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BRIDGING THE GAP IN TRAFFIC SAFETY BY USING SWOT AND TOWS ANALYSIS: A CASE STUDY

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NEAR EAST UNIVERSITY
INSTITUTE OF GRADUATE STUDIES
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M.Sc. THESIS

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Declaration

I hereby declare that all information, documents, analysis, and results in this thesis have been collected and presented according to the academic rules and ethical guidelines of the Institute of Graduate Studies, Near East University. I also declare that as required by these rules and conduct, I have fully cited and referenced information and data that are not original to this study.

Sakariye Adam FARAH

05/02/2024

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Abstract

BRIDGING THE GAP IN TRAFFIC SAFETY BY USING SWOT AND TOWS ANALYSIS: A CASE STUDY OF NORTHERN CYPRUS.

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This thesis will provide an in-depth analysis of strategies implemented to improve road traffic safety in Northern Cyprus, with a special focus on the Lefkoşa area. Different analyses, for example, the SWOT (Strengths, Weaknesses, Opportunities, and Threats) and TOWS analyses, in conjunction with the Quantitative Strategic Planning Matrix (QSPM), are used to explore different facets of issues concerning road safety. The research seeks to establish the opinion of transport experts and the local people, and it reviews related studies in search of the best ways to enhance road safety. Surveys were carried out with the experts alongside ordinary road users on the most effective safety strategies deemed important. This finding, therefore, underscores the need for reinforced enforcement of traffic laws, investments in technological innovations, comprehensive education and training programs, improvement in road maintenance practices, and promotion of travel modes such as public transport and alternatives. Thus, the study concludes that a multi-pronged approach encapsulating strict law enforcement, technical advancements, education, infrastructure upgrades, and policy reformulation is needed to ensure road safety. Recommendations for future research include a study of the tactics through which traffic laws can be effectively enforced, an investigation of the technical feasibility of proposed solutions across a range of high and low traffic cases, the long-term effectiveness of educational programs in shifting driving patterns, and the impact of good public transport systems on traffic dynamics in terms of safety.

Keywords: Road Traffic Safety, Northern Cyprus, SWOT Analysis, TOWS Matrix, QSPM.

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List of Abbreviations

RTAs:	Road Traffic Accidents
QSPM:	Quantitative Strategic Planning Matrix
SWOT:	Strengths Weaknesses Opportunities Threats
TOWS:	Threats Opportunities Weaknesses Strength
WHO:	World Health Organization
LEOs:	Law Enforcement Officers
RTIs:	Road Traffic Injuries
RTCs:	Road Traffic Collisions
CAVs:	Connected and Automated Vehicles
SVC:	Support Vector Classifier
NHTSA:	National Highway Traffic Safety Administration
LMICs:	Low- and Middle-Income Countries
AS:	Attractiveness Score
TS:	Total Score
EFE:	External Factor Evaluation
IFE:	Internal Factor Evaluation
SO:	Strength-Opportunities
ST:	Strengths-Threats
WO:	Weaknesses-Opportunities
WT:	Weaknesses-Threats

CHAPTER I

Introduction

1.1 Background

Road traffic accidents, or RTAs for short, are an internationally significant problem. They are seen to be one of the major threats to public health, leading to injuries, disabilities, and deaths. The annual death rate regarding RTAs amounts to 1.35 million, and these accidents may result in up to 50 million injuries. In other words, 3,700 people die of an RTA every day. RTAs are the primary cause of fatalities for children and young people in all age groups from 5 to 29, and the seventh most common cause of death overall. The report by the Global Status Report on Road Safety that was released in 2018 indicates that the death rates in low-income countries are three times higher compared to high-income countries (Organization, 2019).

Over the past decade, there has been an increase in the total number of automobiles worldwide (Farooq et al., 2021). Urbanization and the number of vehicles on the road continue to generate traffic congestion in major cities, hence the increased frequency of RTAs. The rate of urbanization that is on the increase, coupled with an exponentially growing population of vehicles, has made the need for safety measures urgent (Igboanugo & Ekhuemelo, 2007).

Moreover, the issue of improvement in road conditions and other inflowing traffic safety attributes is one of the main drivers by which RTAs are to be mitigated (Touahmia, 2018). However, it has been found from the study that environmental factors and different kinds of stresses also play major independent roles in the occurrence of RTAs. determining how catastrophic these accidents are caused by the age of the vehicle, human errors, safety precautions, and even the place and time of the accident. (Muthusamy et al., 2015).

The impact has been of a significant proportion in Northern Cyprus as a result of road traffic accidents (RTAs). In the meantime, in the same 2007-2018 range, 478 people died tragically while 12,551 people got injured (Angın & Albrka Ali, 2021). It was also observed from a survey made within this area that human behavior and road

conditions were reasons for such accidents. Some of the main identified causes include reckless driving, overspeeding, ignoring road signs, and a lack of proper spacing (Angın & Albrka Ali, 2021).

1.2 Problem Statement

From 2007 to 2018 in North Cyprus, the number of road traffic accidents (RTAs) peaked in 2008 at 4,584 and then generally declined, reaching the lowest point in 2017 with 3,115 accidents before rising slightly to 4,115 in 2018. The ongoing road safety issues in Northern Cyprus, especially around Lefkoşa, showed a clear need for better strategies to reduce accidents and improve safety. This study addressed the lack of strategic planning in this area.

1.3 Aim of the Study

This study's goal was to improve road safety in Northern Cyprus, with a particular emphasis on Lefkosa. The researchers used the QSPM approach to conduct the research for this objective. This approach combines the opportunities and threats that arise from TOWS strategies with the strengths and weaknesses that come from SWOT analysis. The opinions collected from professionals helped in determining the importance and rates of these factors in a realistic way, enabling us to choose an appropriate strategy for increasing road safety. Furthermore, the road users' views were considered to gain insight into their opinions towards these strategies.

1.4 Objectives of the Study

The specific aims of the study are as follows:

1. To identify the key SWOT factors affecting road safety in Northern Cyprus through experts.
2. To outline TOWS strategies aiming at improved road safety in collaboration with the expert.
3. Use the QSPM approach to evaluate and rank these strategies in terms of their effectiveness.
4. The addition of findings from the questionnaires given to road users in Northern Cyprus so that more information may be obtained.

1.5 Research Question

The main question was: "What are the most effective strategies for improving road traffic safety in the Lefkoşa area of Northern Cyprus, based on the QSPM approach, expert input, and road users' opinions?"

1.6 Scope of the Study

The study focused on Northern Cyprus, mainly in the Lefkoşa area. It looked at various internal and external factors that affect road safety, with strategies tailored for this specific region.

1.7 Limitations

The study's limitations included its focus on a specific area and the number of experts and road users involved. Depending on these experts and the self-reported data might introduce some bias, and the results might not apply outside Northern Cyprus.

CHAPTER II

Literature Review

1.1 Introduction

In this chapter, both the historical background and contemporary trends in traffic safety will be explored. Significant attention will be paid to the positive aspects of SWOT and TOWS analyses, reviewing strengths and weaknesses and opportunities and threats given certain situations. The northern part of Cyprus will be concentrated on in our case study, and how these analytical techniques can identify road safety deficiencies and provide readily available solutions will be analyzed. Besides, creative approaches to improve road security will be considered, and reasons for traffic safety issues will be provided based on simple academic language.

2.2 Perspective on Traffic Safety Issues

2.2.1 Public Perspective on Traffic Safety Issues

The perception of the public toward traffic safety is influenced by several factors. The issues explored include law enforcers' experiences and observations, public health implications associated with road accidents, and economic outcomes from the collisions.

RTAs are an important issue from the standpoint of public health. Meanwhile, around 85% of fatalities and over 90% of serious life-altering injuries in developing regions come from these events. There is a glaring case of this problem in India (Gopalakrishnan, 2012). WHO estimates that over 1.23 million people die every year as a result of road accidents across the world. Interestingly, this number has remained fairly steady as the population and vehicle numbers have increased (Alonso et al., 2017).

In the year 2000, motor vehicle accidents in the United States resulted in an economic burden of $231 billion. This was a significant economic burden for the country, considering that at that time the U.S. occupied first place among all countries in the world by the number of personal motor vehicles per capita, as many as 765 motor vehicles per 1,000 people (Peden & Sminkey, 2004). Awareness on the part of the

public that the federal government was interested in improving traffic safety all across the United States changed dramatically in 1986 when Congress provided funding for a national injury prevention research program located at the Centers for Disease Control and Prevention (CDC). An epidemiologic approach was brought to the prevention of traffic injuries from a public health framework (Sleet, Dellinger et al., 2011).

Law enforcement officers (LEOs), regularly involved in road traffic collisions (RTCs) and daily interactions with victims of road traffic injuries (RTIs), possess unique insights into preventing these injuries. RTIs are responsible for approximately 1.35 million deaths annually and stand as the primary cause of death among individuals aged 5 to 29 (Fanai et al., 2021).

The public's perspective plays a crucial role in implementing effective traffic safety measures. The general public recognizes the importance of heightened awareness and seriousness concerning traffic safety procedures (Khan & Gajbhiye, 2022). Public opinion suggests that there is a lack of awareness and seriousness about road safety. There is a consensus among the general population that improved policy measures are necessary to enhance road safety. These include stricter enforcement of traffic laws, mandatory helmet use, regular maintenance of roads, and more rigorous licensing requirements (Khan & Gajbhiye, 2022).

For example, in 2011, the Center for Social and Behavioral Research at Northern Iowa University conducted a study that revealed quite serious problems related to traffic safety in the said state. One major concern from the survey's findings was distracted driving, which emerged at the forefront, with about 72% of respondents describing it as an extremely serious threat to road safety. 62% more felt that the efforts of the state to curb distracted driving were insufficient; 42% rated them as average and 20% as poor. Outstanding or excellent was, however, the rating of 34% for the efforts done by the state. It was also established from the research that there is an obvious lack of general awareness concerning recent changes in laws regarding text messaging and talking on cell phones while driving. A good number of the respondents were aware of the dangers and confessed to texting themselves and using their phones while at the wheel. Almost 90% of respondents held the view that using a cell phone while driving was a serious or moderately serious threat to drivers' safety.

According to the results of the study, there was a wider public perception of the need for more awareness measures about road safety and training programs, besides school curricula incorporating road safety as well as other common awareness campaigns (Li et al., 2014). The survey underscores the public's call for changes in individual behavior, emphasizing the importance of adhering to traffic laws, maintaining vehicles properly, and following licensing procedures correctly.

