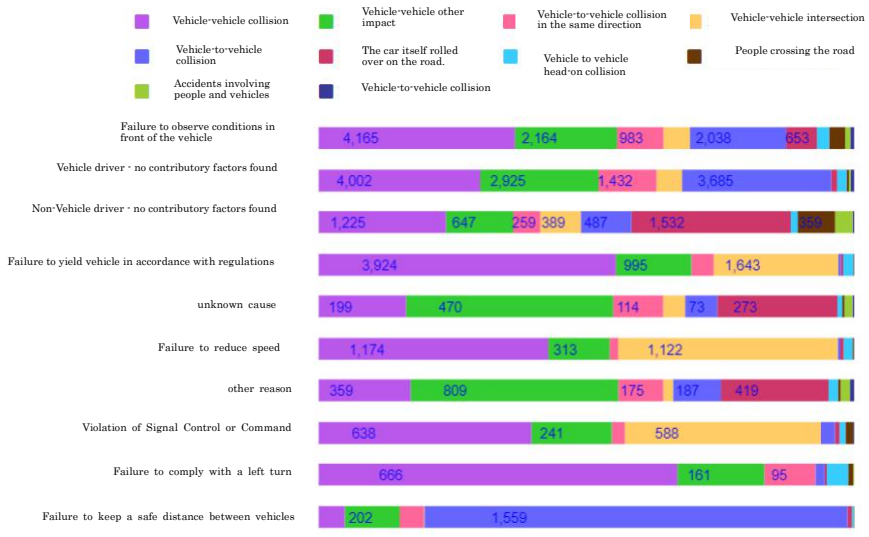
(b) Comparative analysis of causes of accidents and number of vehicles



(c) Comparative analysis of age and collision type



(d) Comparative analysis of collision type and vehicles



(e) Comparison of collision types and causes of accidents

Fig.7. Cross Analysis Results between Age, Road and Means of Transportation in Taichung City

However, the implements driven in an accident are different for different age groups of drivers, with higher proportions of motorcycle accidents than other modes of transportation among 18-29 and 70-79-year-olds, higher proportions of motorcycle accidents than other modes of transportation among 30-69-year-olds, and higher proportions of accidents than other modes of transportation among 30-69-year-olds in minibuses (including commercial), pickups (including commercial), and large vehicles (e.g., semi-copulas). For individuals without a driver's license, like students, a significant proportion of accidents occur while they are passengers in vehicles. These details are illustrated in Figure 8.

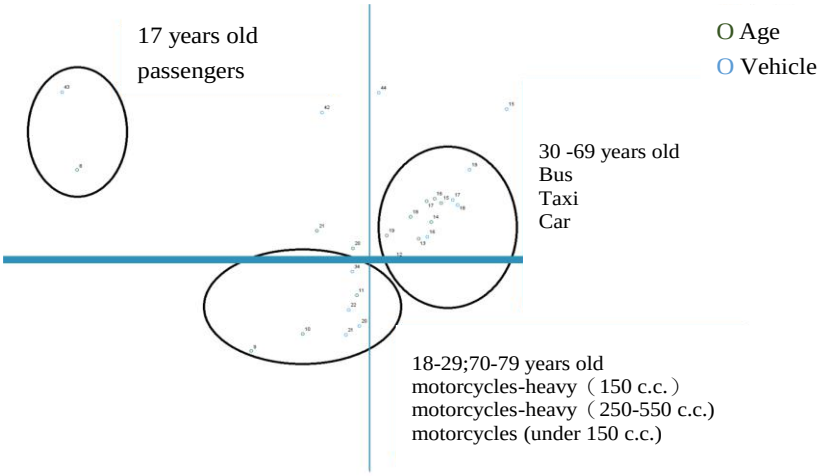


Fig.8 The Results of the Analysis of the Correspondence between the Age and the Vehicles.

On the other hand, accidents involving motorcycles and large heavy-duty vehicles (250-550 c.c.) were caused by illegal overtaking and failure to keep a safe distance between vehicles more than any other factors, while accidents involving motorcycles and ordinary heavy-duty vehicles were caused by failure to slow down according to regulations and failure to pay attention to the situation in front of the vehicle. In the case of motorcycles and light motorcycles, accidents occurred due to snaking, erratic direction, failure to make left turns, and loss of control by drunken drivers. Lastly, failure to yield to others, failure to pay attention to the safety of other vehicles (people) at the start, driving out of control after taking illegal substances, and failure to use lights are the main factors for accidents involving small and large-sized trucks and light buses. The clusters are shown in Figure 9.