2.2.2 Agency Perspective on Traffic Safety Issues

Years ago, in 1990, road traffic accidents ranked as the ninth killer globally (Peden et al., 2004). But by the year 2030, they are predicted to rise to become the five leading causes of death across the globe (Organization, 2009). These accidents claim the lives of 1.3 million people every year, while also injuring another 20 to 50 million people around the world annually. What is even more concerning is that they are the leading cause of death among young adults aged 15–29. But there is also some good news. Data monitored by the World Health Organization in 88 countries reported that the number of road-related fatalities has stabilized from 2007 to 2010, which may reflect improvements in measures to reinforce road safety. However, unacceptably high mortality still exists, especially in Third World countries (Sleet, Baldwin et al., 2011).

The area of road safety tends to be very interdisciplinary, and it enters several areas of policy, including health and environmental goals (Dupont et al., 2012). The World Report summarizes the critical need for institutional coordination. Its main recommendation is that a legal authority be set up with the mandate and power to oversee resource control, make decisions, and coordinate across all relevant government sectors (Peden et al., 2004). It is widely recognized that for a nation to implement measures of road safety effectively, it has to have effective institutional management that cuts across the strategies of road safety. For this to be realized, there must be a body that is responsible not only for taking part in discussions but also takes the initiative of organizing and managing the processes through which decisions are made within road safety partnerships (Bliss & Breen, 2012).

The lead agency designated by the government should coordinate efforts to enhance national traffic safety (2015, This agency is responsible for assessing the issue, the institutional framework, and policies related to road traffic injuries to determine each

country's capacity for injury prevention. It should also develop a national road safety strategy and action plan to address the identified issues effectively. Furthermore, the agency must provide adequate human and financial resources to tackle the road traffic safety problem. Implementing a range of interventions is necessary to prevent traffic accidents and reduce the number of fatalities and their consequences. Moreover, evaluations need to be performed that assess the efficacy and reach of such interventions. Such measures should also support national capacities and promote international collaboration in road traffic safety. This strategy would enable agencies to operate according to the guidelines and take a holistic approach to safety management, leading to improved road traffic safety and preventing injuries in accidents on the roads. Road traffic safety encompasses three interconnected elements: roles in institutional management, specific actions, and results (Stec 2019).

2.2.3 Traffic Safety Measures and Regulations

Road users' safety depends on the rigorousness of traffic safety rules and measures leading to limited incidents and fatalities. The main purpose of these regulations and procedures is to reduce the number of fatalities and injuries caused by road accidents. One of the major aspects of preventing traffic safety is promoting road users' awareness of the rules of traffic and precautionary measures. According to Gare et al. (2021), the increasing number of road accidents is associated with reduced awareness, especially among teenagers and young adults. So, it is important to spread knowledge of traffic regulations and acceptable use of the road.

Further, the behavior of road users and their response to road conditions and vehicle characteristics in terms of accident rate is informative towards adopting various safety features as well as defining traffic calming measures (Kopits & Cropper 2005). Kopits & Cropper (2005) have investigated the need to look at the behavior of road users and conditions on roads while trying to implement safety measures.

Different factors, which vary by region, also influence road traffic accidents and injuries. For instance, in China, factors like high vehicle speeds as a result of weak traffic law enforcement systems and poor accessibility to emergency services, among other developments, lead to fatal road accidents (Jiang et al., 2017). As suggested by L. Wang et al. (2019), to alleviate traffic-related mortalities in China, measures can

include better transport and urban planning protection of vulnerable drivers; improved post-crash response works; and pedestrian friendlier infrastructure placements paired with enforcement restrictions against hazardous behavior as well.

Road safety is also affected by economic factors. (Sun et al., 2019) highlight the necessity of more road miles, financial investment in traffic infrastructure, and economic development to enhance safety measures on roads. A network of safe and user-friendly roads must be created, and this process must be carried out carefully. Recently in Holland, the emphasis has been on what they call "sustainable safety," which means making retrofits for safety improvements along high-traffic routes. This strategy will not only improve road safety but also enhance the quality of life in general. This approach employs new ways to reduce traffic speeds while putting into practice intelligent traffic engineering to make sure that all people move safely (Weijermars & Wegman, 2011).

When we examine the effectiveness of road safety measures that were implemented in the Netherlands from 1998 to 2007, the evidence looks very promising indeed. There was significant improvement in road safety during these years, mainly as a result of the measures that had been put into practice (Weijermars & Wegman, 2011).

Laws help maintain road safety. (Hjar et al., 2012) emphasize that it is not just enough to have laws; they need to be strengthened to address the hazards associated with automobile accidents. They also argued that laws should cover the principal aspects of safety: obligatory use of seat belts, not driving under the influence, and motorcycle safety. Such elements are essential to preventing injuries from common causes of traffic accidents.

In summary, the key to pushing down accidents and ensuring that passengers reach their destinations safely is the combination of traffic safety regulations being set up and observed. This includes ensuring that traffic rules and necessary safety measures are known to everyone, factors that impact people's use of roads are kept track of from social science research perspectives, and the pace of technological developments quickens. Traffic psychology needs to be understood, and the kind of market environment that is conducive to safe driving needs to be known. Developing road infrastructure and putting in place and implementing appropriate laws are

indispensable parts of this endeavor as well. With these measures taken, the probability of people being hurt or killed on the roads will be greatly lessened.

2.2.3 Traffic Safety Interventions and Initiative

To lower the number of traffic accidents and fatalities, it is crucial to support the advancement of traffic safety in all its forms. Reaching teenage drivers effectively is one of Saudi Arabia's biggest issues when it comes to enhancing driving safety [17–21]. This demographic is more likely to drive recklessly, which increases the chance of accidents (DeNicola et al., 2016). As a result, it is crucial to create strategies that are especially aimed at addressing these needs using intervention forms and characteristics appropriate for this age range.

Traffic safety can be increased by using online reachability analysis for automated road vehicle verification (Dolan & Althoff, 2014). This technique can be used as an automated vehicle's real-time safety monitoring and assessment tool, depending on the traffic circumstances at various times. Safety considerably helps in spotting possible threats and averting catastrophes since it continues to be monitored at every stage of the process.

This is similar to the use of traffic simulation models, which, if iterated in these types of research, can provide valuable information in proving the effectiveness and safety of traffic crossings (Gettman & Head, 2003). These virtual safety measures will make it easy to describe particular areas in which real accidents and near-misses may differ. It is of great importance that a person has a clear understanding of what is working well and where there may be a possibility of areas for improvement in such a dangerous scenario.

According to Bishai et al. (2008), traffic law enforcement and media outreach are critical to the improvement of road safety. Enforcement of strictness may be a major agenda item that will make road users abide by the required rules and regulations. Moreover, the effect of all this can be further supplemented by effective media campaigns that not only inform but also educate people about following road safety protocols.

Proper education related to road safety is required to back up upcoming generations towards responsible driving behaviors in resource-limited countries (Heydari et al., 2019). Regular education programs, with the support of laws and enforcement actions, become important for a long-lasting outcome. For example, one of the measures that Uganda has adopted to reduce the number of pedestrian road accidents includes the construction of footbridges and walkways for pedestrians. Secondly, intervention in traffic calming to ease traffic congestion and improve safety for pedestrians while crossing the roads, facilitating sensitization on road safety through advertisement and other communication forums, and improved police visibility along the roads to discourage drivers from flouting traffic rules (Osuret et al., 2021).

Graduate students are generally oblivious to traffic signs, although they do possess adequate awareness and knowledge regarding safe driving practices (Ratna et al., 2017). This highlights the significance of thorough road safety education even more. Knowing traffic signs and signals alone shouldn't be the only thing covered in such training.

Effective assessment and progress toward reducing road traffic fatalities depend on monitoring and evaluation (Hyder et al., 2017). A Decade of Action for Road Safety has been established, the goal of which is to reduce and stabilize traffic-related fatal injuries (Hyder et al., 2017).

Efforts were continued within Saudi Arabia to enable road safety awareness for the educational institutes, but all efforts are not sufficient in educating the people regarding conformity to traffic regulations and signage (Alshehri, 2019). This underscores the necessity to hold educational and informational programs on the need to improve road safety guards with a focus on academically qualified drivers, especially among youth.

Deeper insights regarding the cultural norms and practices concerning traffic safety issues would help frame adequate strategies to augment traffic safety (Islam et al., 2017). With critical analysis of the attitudes and actions of people, specific solutions can be targeted towards bringing out safe road use practices within given cultural contexts. In this respect, interventions geared towards promoting road safety should target the particular cultural elements that sway people's behaviors along the way. By

targeting these elements, interventions can effectively encourage the adoption of safe behaviors.

To conclude, several tactics are used in traffic safety interventions and campaigns. These include infrastructure upgrades, monitoring and assessment, surrogate safety measures, online verification for autonomous cars, traffic regulation enforcement, road safety education, and behavioral modification initiatives. Every facet of road safety, from individual attitudes.

2.3 Factors Contributing to Traffic Accidents

2.3.1 Human Factors

(Petridou & Moustaki (2000a) conducted a study that aimed to identify various factors contributing to road traffic collisions (RTCs). The findings revealed that in three out of five car accidents, the driver's behavior is primarily at fault. Interestingly, driver-related issues are involved in about 95% of all accidents. This indicates that improved driving behavior could potentially lead to fewer accidents. However, it's noted that even highly skilled race car drivers in the USA are involved in more accidents than average drivers, mainly due to their propensity for taking significant risks (Williams & Neill, 1972). This highlights how a driver's behavior significantly influences their likelihood of being in a crash. Shinar (1978) introduced a psychological perspective, suggesting that driving behavior often mirrors one's overall approach to life.

When examining the causes of car accidents, it becomes evident that human factors play a substantial role. Various studies have explored numerous reasons behind these accidents. Some factors have long-term effects, such as aging or chronic health conditions, while others might temporarily impair driving ability, like fatigue or stress. Besides, the universal vulnerability to commit mistakes or make wrong judgments while driving an automobile, irrespective of age or experience, is another key factor.

Aging, inexperience, illness, disability, alcoholism, and drug addiction are common long-term factors affecting human potential towards impairment and hence remain an important area of research on road safety. Especially, inexperience associated with young drivers is the primary risk factor for road accidents. The learning process that they continue experiencing and the higher possible risks taken make them more

susceptible to an accident situation (Rolison et al., 2018). There are, however, unique challenges that aging may present for drivers as well. Vision, cognitive speed, and physical mobility degenerate in many aging drivers, and these have been linked to increased risks of accidents by elderly drivers (Rolison et al., 2018).

Simultaneously, there are also transitory factors that can impair driving ability. Some conditions, like extreme fatigue, stress, alcohol, and drug influence, can significantly increase the chance of a car accident (Petridou & Moustaki, 2000b). While these may affect the driving ability only temporarily, their impact may lead to serious and, in some unfortunate instances, fatal road accidents.

Going more deeply into causes, it can be easily observed that what usually leads to road accidents is simple human error as well as traffic law violations. Other common behaviors that increase crash risk include speeding, reckless driving, failure to follow traffic laws, poor vehicle maintenance, driving under the influence, and driving while fatigued (Gopalakrishnan, 2012). The seminal research, The Tri-Level Study of the Causes of Traffic Accidents, found that human errors and deficiencies are to blame for the astounding 90–93% of car crashes analyzed (“Causes of Road Accidents,” 1956). This underscores the critical role of human behavior in both causing and exacerbating road accidents.

On the other side, factors such as huge vehicles bullying the small ones, often termed the "right of the mighty," together with the overloading capacities of public and transport vehicles, highlight the greater human contribution to road accidents (Gopalakrishnan, 2012). This, in addition to the other issues elucidated above, paints a complete picture of human action and choices about road safety.

Human factors sit at the heart of any occurrence of accidents on the roads. Addressing these issues will require a comprehensive approach that includes education, work on new regulations, and road improvements. The wide range of research available in this area suggests that changing behaviors and attitudes towards driving remain a major focus of the holistic approach. This multifaceted strategy is essential for creating safer roads and reducing the incidence of accidents.

2.3.2 Environmental Factors

The environment within which driving takes place is a huge consideration in car accidents and one that has been researched and extensively studied for quite some time. There are several factors specifically related to the road and surroundings surrounding it that will be hugely important in helping determine accident proneness and crash severity. They include the type of road, location, layout, lighting, road surface conditions, and speed limits, among others, that affect the probability of their occurrence and also the severity of accidents (Y. Wang & Zhang, 2017). In addition, the road infrastructures attached to traffic congestion are critical factors significantly contributing to road crashes generally (Sohail et al., 2023).

Without a doubt, weather conditions have a significant impact on the frequency of traffic accidents (RTAs). In addition, environmental factors such as man-made air pollution will account for a greater number of potential accidents by elucidating the close relationship between weather and road safety (Hammad et al., 2019). Unexpected extreme weather, such as intense rain, snowfall, fog, or even abrupt temperature changes, can undoubtedly increase the stress on drivers and the safety features intended to keep everyone safe on the road (Sohail et al., 2023).

Good lighting has a significant impact on both the quantity and the severity of traffic accidents, particularly at key times of the day like sunrise and sunset. According to studies conducted in Iran, there is a larger chance of injury in traffic accidents that occur between sunrise and sunset compared to other times of the day (Lankarani et al., 2014). This emphasizes even more how important good lighting and visibility are in preventing mishaps. In addition to supporting intent considerations for smart lighting based on modifiable ambient circumstances, this makes it relevant for well-maintained road lighting systems.

When all these environmental factors are pieced together, it becomes clear how a complex relationship exists between the environment and road safety. The relationship is complex due to the challenges experienced while dealing with an intricate balance and flow of related factors, hence requiring a multiplicity of approaches to preventing accidents in the process. Understanding all the environmental influences on road safety

is important to improve driving experiences; accidents need to be reduced, and the safety of every individual on the road needs to be ensured.

But it's not enough to just point out these environmental factors; the way traffic is managed, the way roads are designed, and even the current driving rules and regulations need to be explored and reimagined. Improving road safety under poor weather or lighting conditions necessitates the involvement of more than one party. Harmony needs to be maintained among policymakers, city planners, engineers, and drivers. With intense research, innovative ideas, and actionable policy, the adverse impact of the environment on road safety can be tremendously curtailed, and every person who hits the streets can be assured of their safety.

2.3.3 Technological Factors

Technology has a significant impact on traffic safety, but depending on how it is used, it may also reduce or increase the number of accidents. Due to the rising breakthroughs being made, particularly in the field of connected and automated vehicles (CAVs), which includes both passenger cars and buses as well as trucks, there has been a growing interest in advanced transportation technologies and their investments in recent decades. When Google joined the autonomous car space in 2010, this field took off (Yang & Fisher, 2021).

Moreover, modern technology has brought out means of using information collected from accidents involved in intelligent vehicle incidents and doing research deeper into understanding the characteristics of accidents. Essentially, the new development of intelligent vehicle accident investigation systems involves a combination of modern insights and traditional techniques to better the approach that has been applied in understanding accidents (Q. Yuan et al., 2021).

More currently in focus are studies into the convergence of automated driving technology with safe driving and how harmony can be created so that human-driven and machine-driven traffic can conjoin. The technological improvements aim to further reduce road operational risks and illustrate the automation and hybrid systems' capabilities in raising the levels of road security (Ma et al., 2022).

Better technology has further enhanced the development of effective systems for accident detection and making accurate predictions of traffic flows. And these systems are very important for quickly responding to accidents to lessen their effects and intelligently managing traffic. This is especially true in situations with self-driving cars and high traffic congestion rates, which have become a persistent problem. According to Zhang et al. (2023), grid-based data extraction and support vector classifier (SVC)-based traffic state classification are two proposed ways to find traffic accidents in automated and connected transportation systems. These methods show how technology can help improve real-time response and lower traffic accidents.

Together, these technological elements comprise a critical element in the grand scheme of discussing just how traffic technology synergizes with safety. In this regard, the application of technology, whether through autonomous vehicles, smart accident investigation systems, or highly developed approaches to detecting accidents, can be identified as a strategic way of dealing with issues created by traffic accidents. The effectiveness of such technologies, however, might eventually depend on some factors, including regulatory policies, public acceptance, and the adaptability of the existing infrastructure to accommodate these technological advancements.

2.4 Challenges in achieving traffic safety goals

2.4.1 Cultural and behavioral challenges

In the field of psychology, the distinction between attitudes and behaviors has long been discussed and is frequently unclear. This hasn't stopped people from texting and driving, despite younger drivers, for example, freely acknowledging that it's one of the riskiest things they can do when driving (Atchley et al., 2011) and thinking that a texting driver is much more likely to cause an accident than a drunk driver (Atchley et al., 2012). According to Atchley et al. (2011), 97% of respondents acknowledged sending texts while operating a motor vehicle. These drivers frequently base their decisions on the examples set by others and are not aware of the subtle cues that are influencing their behavior. People's behaviors—from those unique to a family or place of employment to those typical of that country's culture—can be considered part of perceived norms. The phrase "safety culture" refers to the accepted standards that influence people's propensity to engage in risky or safe conduct.

Behavioral factors and culture have a critical role in determining how to approach the goal of improving traffic safety. Different cultural norms and value systems in countries like the USA, China, and Japan have an impact on disparities in preference for road safety (Atchley et al., 2014). In essence, cultural norms have a big impact on how closely people adhere to traffic laws, drive safely, and generally increase road safety (Nordfjaern et al., 2014; Otto et al., 2022). However, a country's deep-rooted cultural beliefs and values impact its attitude toward road safety more than any other element (Atchley et al., 2014).

In terms of behavior, people are occasionally identified as a significant contributing factor to traffic accidents, frequently surpassing several other elements such as features of the road or the characteristics of the vehicle (Ward et al., 2019). Remarkably, research has shown that, to address concerns related to road traffic safety, it is necessary to investigate the behavioral characteristics of motorcyclists in the context of examining their safety culture (Andrijanto et al., 2022). Risky driving habits, such as driving while intoxicated and failing to buckle up, have a significant impact on the frequency of fatal accidents on rural roadways (U.S. Department of Transportation and Federal Highway Administration, 2014). Applied behavior analysis methods can help with these kinds of behavior problems by using techniques like managing what might go wrong and changing the environmental cues that cause drivers and pedestrians to act in certain ways (Sleet & Lonero, 2002).

To encourage a positive attitude in the safety culture, educational programs and efforts that focus on changing cultural attitudes about safety are crucial (Traffic et al., 2018). Additionally, implementing behavior-based solutions may lessen actions that increase the risk of harm and enhance traffic safety results (Sleet & Lonero, 2002). To achieve traffic safety goals, a complete strategy that takes into account legislation, enforcement, and education can only aid in overcoming the difficulties brought on by the intricate interaction of behavioral and cultural elements.

2.4.2 Funding and Resources Constraints

Lack of funding and resources frequently makes it difficult to implement a comprehensive strategy for achieving traffic safety goals. The bulk of funding is essential for implementing successful safety programs and broadcasting them during prime time, which is frequently the case in wealthy states with high rates of traffic safety. Rich nations can serve as role models for other unrest-prone nations that are making great efforts to increase transportation safety. However, it is frequently necessary to undertake considerable financial engineering for the implementation and modification of these effective approaches, which may not always be easily accessible (Board, 2010).

The National Highway Traffic Safety Administration (NHTSA), a clearinghouse for the Road to Zero Coalition, provides Community Traffic Safety Grants, among other strategic initiatives, as a means of funding research and project development to achieve zero fatalities. Nonetheless, maintaining the necessary level of funding remains a significant concern, particularly in light of the startling increase in road crash fatalities and their all-time high (Ecola et al., 2018).

The financial support for road safety would, in addition, include carrying along those for immediate improvement, capacity building, research, and advocacy, and that would be continued. Most countries depend on private investors to provide the requirements needed to fill in the gaps through financing (United Nations Road Safety Collaboration, 2011).

This is quite obvious in low- and middle-income countries (LMICs), where a lack of resources has aggravated a trend of an increase in the number of people killed or injured in traffic accidents. Additionally, the lack of enough funding and resources in low- and middle-income countries (LMICs) is also associated with poor road safety procedures to worsen the cycle of road crash mortality and injury (Bank, 2020).

Legislative support is also essential for promoting the objectives of traffic safety. This includes making sure that programs are held responsible for their prior success in getting financing, as well as connecting agency performance evaluations to the budgeting process. This encourages the responsibility of the funds to guarantee their efficient use in achieving the goals of traffic safety (Board, 2010).

Achieving enormous traffic safety goals, like a noticeable decrease in accidents or an improvement in general road safety, requires a large investment in both financial and technological know-how. Reducing junction accidents is a difficult problem that requires many different infrastructure features and design considerations, including the angles at junction sites and the spacing between junctions (Dalal et al., 2023). These problems are multifaceted, which highlights the intricate relationships between funding, resource distribution, legislative backing, and technical expertise. To effectively tackle these challenges and put the country on the right track toward improving traffic safety, only a comprehensive, multidisciplinary approach involving community participation, international collaboration, and appropriate financing and resource allocation backed by legislation will be able to overcome them. This collaboration will help reduce world accident rates, leading to a rise in safety on the roads.