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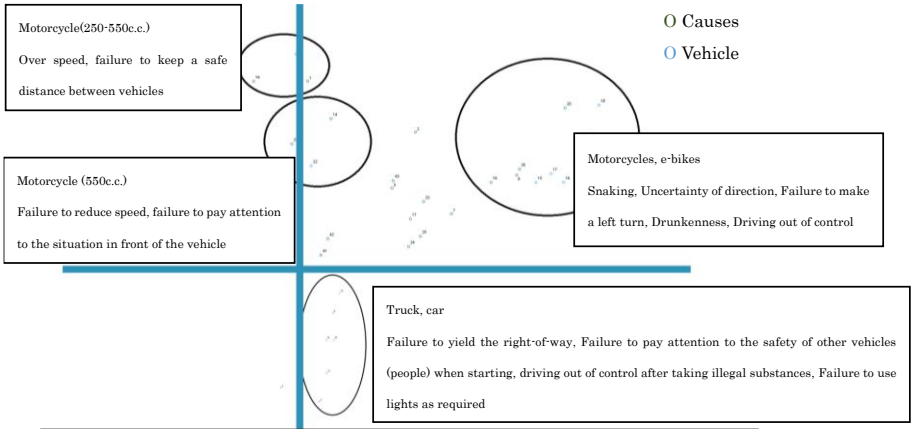


Fig.9. The Results of the Analysis of the Correspondence between the Cause of the Accident and Vehicles

4.2 The Solution of the Study

Based on the results of the study, it is recommended that Taichung City can strengthen the speed management of motorized vehicles, and the relevant actions can be referred to as follows:

1. Setting speed limits: The government may set appropriate speed limits on different road types. These speed limits should be set according to the characteristics of the road section, traffic flow, and pedestrian activities. The city regularly checks the speed limit signs and adjusts the speed limits as necessary to match the conditions of the intersection/road section.

2. Increase Traffic Enforcement: Enhanced traffic enforcement is an important measure to penalize speeding drivers and act as a deterrent. Through regular traffic patrols and the use of speed monitors, people's awareness of the need to comply with traffic rules can be increased.

3. Raising public awareness: The government can raise public awareness of safe driving and the risks of excessive speed through publicity and educational activities. This includes television advertisements, posters, pamphlets, and Internet publicity.

4. Adoption of technology for enforcement: The use of technology to monitor and control excessive speed is an effective means. For example, some countries and cities have started to use automated traffic light cameras and radar detectors to detect speeding and issue tickets automatically.

5. Driving training and examination: Enhancing the quality and requirements of driving training, as well as strengthening the difficulty and rigor of driving examinations, can ensure that drivers acquire safe driving knowledge and skills.

6. Fines and penalties: The government can set up a stringent system of fines and penalties for speeding. High fines and penalties may make people drive more cautiously.

7. Directing traffic flow: In case of traffic congestion, timely direction of traffic flow and measures to divert traffic will reduce congestion and risk of collision between vehicles.

8. Safe Design and Improvement: In designing and improving roads, it is necessary to consider the traffic flow and speed of vehicles in order to provide a safer road environment by putting in place appropriate traffic signs and traffic directions.

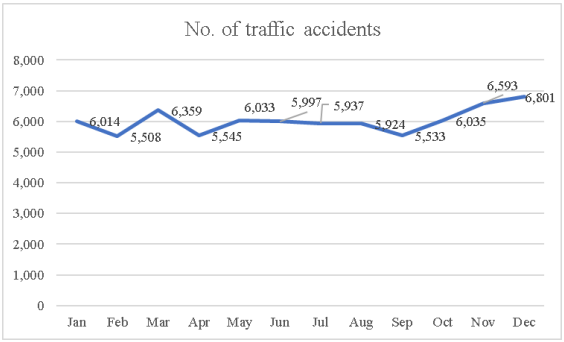
4.3 In Real Data of the City

The number of accidents and 30-day fatalities in

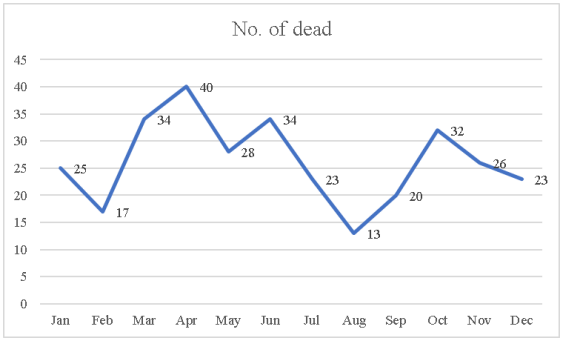
Taichung City in 2023 is shown in Figures (a) and (b). The highest number of injuries was 6,593 in November 2023, and the lowest was 5,263 in February 2023. Meanwhile, the highest number of deaths was 40 in April 2023, and the lowest number of injuries was 13 in August 2023. In recent years, in addition to the policy of improving motorcycle accidents, pedestrian accidents have also been one of the key areas of improvement in Taiwan.