2.4.3 Political and Regulatory Challenges

In recent years, there has been a very great change in the global perception of road safety, with most people acknowledging that it is one of the major public health issues today. These political and economic forces, in turn, greatly influence the dynamics of this transformation when considered in terms of road safety regulations and policies (Hyder et al., 2022).

At all levels, governments are increasingly called upon to back sound and bold initiatives for promoting road safety. Their involvement extends to the drafting and implementation of strong legislation intended to improve traffic safety. For example, national governments often have the responsibility of implementing laws that ban things like drinking alcohol and the need for people to wear protective clothing like helmets, child seats, and seatbelts. All of these actions are aimed at reducing the risks associated with car accidents (Bertoli & Grembi, 2021).

A serious problem that hampers effective management of road safety is the lack of political involvement in such affairs. Road safety is rarely prioritized on the political agenda to the same degree as some other public health topics. Yet occasionally pandemics, such as COVID-19, have made some road safety politically more urgent to meet broader public health agendas between events outside of immediate road crash

contexts on which to build political salience and support. This has resulted in actions like lowering speed limits (Job, 2020).

For instance, there are three discourse dimensions related to traffic accident safety in different political contexts, including China's: economic, regulatory, and behavioral. The issue of advocating for road safety and the appropriate solutions is linked to a complicated triangle that includes user behavior, structural controls, and economic considerations (Huang et al., 2016). In summary, the political-regulatory obstacles to achieving traffic safety objectives are complex and intricately linked to broader political-economic debates. A broad strategy like this would deal with those problems by encouraging the creation of an environment that isn't limited to traditional road safety programs, making sure that rules are followed properly, and getting politicians to see road safety as an important part of public health in general.

2.5 SWOT and TOWS Analysis

2.5.1 Conceptual Framework of SWOT Analysis

The term SWOT, which stands for strengths, weaknesses, opportunities, and threats, was developed from the SOFT approach, a strategic tool. This tool's justification was to help businesses create long-term strategies in which all of their management would be involved. Despite being utilized for more than 60 years, no one has a clear concept of what a SWOT analysis is as of yet (Puyt et al., 2023) (Benzaghta et al., 2021).

The application of SWOT analysis has significantly improved over time. I. The creation of SWOT analysis initially Professors George Albert Smith Jr. and C. Roland Christensen developed SWOT analysis in the early 1950s at Harvard Company School as a method of analysis for examining company case studies. They contended that organizational methods have applications in the corporate world (Chang & Chow, 1999; Chermack & Kasshanna, 2007; Doolittle & Camp, 1995).

According to some academics, Albert Humphrey of the Stanford Research Institute came up with the SWOT concept in the 1960s. Humphrey set out to create a new change management and control system by examining Fortune 500 businesses (Oivind Madsen, 2016). This indicates that, while becoming a commonly used method for

strategic planning since then, it may have originated from various SWOT analysis attributions.

These results led to Alfred Humphrey's efforts, which followed a 1963 Harvard business policy conference, to bring the SWOT analysis to light and achieve acceptance as a crucial tool in strategic thinking (Hill & Westbrook, 1997; Panagiotou, 2003; King, 2004). After the 1960s, the SWOT analysis did not receive much attention until many years later, in the 1980s, when several academics and researchers in the field of strategic planning once again gave it serious consideration. Following the 1980s, there was a resurgence in the acceptance and use of SWOT analysis (Mahdavi, 2012; Vance, 2012). According to Prasad (1987), SWOT emerged as the predominant framework in strategic management by the 1990s. This illustrates the SWOT analysis's enduring and widespread effect on strategic decision-making.

Without a doubt, SWOT analysis is a crucial tool for businesses to evaluate their market positioning and understand their internal and external environments (Nur et al., 2018). The four components of a SWOT analysis assist in determining the organization's internal and external influences:

Strengths: Internal qualities that help the organization achieve its goals are what make it strong. Strengths are attributes or assets that provide an organization with a competitive edge.

Weaknesses: These are the internal elements that could make an organization less successful. Therefore, weaknesses represent the organizational gaps that are required to be filled, improved, or addressed to increase competitiveness.

The opportunities are those that arise from outside the company, from environmental situations that encourage an organization to grow, close the gap, or launch new initiatives or plans.

Threats: These are outside forces that come from the organization's surroundings and interact with it. These could present difficulties or obstacles in the way of its attempts to accomplish the objective.

Companies can identify opportunities and threats, as well as their core strengths and weaknesses, in their operational environment by doing a SWOT analysis. From there,

they can develop strategies to build on their strengths and address their weaknesses, make the most of their opportunities, and minimize any threats they may face. Organizations can only make appropriate decisions and plan for future success with the help of this strategic analysis (Aldehayyat & Anchor, 2008; Fleisher & Bensoussan, 2003; Shrestha et al., 2004).

Alejos (2017) states that SWOT analysis is viewed as an interactive technique that takes into account both the positive and negative aspects of an organization's operation and its external environment. It acts as a first step in providing a comprehensive overview of the topic to lay the groundwork for more in-depth and sophisticated strategic planning. The essay does, however, also highlight some of the shortcomings of SWOT analysis, particularly its static nature and the difficulties in implementing it in the constantly shifting dynamics of business contexts. It suggests SWOT analysis to be the leading evaluation tool while pointing out the necessity of additional analytical approaches to provide a more comprehensive and flexible understanding of the strategic position of the company.

To address these shortcomings, attempts have been undertaken to improve the conventional SWOT analysis. For instance, Valentin first referred to the resource-based SWOT analysis as late as 2001. In focusing its analysis, it establishes the real cause of opportunities, threats, and strengths and weaknesses. Thus, the concept has grown to be that of a sophisticated and contemporary aspect of strategic management (Nyarku & Agyapong, 2011).

On the other hand, new frameworks of SWOT analysis have emerged to explain how managers articulate these concepts in a large variety of business contexts. Such creativity aims to generate more practical SWOT models that will flexibly address the diverse industry needs in the current digital era (Namugenyi et al., 2019).

In addition, discussions and academic criticism have been centered on some of the drawbacks exhibited by the traditional SWOT analyses. Discussions like that have contributed to a better understanding of the role of SWOT in strategy and, therefore, its adaptation in different strategic situations through time (Vlados, 2019).

From the discussion, it is evident that the concept of SWOT analysis has developed from its original state; several academicians as well as practitioners have refined it to have a view of business strategic planning as dynamic.

2.5.2 Conceptual Framework of TOWS Analysis

An abbreviation for TOWS analysis, originally introduced by Weihrich in 1982, is a strategy option tool. It is a tool for strategic management that is derived from the SWOT analysis components and aids in identifying the optimal course of action. The second type of analysis aids in generating knowledge of the organization's internal strengths and weaknesses about external opportunities and threats. The TOWS matrix is then used to trace back the relationships between these components to generally develop a strategy (Weihrich, 1982).

Since the TOWS analysis tool may be exported to a variety of businesses, this reveals its adaptability. For example, Szeliga-Duchnowska and Goranczewski (2017) state that one local government uses an analysis tool for strategic planning related to tourism and recreation in one hosting region. That shows how flexible a TOWS analysis is as a tool for strategic planning that may be used in a wide range of situations.

Weihrich created the TOWS matrix in 1982, and it produces four conceptually distinct strategic categories that are rigorously categorical:

Strategies for Strengths and Opportunities (SO): This is the process of maximizing one's advantages to take advantage of opportunities that arise in the outside world. Perhaps the plan suggests using improvements in traffic management technology to improve human security and reduce traffic—two advantages of having a robust infrastructure.

Strategies for Weaknesses and Opportunities (WO): The WO strategies are those that will leverage either present or future opportunities externally to combat the pertinent internal shortcomings. For example, a plan is created to address infrastructural deficiencies by utilizing funding sources like public-private partnerships to build and enhance road networks to improve user conditions.

Strategies for ST (Strengths and Threats) Strategies: The foundation of ST strategies is the utilization of internal strengths to obstruct and prevent external dangers. For

example, bolstering the current pool of qualified workers and emergency response teams could be useful in light of population growth and increased traffic.

Strategies for WT: WT methods typically function as preventative measures to lessen both external and internal dangers. One such tactic might involve creating defensive measures against the threats by strengthening the areas of vulnerability so that public transportation could be enhanced to reduce reliance on private vehicles, which would reduce traffic and pollution.

As for the sequence in which to analyze the strengths in a SWOT analysis, Ciampa & Watkins (1999) propose that managers start by identifying all environmental threats. This strategy aims to prioritize the detection of outside variables that may pose a danger to the operations of the company. In fact, by highlighting the significance of identifying and assessing business opportunities, the TOWS analysis approach can provide an alternative perspective on and complement SWOT analysis. In the current situation, SWOT and TOWS assessments could be two helpful methods for traffic safety management.

Through strengths, weaknesses, opportunities, and threats, both SWOT and TOWS assessments aid in framing focused strategies. For instance, the use of strengths may include the implementation of sophisticated traffic monitoring systems that could involve methods through which real-time management can be enhanced. On the other hand, public education campaigns and infrastructure reconstruction are considered to be vulnerabilities associated with high-risk intersections. Emerging safety technologies provide opportunities where they can be leveraged to further strengthen the improvement of measures of enhanced traffic safety while the hazards posed by a rise in vehicle traffic can be proactively controlled.

More so, the inclusion of SWOT and TOWS analyses in traffic safety planning would also give a comprehensive and systematic manner to take up on the complexities and hindrances in the addressing management of traffic safety.

2.5.3 Adaptation of SWOT and TOWS Analysis in Traffic Safety

The derived adaptable strategic planning techniques, SWOT and TOWS analyses, were first created for use in business and are now spreading to other industries surrounding public safety and education. These tools prove very beneficial in several aspects, like traffic safety, strategic planning activities, and decision-making processes, as they provide structured frameworks for the examination of both offered opportunities and threats associated with internal and external environments (Satria & Shahbana, 2020; Kulshrestha, 2017).

Applying SWOT and TOWS analyses to traffic safety is an approach that promises insights and direction toward strategizing for the measures required to boost traffic safety. It should be noted, on the other hand, that applications for traffic systems are dynamic and thus could be subjected to continuous change. It is important to put those strategies under review and update them from time to time so that they remain relevant and suitable considering the newer possibilities and problems of traffic safety management. In particular, empirical investigation into and validation of their effectiveness would help unite further application of these instruments in the area of traffic safety.

One of the SWOT analyses applied as a strategic tool for improving road traffic safety in the busy street markets of Palermo is shown by Campisi et al. (2018) in a survey. This analysis helped the researchers arrive at the key strengths, weaknesses, opportunities, and threats, more so judging by the traffic conditions due to which market areas are teeming.

Strengths: Promised pedestrian number increase: With most of the vibrant markets seeing increased pedestrian numbers, this is a strength since it promises potential economic activity and vibrancy. Cultural advantages: The cultural worth of these markets is considered to be a good characteristic for the area.

Weaknesses: Limited infrastructure: The already-established infrastructure in these areas can be a problem because it may not adequately support an increased number of pedestrians and vehicles. Opposition from local vendors and motorists: Locals who are accustomed to the old system of moving around town may offer some sort of resistance to embracing the new traffic arrangement.

Opportunities: Boosting business and tourism: Improving traffic safety in market areas can invite more people, which is good for local businesses as well as tourism. Infusing eco-friendliness in transportation: Another opportunity is informing the user about adopting sustainable and green modes of transport.

Threat: Increased traffic jams: Improvements in traffic safety issues may result in congestion and increased traffic jams without intention. Road accidents: Even with the improved conditions, road accidents will be at risk in a particular area.

Generally, the SWOT analysis provides the whole picture of the situation, and it is possible to construct effectively sound measures of strategic urban planning. Such measures are designed to capitalize on the identified benefits and opportunities while mitigating the challenges and risks experienced with traffic conditions in terms of busy street markets for a double gain: traffic safety as well as vibrancy.

The manuscript "A SWOT Analysis of Maritime Transportation and Security in the Gulf of Guinea" (Ofosu-Boateng, 2017) is a vital source for academic exercise. The paper emphasizes the pressing issue of oil piracy in the Gulf of Guinea, considering SWOT analysis as the primary tool.

Key Highlights of the Study:

Comprehensive Scrutiny: The study goes in for a comprehensive look at maritime security, with a specific account taken of the problem of oil piracy. This brings out the considerable breadth of analysis pursued by the researchers.

Stakeholder participation: One of the strengths lies in engaging with a different set of stakeholders than only government actors. National entities, international organizations, and dedicated task forces assigned to maritime security offered a variety of perspectives on this matter of concern. Insights and a multi-faceted understanding of the issue were intrinsically richer, as explained above.

Method of Data Collection: The method of data collection that was followed in this research was essentially questionnaire-based. The questionnaires used were carefully designed, covering content from both the academic literature and the inputs of respondents about different categories. The use of a moderate Likert scale kind of

questionnaire made an approach that is most balanced and suitable for analysis of every point within a more holistic SWOT framework.

Assessment of Importance: The relative importance of each point, which has been identified from the analysis of strengths, weaknesses, opportunities, and threats concerning maritime security in the Gulf of Guinea, was also assessed by the study. This added a quantitative dimension to the analysis of the situation.

This paper overall highlighted that the study (Ofosu-Boateng, 2017) was a well-structured, comprehensive study aimed at exploring maritime security issues. With the assistance of SWOT analysis and through engagement with different stakeholders, several implications have been offered in the research to ensure challenges related to maritime transportation and security in the Gulf of Guinea can be dealt with appropriately.

Highlights of some of the findings from research (Ofosu-Boateng, 2017) that brought to light various issues of maritime security in the Gulf of Guinea are as follows:

Here is a summary of some of the findings:

Strengths: The Emergence of Dedicated Agencies: Dedicated agencies and organizations that are actually in place to handle the issue of maritime have been discovered. Such entities act as a point of focus towards the implementation of rigid security measures, especially through escorted services, which will highly determine the safety of vessels. This is a positive attitude towards the issue.

Use of pseudo-contracting personnel: Such use was noted as a strength. The personnel contribute to enhancing the security measures to respond to threats within the maritime domain. Weaknesses: Lack of Strong Maritime Protection Strategies: One of the weaknesses that has been identified is the absence of strong maritime protection strategies. This would mean some regions do not have comprehensive plans or resources dedicated to maritime security.

Poor Emphasis on Maritime Security in Poorly Developed Countries: The study identified that focus may not be present on maritime security in poor developed countries. This can put their maritime zones at risk from vulnerabilities. Opportunities: International cooperation: The research indicated in its results opportunities for

improving maritime security through international cooperation. International efforts increase the capacity of the country as an individual to raise its security level in Gulf Guinea.

Local and regional initiatives: The study also sought out the potential that may arise in spreading local and regional initiatives meant for maritime security. According to this, it shows that proactive steps at the local and regional levels are significant in improving overall safety.

Quantified Importance: The quantification of importance can be assessed with each element assumed within the SWOT analysis. Through the quantitative approach, perception gained depth and articulation, outlining the relative impracticability of various factors assumed in the understanding of dimensions of maritime security.

In totality, this (Ofosu-Boateng, 2017) surveyed the maritime security landscape, identified its strengths, weaknesses, opportunities, and threats, and quantified them. It expanded substantive discussions in the academic area of maritime security by providing an enumeration of key issues and challenges relating to maritime security in the Gulf of Guinea region that policy stakeholders might consider.

Informed by the case study "A SWOT Analysis of Maritime Transportation and Security in the Gulf of Guinea," we can copy this strategy for improving security concerning traffic in North Cyprus. This strategy includes the elements of seeking input from all those who use the roads daily. One such important part of this mechanism is formulating a questionnaire that ideally serves the purpose of the local community. The goal of this tool is to capture the day-to-day experiences of residents regarding traffic conditions. Residents may provide examples of what currently functions well in the traffic system, such as efficient road layouts or well-signed streets, and what should be improved, such as congestion management or the adjustment of street lighting. Including the community's perspective through this questionnaire is likely to open up practical challenges and opportunities that would not be apparent to the planners themselves in traffic management.

Public input is invaluable because it reflects the real struggles and experiences of the residents concerning daily traffic policies and infrastructure. In this view, having these firsthand experiences incorporated into both the SWOT and TOWS analyses is

therefore a crucial step in building traffic safety strategies that are not only evidence-based but also enriched by the experiential knowledge of the Northern Cyprus people.

In another study by X. Yuan et al. (2021), on the drop-and-pull transport system of China, they use a comprehensive evaluation through their SWOT analysis. Some aspects decrypted from the analysis are:

Strengths: Among these are strong government support, potential for advancements in technical aspects of vehicle technology, and highlighting the existing advantages that can be tapped into.

Weaknesses: The subsequent analysis has also flagged some of the weaknesses, particularly the current technical limitations in vehicle infrastructure, signifying areas for improvement.

Opportunities: The study expands on opportunities offered by the developed technological landscape, which includes the incorporation of a self-driven vehicle system, which can improve the transport system.

Threats: Other potential threats among external factors that may potentially negatively impact the transport sector include financial challenges as well as issues related to cybersecurity.

The SWOT analysis is therefore imperative in building strategic approaches aimed at adopting new technologies while optimally managing the available resources. The strategies hence call for an improvement in both safety and efficiency concerning the Chinese transportation sector.

Understanding SWOT Analysis in Maritime Operations

SWOT analysis, just like a compass, offers an orientation tool for organizations to form their strategies. However, when applied in the maritime operational world, this compass assumes another dimension. Weber's study in 2006 has contributed a fresh point of view to this effective working relationship. Weber mentions that in high-sea situations and the ensuing management scenarios that concern bridge team operations, the core elements of SWOT—Strengths, Weaknesses, Opportunities, and Threats—take significantly relevant angles. This study proposes that irrespective of being engineering marvels, at times, ships have been managed in a way where resources

available on the bridge may not help with smooth navigation and optimum operational conditions. In this situation, the human element—involving how the crew members think and how they act and interact with one another—becomes a critical factor. The human element may be seen as a challenge, but for all it's worth, the solution can hold in its grasp a significant key to solving them, especially when viewed under the scrutiny of the SWOT analysis. What separates ARSLAN and ER (Weber, 2006) is the uniqueness of fine-tuning the SWOT analysis with an incisive surgical precision that enables customization as close as possible to the perfect demands of maritime operations. They view it not only as a tool but also as a means to chart a better course for ship management companies. They envisage converting challenges into opportunities and transforming shortcomings into assets in the ultimate setting of safer and more efficient sea voyages.

Decoding Iran's Marine Transport Landscape through SWOT Analysis

In marine transport space in Iran, a master's hunch wouldn't be enough to navigate these vast and complex waters. Furthermore, a paper by Sebt et al. (2018) titled "Decoding the Marine Transport Landscape in Iran using SWOT Analysis" embarked on a courageous journey with the hope of charting this complex landscape using the trusted SWOT compass. Applying it to Iranian marine transport companies was a venture into uncharted territory. While using SWOT analysis has been a guiding star for businesses, With the massive impact of the sea on neighboring communities clearly expressed in facets such as the economy and social world, the research sought to establish the strengths, weaknesses, opportunities, and threats of the firms that are engaging in marine transport within Iran. Its mission extended beyond mere identification; it had the aim of crafting strategies that would eventually change the tide in favor of these firms. Through this study, Sebt et al. not only bridged a gap in providing valuable academic material but also set a new course for marine transport companies in Iran and outlined the future destinations for them within the high seas.

Navigating the Transport System of Saqqez City with SWOT Analysis

In venturing into the transport system of Saqqez City, Rahmani and Baghbani (2015) and his team took into account the finer details of this urban fabric. With the ever-reliable SWOT compass on hand, he embarked on an odyssey of charting this city's

transportation network that went way beyond mere roads and routes. Their mission was to unveil the strengths powering the city transport system, identify weaknesses that may disrupt its flow, and then identify opportunities being offered by it for making improvements.

Finally, reveal the lurking threats posing challenges. Their work vividly presented Saqqez's transportation dynamics, right from unbundling the complex urban policies to extrapolating the very physiological aspect of the city's infrastructure.

Strategic Planning for a Rural Engineering College. Using the TOWS Matrix Utilizing the insights of the SWOT analysis, Ravanavar and Charantimath (2012) utilized the TOWS matrix to develop strategic plans for the rural engineering college. It involved a strategic integration of the institution's internal strengths and areas of weakness with the external opportunities and threats that were available. The result would be a comprehensive strategic framework that comprised strategies for capitalizing on the college's strengths to exploit the available opportunities while, at the same time, enforcing measures for addressing external threats. It also involved devising plans to use external opportunities to strengthen the many weak links of the college and respond to the challenge posed by key threats from the external environment. In this study, aside from being a defensive tool, the TOWS matrix is used as an offensive one for gaining competitive positions. For example, it showed how the strong college faculty could be a basis for adopting the increasing need for digital capabilities with the new emergence of digital-focused courses. Similarly, the college was able to meet its economic challenges by identifying new sources of funding that included the use of government grants to further equalize its resources and enhance its educational offerings. This holistic approach, through the TOWS matrix, outlines a strategic blueprint for the college that provides a platform for long-term sustainability as it develops progressively and based on changing circumstances.