The pedestrian and motorcycle accidents in Taichung are shown in Figures (c) and (d). The highest number of pedestrian fatalities is 316 in March 2023, and the lowest is 208 in June 2023, while the highest number of motorcycle cases is 8,596 in November 2023, and the lowest is 6,846 in October 2023, as shown in Figures (c) and (d).

These data show that Taichung City has a relatively high number of traffic accidents due to its rapid population development. Another reason for the higher number of accidents is that Taiwan has a vacation period of about one week to 10 days, during which people travel in February and April, thus resulting in traffic accidents. Based on these data, this study concludes that a long observation period is needed to see the government's effectiveness in improving traffic accidents.

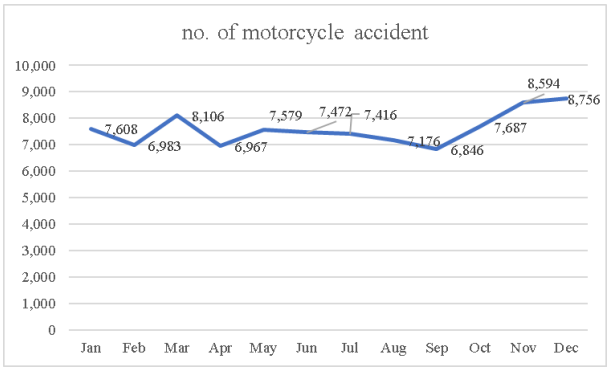


(a) Number of accident cases in 2023



(b) Number of deaths at 30 days in 2023

(c)Number of pedestrian accident cases 2023



(d) Number of motorcycle accident cases in 2023

Fig.10 The Real Data during Jan to Sep 2023

IV. CONCLUSION

Since 2018, the number of deaths and injuries from road traffic accidents in Taiwan has been steadily rising, reaching 3,085 in 2023, indicating that there is still significant room for improvement in road safety. Past road planning emphasized smooth traffic flow and a "car-oriented" approach; however, social progress has shifted to respecting disadvantaged groups, protecting pedestrians, and ensuring fair and reasonable use of roads by both people and vehicles in modern urban road planning.

This study proposes a road safety improvement process based on the PDCA framework, aimed at effectively reducing the number of fatalities through

cooperation between schools and the government. The study analyses road safety issues in Taichung City. It utilizes the KPIs of concern from the Department of Highways and Road Safety of the Ministry of Transportation and Communications (MOTC). Through radar charts, cross-tabulation analysis, and contingency analysis, the study organizes the road safety problems in the city.

Through radar chart analysis, this study first identifies the KPIs. The results of the radar chart indicate that the primary type of collision in Taichung City is rear-end collisions at intersections, with higher rates among motorcycle riders aged 35-39 and 55-59, which also falls within the adult age range of 25-64. The primary reason is the failure to maintain a safe following distance.

Therefore, the study proposes the following improvement strategies:

Technical-Oriented:

1. Setting speed limits to reduce accidents caused by speeding.
2. Implementing traffic control measures, such as optimizing traffic lights and clarifying traffic signs to enhance driver awareness.
3. Conducting traffic flow monitoring to manage vehicle flow during peak hours and reduce congestion effectively.

Management-Oriented:

1. Raising public awareness through promotional activities and community seminars to strengthen citizens' understanding of traffic safety.
2. Enhancing traffic enforcement to ensure that violations are met with strict penalties, creating an effective deterrent.
3. Establishing fines and penalties for traffic rule violations, using economic measures to encourage compliance.
4. Providing traffic safety education and examinations, mainly targeting young drivers and motorcycle riders for specialized safe driving training.

Through the program proposed by schools and implemented by the government, initial improvements in road safety issues in Taichung City have been observed, demonstrating the effectiveness of this process in addressing road safety concerns. Furthermore, this process should not be limited to short-term improvements. Still, it should be sustained to reduce the number of traffic accidents further and achieve the government's long-term traffic safety goals.

In the future, collaboration among various stakeholders, including communities, schools, and government agencies, should be strengthened to jointly promote road safety education and outreach activities, enhancing citizens' awareness of traffic safety. Regular traffic safety lectures and activities should be organized in schools to instill good traffic safety habits from a young age. At the same time, proactive collection and analysis of traffic accident data are necessary to adjust and promptly optimize traffic management measures in response to the ever-changing traffic environment. This includes focusing on accident hotspots and making corresponding infrastructure improvements based on data results, such as adding pedestrian crossing facilities and improving lighting and visibility. Considering technology's rapid advancement, exploring intelligent transportation systems' applications should be prioritized. Utilizing big data and artificial intelligence for traffic flow prediction and management can further enhance road safety. Through continuous efforts and multi-party cooperation, we can achieve substantial progress in road safety, creating a safer travel environment for every citizen. This responsibility lies with the government and is also a shared mission of every citizen. Only by working together can we look forward to a better future.