SWOT analysis is an essential tool for organizations to critically assess their internal strengths and weaknesses on the one hand and, on the other hand, the opportunities and threats that they are exposed to from their environment. TOWS analysis further moves this thought by outlining strategies that move internal strengths and weaknesses besides external opportunities and threats in the same direction, thereby propping up

proactive moving planning. A situation like this works very well for dynamic fields like traffic safety (Kulshrestha, 2017).

Additionally, a developed version of the SWOT analysis outside the traditional paradigm incorporates the historical background, core competencies, and stakeholder expectations. This version offers more insights to an organization in taking strategic positioning in the business environment (Nyarku & Agyapong, 2011). The SWOT and TOWS analyses, indeed, can provide a structured approach to traffic safety management and the entire program. These analyses enable the systematic identification of various factors, including strengths like advanced traffic monitoring systems, weaknesses like accident-prone high-risk intersections, opportunities like new safety technologies, and threats such as growing vehicular traffic. These analyses can help traffic safety planners come up with strategies that are focused and, hence, effectively implemented.

On one hand, such strengths and opportunities will enable them to improve their real-time traffic management systems. At the same time, on the other hand, they have a chance to mitigate against weaknesses and threats by developing their infrastructure and making the people aware of the dangers out in the streets. This further helps in ensuring a balanced and comprehensive approach targeted towards the enhancement of traffic safety.The methods of SWOT and TOWS analysis are genuinely flexible as well as versatile. They can also be used in other environments apart from business, like schools, for evaluating programs for character education, as argued by Satria and Shahbana (2020).

Besides, these tools apply to traffic safety agencies, and they enable them to assess safety programs, identify areas that need improvement, and develop strategic planning initiatives aimed at reducing road accidents and enhancing road safety, much the same as this is done in schools. Still, it should be underlined that although SWOT and TOWS analyses provide structured frameworks to understand complex environments such as traffic safety, they need to be validated through empirical means about their effectiveness. Traffic systems are dynamic, and thus every strategy relating to the tools must be an ongoing process of monitoring and re-evaluation to fit the current changes. This way, the strategy always meets the challenge as it arises with traffic safety.

CHAPTER III

Methodology

3.1 Overview

Our study, focusing on enhancing road safety in Northern Cyprus, particularly around Lefkoşa, utilized a combination of SWOT (Strengths, Weaknesses, Opportunities, and Threats) and TOWS analyses, along with the Quantitative Strategic Planning Matrix (QSPM).

Two distinct questionnaires were carried out for a comprehensive evaluation of traffic safety measures. The first questionnaire was aimed at seven transportation experts from academic institutions, who were asked to rate SWOT factors using the QSPM technique on a scale of 1 (very strong) to 5 (very weak). The strategies were assessed from a professional perspective, making this rating important.

The second questionnaire involved 200 regular road users, who were asked to point out which traffic safety strategies they thought were most effective. The purpose here was to get insights from everyday users of the roads. The strategies were organized into four main categories, each with four specific strategies.

The effectiveness of these strategies was then evaluated by comparing the expert-driven QSPM analysis results with the choices made by the road users. This step was key in identifying the most practical and suitable strategies for traffic safety, combining expert knowledge with real-life user feedback.

In the final stage of our study, the questionnaire results were compared with the outcomes from the QSPM analysis. This comparison played an instrumental role in selecting the most impactful strategies for improving road safety. Throughout our methodology section, our choice of these methods and how they contributed to our goal of making the roads in Northern Cyprus safer were explained. By integrating a variety of methods and viewpoints, a comprehensive and actionable plan for safer roads in the region was aimed at being developed.

3.2 Data Collection

3.2.1 Study Area

Cyprus, an island in the Eastern Mediterranean, encompasses Northern Cyprus, which makes up roughly one-third of the island. This northern region shown in Fig 1: is split into six areas: Nicosia, Famagusta, Kyrenia, Morphou, Trikomo, and Lefka (Koprulu, 2010). In this study, however, the data collection was specifically carried out in the Nicosia (Lefkoşa) district, offering a focused analysis of traffic safety in this particular area.

Figure 3.1

Map of Cyprus showing main cities and the north-south divide.

3.2.2 Data Sampling

In this thesis, which aims to enhance traffic safety in Northern Cyprus, a specific approach to sampling has been adopted. The total population of interest, encompassing road users across the region, is approximately 400,000 individuals. To determine an appropriate sample size, Slovin's formula was initially considered:

$$n=N/(1+Nxe^{2}) =400000/(1+400000x〖0.05〗^{2})= 400$$

Where n is the sample size, N is the total population (400,000), and e is the margin of error (5%, or 0.05). The formula suggests a sample size of approximately 400 to achieve a 5% margin of error.

However, for practical purposes, including resource constraints and the focused nature of the study within the Lefkoşa area, the sample size has been set at 200 individuals. This decision balances the need for a manageable yet sufficiently diverse group of respondents to provide meaningful data for the study.

3.3 Questionnaire Design

3.3.1 Local Road Users

The questionnaire given to local road users in Northern Cyprus aimed to gather their views on traffic safety. It involved assessing the significance of 16 different strategies, evenly distributed across the TOWS categories: SO (Strengths/Opportunities), ST (Strengths/Threats), WO (Weaknesses/Opportunities), and WT (Weaknesses/Threats). The goal was to find out which strategies the participants considered most important for enhancing traffic safety in the region.

Key Features:

Objective: To capture the views of local road users on the effectiveness and importance of various traffic safety strategies.

Question Format: Participants are asked to select the most important item within each strategy group related to the Tows categories.

Content Relevance: The questions are designed to directly relate to the everyday experiences and observations of road users regarding traffic safety.

Length and Clarity: The questionnaire is concise yet comprehensive, ensuring clarity and ease of understanding for the general public.

3.3.2 Expert Opinions

This part of the study involved a special questionnaire for people who are experts in traffic safety, mainly those who work in academics and transportation departments. Their thoughts are really important for understanding the different parts of the SWOT

analysis (like strengths, weaknesses, opportunities, and threats) in a detailed way, especially for traffic safety.

Main Points of the Expert Questionnaire:

Purpose: Deep and knowledgeable feedback was being sought from these experts about different ways to improve traffic safety. The questions were designed to fit well with the SWOT analysis, ensuring that all aspects of traffic safety were covered.

How the Questions Are Set Up: The experts were asked to evaluate each traffic safety factor in our SWOT analysis, and the factors were rated from 1 for 'very strong' to 5 for 'very weak'. This step was deemed important in assigning weights to these factors when using the Quantitative Strategic Planning Matrix (QSPM). Through this method, the views of the experts on the effectiveness of these traffic safety factors were understood.

Depth of the Questions: Since these experts know a lot about traffic and have a lot of experience, the questions went into detail about traffic safety. We want to get as much of their knowledge as possible.

The Way We Ask: The language and style of the questions were chosen to be just right for people who work in academics and transportation. This means we used terms and ideas that they're familiar with, so they can give us really good answers.

3.3.3 Collecting and Handling Responses

Questionnaires were shared using both Google Forms and paper sheets to ensure that everyone could participate in the way they preferred. This made it easy for people who liked using computers and those who preferred writing on paper. It was ensured that plenty of time was given to everyone to fill out their surveys without feeling rushed.

The information collected will be kept safe on Google Forms, protected by a password and encryption. After the research is finished, we will keep the data for six months and then get rid of it for good. It will be ensured that personal information is not shared with others, and the participants' identities will be kept confidential by analyzing the responses collectively. The paper forms filled out manually by people will also be securely stored and disposed of afterward.

3.4 SWOT Analysis

The SWOT analysis, a method for strategic planning, was applied to evaluate factors related to traffic safety both within and outside the organization. This process included identifying internal strengths and weaknesses and external opportunities and threats that could impact traffic safety (Kulshrestha, 2017). Generally, strengths and weaknesses are areas the organization can control, while it also needs to address external opportunities and threats (Helms & Nixon, 2010).

In the SWOT analysis in Table 3.1, it is important to mention that the factors listed were gathered with input from transportation experts in academia. Their expertise helped to thoroughly assess the various aspects of traffic safety.

Table 3.1

Swot Analysis Factors

SWOT Analysis for Traffic Safety Improvement			
		Helpful	**Harmful**
Internal		**Strength**	**Weakness**
	1	Well-prepared and up-to-date regulations and effective enforcement.	Easy training and exam practices for driving license
	2	Cheap vehicle imports and rational road tax regulations.	Poor public transportation
	3	Efficient insurance policies	Poor road infrastructure
	4	Public awareness and education programs	Inadequate maintenance strategies
	5	Sufficient traffic signs and signals	Low budget for research and investment
	6	Advanced technology and infrastructure	Right hand driving
External		**Opportunities**	**Threads**
	1	Modern and technological road infrastructure	Distracted driving
	2	Partnerships and collaboration between stakeholders	Impaired driving
	3	Data-driven decision making	Increase in traffic volume
	4	Enhanced vehicle safety systems	Adverse weather conditions
	5	Sustainable transportation initiatives (non-motorized modes of transport)	Incompetent road users
	6	Compliance with traffic rules and regulations	The psychological feeling of safety and security

3.5 Tows Analysis

The TOWS analysis was conducted to create strategic options for better traffic safety by using external opportunities and threats to inform strategies based on internal strengths and weaknesses. TOWS is a variation of SWOT and was emphasized (Weihrich, 1982). In our TOWS analysis, four kinds of strategies were identified by mixing internal strengths and weaknesses with external opportunities and threats. These strategies include (1) SO-strategies, where outside chances are taken advantage of by using internal strengths; (2) WO-strategies, where external opportunities are seized by working on internal weak points or building new strengths; (3) ST-strategies, where outside threats are handled by using strong points; and (4) WT-strategies, where internal weaknesses are addressed to steer clear of external dangers.

To create these strategies, helpful discussions and brainstorming were performed with experts in transportation from the academic world. For each strategy thought of, match specific strengths, weaknesses, opportunities, and threats to make them clear and logical (like combining the first strength with the sixth opportunity, labeled as S1, O6), as shown in the TOWS Matrix (Table 3.2).

Table 3.2

Tows Analysis strategies

		Strategies
S-O	S1-O6	Well-established and effectively enforced traffic laws and regulations encourage road users to comply with the rules and regulations
	S2-O4	Cheap car import policies and rational road tax implementation enable road users to purchase vehicles equipped with enhanced vehicle safety systems
	S4-O2	Collaboration between government and entities, private companies, and community organizations can enhance efforts to promote traffic safety, averseness, and consciousness

	S6-O3	Technological advancements in road infrastructure enable efficient data collection which aids in developing data-driven decision-making systems
S-T	S2-T3	Cheap vehicle purchase encourages the possession of personal vehicles which increases the volume of traffic
	S3-T6	Psychological feelings of security due to coverage by insurance policy can cause road users to drive carelessly
	S1-T2	Efficient enforcement of traffic regulations prohibits impaired driving
	S6-T4	Utilizing advanced technological infrastructure such as sensors can help overcome dangerous road surface states due to adverse weather conditions
W-O	W2-O5	There is an opportunity to improve public transportation and other non-motorized modes of sustainable transportation
	W5-O3	Low budget investment raises the necessity for the efficient use of limited sources which can only be performed by data-driven decision-making
	W1-O2	The qualification of road users can be improved through continued training and education conducted by relevant authorities and joint stakeholders
	W3-O1	Poor road infrastructure can be improved by incorporating innovative and modern technological solutions
W-T	W4-T1	Poor maintenance strategies lead to continuous maintenance works which lead to distracted driving
	W6-T5	The high number of tourists and foreign students who are accustomed to traditional left-hand driving impose danger to traffic when the driving direction is opposite
	W2-T3	The unavailability of public transportation forces road users to use personal vehicles
	W1-T5	Easy procedures and poor training practices for obtaining a driving license increase the number of incompetent road users

3.6 Quantitative Strategies Planning Matrix (QSPM)

The Quantitative Strategic Planning Matrix (QSPM) helps us decide how good different strategies are by looking at important internal factors (like strengths and weaknesses) and external factors (like opportunities and threats). First, we list these factors and give them weights based on how important they are. It's important that the total weights for strengths and weaknesses and opportunities and threats each add up to 1 (Austin & Hopkins, 2004).

First, the weight score for each SWOT factor was calculated by adding up all the ratings given by the experts and then dividing by the number of experts.

After calculating the average rating for each factor, the inverse weight was calculated by dividing 1 by the average rating.

Finally, the inverse weights of each factor were adjusted so that they could be compared. This was done by dividing the inverse weight of each factor by the total of all the inverse weights in its group (either Strengths/Weaknesses or Opportunities/Threats). When planning our strategies in the QSPM, normalized weights help us understand which SWOT factors are most important.

The QSPM (Quantitative Strategic Planning Matrix) is a tool used to evaluate potential strategies. The strategies are listed at the top of the matrix, and each one is scored based on how well it aligns with the important factors. The scores range from 1 (not very attractive) to 4 (very attractive) and are only given to factors that are essential in determining the effectiveness of a strategy.

To evaluate the attractiveness of different strategies, scores are calculated for each strategy based on several factors. These factors are assigned weights based on their importance, and each factor's attractiveness is rated. The weight of each factor is then multiplied by its attractiveness score, and the resulting scores are added up for each strategy. This provides an overall score for each strategy, indicating its level of attractiveness. The strategy with the highest score is considered the best fit, as it aligns well with the most important factors. Using this method, one can determine which strategies are the most effective by considering all relevant factors. (Management, 2014).

CHAPTER IV

Results and Discussions

One of the techniques that have been worked out to accept a decision about the best feasible strategy from several alternatives is the Quantitative Strategic Planning Matrix (QSPM). The method properly takes into account an in-depth evaluation of critical internal and external factors, covering strengths, weaknesses, opportunities, and threats. Each of these factors is given a weight, which indicates how relevant it is to the total weight of internal factors, and the total weight of the external factors independently does add up to 1.

The strategies under consideration, as provided in Table 3.2 of the TOWS matrix, all receive an attractiveness score (AS) through ranges 1 to 4, according to how strongly different factors support the respective strategy. Since there are only the most critical factors that were given scores, it helps to understand whether a strategy would work well. Then, the total score (TS) for each strategy will be determined by its attractiveness scores multiplied by the weights of those key factors.

Table 4.7 merges the External Factor Evaluation (EFE) and Internal Factor Evaluation (IFE) to obtain an integrated view of various strategies. This is done simply by summing the Total Scores, TS, in both the EFE and IFE for all TOWS strategy categories, which are Strengths-Opportunities, Strengths-Threats, Weaknesses-Opportunities, and Weaknesses-Threats. The total score of each strategy is computed, giving an idea of to what extent a particular strategy makes full use of the internal strengths and weaknesses of an organization to take advantage of external opportunities as well as manage threats. The technique helps in the easy identification of the strategies that are effective from those that are less effective.

The findings in Tables 4.1 and 4.2 were those collected from road users about selecting the most effective strategies for enhancing traffic safety in Northern Cyprus.

Tables 4.1

Overview of 200 Road Users' Opinions on Traffic Safety – for selecting the most important strategy for SO and ST

Strategy No.	**Strength – Opportunities Strategies**	**Selection**	**Strategy No.**	**Strength – Threats Strategies**	**Selection**
S1-O6	Well-established and effectively enforced traffic laws and regulations encourage road users to comply with the rules and regulations.	68	S2-T3	Cheap vehicle purchases encourage the possession of personal vehicles which increases the volume of traffic.	47
S2-O4	Cheap car import policies and rational road tax implementation enable road users to purchase vehicles equipped with enhanced vehicle safety systems.	51	S3-T6	The psychological feeling of security due to coverage by insurance policy can cause road users to drive carelessly.	61
S4-O3	Collaboration between government entities, private companies, and community organizations can enhance efforts to promote traffic safety, awareness, and consciousness.	61	S1-T2	Efficient enforcement of traffic regulations prohibits impaired driving.	64
S6-O3	Technological advancements in road infrastructure enable efficient data collection which aids in developing data-driven decision-making systems.	20	S6-T4	Utilizing advanced technological infrastructure such as sensors can help overcome dangerous road surface states due to adverse weather conditions.	28

Table 4.2

Overview of 200 Road Users' Opinions on Traffic Safety – for selecting the most important strategy for WO and WT

Strategy No.	**Weakness – Opportunities Strategies**	**Selection**	**Strategy No.**	**Weakness – Threats Strategies**	**Selection**
W2-O4	Improving public transportation and promoting non-motorized modes can enhance sustainable transportation.	53	W4-T1	Poor maintenance strategies result in ongoing repairs, leading to distracted driving.	55
W5-O3	Low budget investment raises the necessity for the efficient use of limited sources which can only be performed by data-driven decision making.	85	W6-T5	A high number of tourists and foreign students, accustomed to left-hand driving, pose a danger in areas with opposite driving directions.	46
W1-O2	The qualification of road users can be improved through continuous training and education conducted by relevant authorities and joint stakeholders.	33	W2-T3	The unavailability of public transportation forces road users to use personal vehicles.	37
W3-O1	Poor road infrastructure can be improved by incorporating innovative and modern technological solutions.	29	W1-T5	Easy procedures and poor training practices for obtaining a driving license increase the number of incompetent road users.	62

The findings presented in Tables 4.1 and 4.2 shed light on the road users' perceptions of the key factors that contribute to traffic safety in North Cyprus. The results suggest that a majority of road users believe that strong traffic laws and their enforcement are crucial to ensuring road safety. This is evident from the fact that 68 participants in the survey chose this option. The respondents' emphasis on the need for rules that drivers will respect is indicative of a broader social recognition of the importance of legal frameworks in promoting road safety.

However, it is noteworthy that a significant proportion of the survey participants, 47 individuals, expressed concern regarding the rise in traffic due to affordable car policies. This highlights the need for policymakers to carefully evaluate the effects of such policies to minimize potential risks and ensure sustainable transportation systems.

The findings from Table 4.2 indicate that road users value careful planning and smart spending in promoting road safety. A vast majority of the participants, 85 individuals, stressed the importance of making smart choices with limited resources, particularly in decision-making processes based on data. This underscores the necessity of using evidence-based approaches to develop effective policies and strategies for road safety.

Furthermore, the survey participants expressed concerns over road repairs causing distractions, with 55 individuals choosing this option. This calls for the need for innovative and safer ways of maintaining roads without compromising drivers' safety.

The collective findings from both tables suggest that road users in North Cyprus desire a comprehensive approach to promoting road safety. This approach should include robust traffic laws, the use of new technologies, and education programs for road users. Furthermore, the survey revealed that individuals recognize the dangers that come from feeling too safe due to insurance policies and unfamiliarity with road rules among tourists and students.

In conclusion, the survey results provide valuable insights into the perceptions and preferences of road users in North Cyprus regarding traffic safety. These findings can be used to develop effective policies and strategies that address current challenges and prepare the region for future transportation needs.

4.1 QSPM Analysis for SO and ST Strategies

The QSPM analysis provides a structured approach to assessing the viability of strategic options based on identified strengths, weaknesses, opportunities, and threats. Tables 4.3 and 4.4 share reflect the application of this analysis for SO and ST strategies using both internal (IFE) and external (EFE) factors.