Key Points

- This study proposes a PDCA improvement process to identify the leading causes of traffic accidents and collaborate with local governments to summarize the key factors contributing to accidents, thereby effectively allocating resources to reduce their occurrence.
- The study employs radar diagrams, cross-tabulation analysis, and contingency analysis to identify the primary causes of traffic accidents.
- Accident causes vary by driver age group and vehicle type. Younger drivers (18-29) and elder drivers (70-79) experience a higher proportion of motorcycle accidents, and non-licensed individuals, such as students, often have higher accident rates as vehicle occupants.
- The leading causes of accidents include illegal overtaking and failure to maintain safe distances for motorcycles and heavy-duty vehicles (250-550 c.c.). For ordinary heavy-duty vehicles, common issues and lack of attention are not slowing down as required.
- This study addresses the problem of excessive vehicle speeds through eight approaches: education, engineering, and enforcement (3E).
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REFERENCES

[1] Asadianfam, S., Shamsi, M., & Kenari, A.R. (2020). Big data platform of traffic violation detection system: identifying the risky behaviors of vehicle drivers. *Multimedia Tools and Applications*, 79(33-34), 24645-24684.
[2] Bystrov, V., & Kozak, N. (2018). Issues and concepts of road transport structures' development and provision of traffic and pedestrian safety. *Transportation research procedia*, 36, 103-107.
[3] Fainstein, S. (2005). Cities and Diversity: Should We Want It? Can We Plan for It? *Urban Affairs Review*, 41 (1), 3-19.
[4] Fainstein, S. 2011. The Just City. Ithaca, NY: Cornell University Press.
[5] Gu, X., Abdel-Aty, M., Xiang, Q.J., Cai, Q, & Yuan, J.H. (2019). Utilizing UAV video data for in-depth analysis of drivers' crash risk at interchange merging areas. *Accident Analysis and Prevention*, 123, 159–169.
[6] Irawan, M. Z. (2022). Perceived disadvantages or motorized vehicle use habit? Investigating obstacles in bicycle use among adolescents in Yogyakarta, Indonesia. *Transportation Research Interdisciplinary Perspectives*, 14, 100595.
[7] Krumholz, N., and Hexter, K. W. (2019). Advancing Equity Planning Now. Ithaca, NY: Cornell University Press.
[8] Martens, K. (2016). Transport Justice: Designing Fair Transportation Systems. New York： Routledge.
[9] Mohan, D., Bangdiwala, S. I., & Villaveces, A. (2017). Urban street structure and traffic safety. *Journal of safety research*, 62, 63-71.
[10] NSC (National Safety Council), Advanced Driver Assistance Systems. (2020). Injury Facts. 2020, https：//injuryfacts.nsc.org/motor-vehicle/occupant-protection/advanced-driver-assistance-systems/, Online accessed 11/29/2022.
[11] Piccinini, G. B., Engström, J., Bärgman, J., & Wang, X. (2017). Factors contributing to commercial vehicle rear-end conflicts in China： A study using on-board event data recorders. *Journal of safety research*, 62, 143-153.
[12] Reece, J. W. (2018). In Pursuit of a Twenty-first Century Just City: The Evolution of Equity Planning Theory and Practice. *Journal of Planning Literature,* 33 (3): 299–309.
[13] Salmon, P. M., Read, G. J., & Stevens, N. J. (2016). Who is in control of road safety? A STAMP control structure analysis of the road transport system in Queensland, Australia. *Accident Analysis & Prevention*, 96, 140-151.
[14] Seppelt, B. D., Seaman, S., Lee, J., Angel, L.S., Mehler, B. & Reimer, B, (2017). Glass half-full: on-road glance metrics differentiate crashes from near-crashes in the 100-Car data. *Accident Analysis and Prevention*, 107, 48–62.
[15] Sheller, M. (2018). Mobility Justice: The Politics of Movement in an Age of Extremes. Brooklyn, NY: Verso.
[16] Soja, E. W. (2010). Seeking Spatial Justice. Minneapolis: University of Minnesota Press.
[17] Wang, X., Jiao, Y., Huo, J., Li, R., Zhou, C., Pan, H., & Chai, C. (2021). Analysis of safety climate and individual factors affecting bus drivers' crash involvement using a two-level logit model. *Accident Analysis & Prevention*, 154, 106087.
[18] WHO (World Health Organization) (2018), Global status report on road safety 2018： summary, World Health Organization, WHO/NMH/NVI/18.20.