Table 4.3

The IFE-based QSPM table for SO and ST

IFE	Weight	SO, & ST															
		SO1		SO2		SO3		SO4		ST1		ST2		ST3		ST4	
		AS	TS	AS	TS	AS	TS	AS	TS	AS	TS	AS	TS	AS	TS	AS	TS
S1	0.12	4	0.48	2	0.24	3	0.36	3	0.36	2	0.24	2	0.24	4	0.48	3	0.36
S2	0.05	2	0.1	4	0.2	2	0.1	2	0.1	4	0.2	2	0.1	2	0.1	2	0.1
S3	0.05	3	0.15	2	0.1	2	0.1	2	0.1	2	0.1	4	0.2	2	0.1	2	0.1
S4	0.06	3	0.18	3	0.18	4	0.24	3	0.18	2	0.12	2	0.12	3	0.18	3	0.18
S5	0.07	3	0.21	2	0.14	3	0.21	3	0.21	2	0.14	2	0.14	3	0.21	3	0.21
S6	0.06	3	0.18	3	0.18	3	0.18	4	0.24	3	0.18	2	0.12	3	0.18	4	0.24
W1	0.09	4	0.36	2	0.18	2	0.18	2	0.18	3	0.27	3	0.27	3	0.27	2	0.18
W2	0.15	2	0.3	4	0.6	3	0.45	2	0.3	2	0.3	1	0.15	2	0.3	2	0.3
W3	0.13	3	0.39	3	0.39	3	0.39	4	0.52	2	0.26	2	0.26	2	0.26	4	0.52
W4	0.11	3	0.33	2	0.22	3	0.33	3	0.33	3	0.33	2	0.22	2	0.22	3	0.33
W5	0.06	3	0.18	3	0.18	2	0.12	3	0.18	3	0.18	2	0.12	3	0.18	3	0.18
W6	0.05	2	0.1	1	0.05	1	0.05	1	0.05	1	0.05	2	0.1	1	0.05	1	0.05
Total	1.000		2.96		2.66		2.71		2.75		2.37		2.04		2.53		2.75

Table 4.4

The EFE-based QSPM table for SO and ST

EFE	Weight	SO, & ST															
		SO1		SO2		SO3		SO4		ST1		ST2		ST3		ST4	
		AS	TS	AS	TS	AS	TS	AS	TS	AS	TS	AS	TS	AS	TS	AS	TS
Op1	0.08	4	0.32	4	0.32	3	0.24	4	0.32	3	0.24	2	0.16	3	0.24	4	0.32
Op2	0.06	4	0.24	3	0.18	4	0.24	3	0.18	2	0.12	2	0.12	3	0.18	3	0.18
Op3	0.08	4	0.32	2	0.16	3	0.24	4	0.32	2	0.16	3	0.24	3	0.24	3	0.24
Op4	0.11	3	0.33	4	0.44	3	0.33	3	0.33	3	0.33	3	0.33	3	0.33	4	0.44
Op5	0.07	3	0.21	2	0.14	3	0.21	2	0.14	3	0.21	2	0.14	2	0.14	3	0.21
Op6	0.13	4	0.52	3	0.39	4	0.52	3	0.39	2	0.26	2	0.26	3	0.39	3	0.39
Tr1	0.08	4	0.32	2	0.16	3	0.24	3	0.24	3	0.24	3	0.24	4	0.32	3	0.24
Tr2	0.1	4	0.4	2	0.2	3	0.3	3	0.3	3	0.3	3	0.3	4	0.4	3	0.3
Tr3	0.07	2	0.14	4	0.28	2	0.14	3	0.21	4	0.28	2	0.14	2	0.14	2	0.14
Tr4	0.07	3	0.21	2	0.14	2	0.14	3	0.21	2	0.14	2	0.14	2	0.14	4	0.28
Tr5	0.09	4	0.36	3	0.27	3	0.27	3	0.27	3	0.27	3	0.27	3	0.27	3	0.27
Tr6	0.06	3	0.18	2	0.12	3	0.18	2	0.12	2	0.12	4	0.24	2	0.12	2	0.12
Total	1.000		3.55		2.8		3.05		3.03		2.67		2.58		2.91		3.13

4.2 QSPM Analysis for WT and WO Strategies

The QSPM analysis provides a structured approach to assessing the viability of strategic options based on identified strengths, weaknesses, opportunities, and threats. Tables 4.5 and 4.6 share reflect the application of this analysis for WT and WO strategies using both internal (IFE) and external (EFE) factors.

Table 4.5

The IFE-based QSPM table for WT and WO

IFE	Weight	WO, & WT															
		WO1		WO2		WO3		WO4		WT1		WT2		WT3		WT4	
		AS	TS	AS	TS	AS	TS	AS	TS	AS	TS	AS	TS	AS	TS	AS	TS
S1	0.12	4	0.48	3	0.36	4	0.48	3	0.36	3	0.36	3	0.36	2	0.24	4	0.48
S2	0.05	2	0.1	1	0.05	1	0.05	1	0.05	1	0.05	1	0.05	2	0.1	1	0.05
S3	0.05	2	0.1	2	0.1	2	0.1	2	0.1	2	0.1	2	0.1	1	0.05	2	0.1
S4	0.06	4	0.24	3	0.18	4	0.24	3	0.18	3	0.18	3	0.18	2	0.12	4	0.24
S5	0.07	3	0.21	2	0.14	2	0.14	2	0.14	3	0.21	2	0.14	1	0.07	2	0.14
S6	0.06	4	0.24	3	0.18	3	0.18	4	0.24	3	0.18	2	0.12	2	0.12	3	0.18
W1	0.09	1	0.09	2	0.18	4	0.36	1	0.09	1	0.09	2	0.18	1	0.09	4	0.36
W2	0.15	4	0.6	1	0.15	1	0.15	2	0.3	1	0.15	1	0.15	4	0.6	1	0.15
W3	0.13	3	0.39	2	0.26	2	0.26	4	0.52	2	0.26	1	0.13	2	0.26	1	0.13
W4	0.11	2	0.22	2	0.22	1	0.11	3	0.33	4	0.44	1	0.11	1	0.11	1	0.11
W5	0.06	2	0.12	4	0.24	2	0.12	2	0.12	1	0.06	1	0.06	1	0.06	2	0.12
W6	0.05	1	0.05	1	0.05	1	0.05	1	0.05	1	0.05	4	0.2	1	0.05	1	0.05
Total	1.000		2.84		2.11		2.24		2.48		2.13		1.78		1.87		2.11

Table 4.6

The EFE-based QSPM table for WO and WT

EFE	Weight	WO, & WT															
		WO1		WO2		WO3		WO4		WT1		WT2		WT3		WT4	
		AS	TS	AS	TS	AS	TS	AS	TS	AS	TS	AS	TS	AS	TS	AS	TS
Op1	0.08	4	0.32	2	0.16	2	0.16	4	0.32	3	0.24	2	0.16	3	0.24	2	0.16
OP2	0.06	3	0.18	3	0.18	4	0.24	3	0.18	2	0.12	3	0.18	2	0.12	4	0.24
Op3	0.08	3	0.24	4	0.32	3	0.24	3	0.24	2	0.16	2	0.16	2	0.16	3	0.24
Op4	0.11	2	0.22	2	0.22	3	0.33	3	0.33	3	0.33	2	0.22	1	0.11	4	0.44
Op5	0.07	4	0.28	2	0.14	2	0.14	2	0.14	1	0.07	1	0.07	4	0.28	3	0.21
Op6	0.13	2	0.26	3	0.39	4	0.52	3	0.39	3	0.39	3	0.39	2	0.26	4	0.52
Tr1	0.08	2	0.16	2	0.16	1	0.08	3	0.24	4	0.32	2	0.16	2	0.16	1	0.08
Tr2	0.1	2	0.2	2	0.2	3	0.3	2	0.2	2	0.2	2	0.2	1	0.1	3	0.3
Tr3	0.07	3	0.21	1	0.07	2	0.14	2	0.14	2	0.14	1	0.07	3	0.21	2	0.14
Tr4	0.07	1	0.07	2	0.14	1	0.07	3	0.21	3	0.21	2	0.14	2	0.14	1	0.07
Tr5	0.09	3	0.27	3	0.27	4	0.36	2	0.18	1	0.09	4	0.36	3	0.27	4	0.36
Tr6	0.06	1	0.06	2	0.12	2	0.12	1	0.06	2	0.12	2	0.12	1	0.06	3	0.18
Total	1.000		2.47		2.37		2.7		2.63		2.39		2.23		2.11		2.94

Table 4.7

Based on the Total Scores (TS) provided for each TOWS strategy using QSPM, here is how they are ranked from highest to lowest impact:

Strategy Number	Strategy Code	Strategy Description	Total Scores (TS)
1	S1-O6	Well-established and effectively enforced traffic laws and regulations encourage road users to comply with the rules and regulations.	6.51
2	S6-T4	Utilizing advanced technological infrastructure such as sensors can help overcome dangerous road surface states due to adverse weather conditions.	5.88
3	S6-O3	Technological advancements in road infrastructure enable efficient data collection which aids in developing data-driven decision-making systems.	5.78
4	S4-O2	Collaboration between government entities, private companies, and community organizations can enhance efforts to promote traffic safety, awareness, and consciousness.	5.76
5	S2-O4	Cheap car import policies and rational road tax implementation enable road users to purchase vehicles equipped with enhanced vehicle safety systems.	5.46
6	S1-T2	Efficient enforcement of traffic regulations prohibits impaired driving.	5.44
7	W2-O5	There is an opportunity to improve public transportation and other non-motorized modes of sustainable transportation.	5.31

8	W3-O1	Poor road infrastructure can be improved by incorporating innovative and modern technological solutions.	5.11
9	W1-T5	Easy procedures and poor training practices for obtaining a driving license increase the number of incompetent road users.	5.05
10	S2-T3	Cheap vehicle purchase encourages the possession of personal vehicles which increases the volume of traffic.	5.04
11	W1-O2	The qualification of road users can be improved through continued training and education conducted by relevant authorities and joint stakeholders.	4.94
12	S3-T6	Psychological feelings of security due to coverage by insurance policy can cause road users to drive carelessly.	4.62
13	W4-T1	Poor maintenance strategies lead to continuous maintenance works which lead to distracted driving.	4.52
14	W5-O3	Low budget investment raises the necessity for the efficient use of limited sources which can only be performed by data-driven decision making.	4.48
15	W6-T5	A high number of tourists and foreign students who are accustomed to traditional left-hand driving impose danger to traffic in which the driving direction is opposite.	4.01
16	W2-T3	The unavailability of public transportation forces road users to use personal vehicles.	3.98

Out of the overall critical factors to improve traffic and road safety, in particular, the Quantitative Strategic Planning Matrix (QSPM) analysis, local road users' feedback, and academic studies have identified strategies S1-O6 focused on the effective enforcement of traffic laws and regulations.

The emphasis of the QSPM analysis on this strategy is very big and is shown by being granted the highest score of 6.51, which seems to prove that there is a general agreement among the experts included in the analysis on its crucial importance. This view is similarly reflected in the opinions of the local road users, with 68 out of 200 showing agreement on its importance, indicating the wide acknowledgment of the need for strict enforcement of traffic laws for safer roads.

Literature reviews consolidate this view by supporting the importance of strategy. Gopalakrishnan (2012) points out that road traffic accidents cause severe damage, especially in developing countries where they cause numerous deaths and serious injuries, thereby pinning down the need for strict traffic laws. Alonso et al. (2017) and Peden & Sminkey (2004) also explore how the economic and global burden of traffic accidents is linked to poor adherence to traffic rules, further warranting the need for its enforcement for safety.

Furthermore, studies like Fanai et al. (2021) and Khan & Gajbhiye (2022) have identified the important role of traffic police in managing traffic accidents and the public's outcry for more strict measures on traffic safety. This is associated with the strategy focusing on strong law enforcement. Li et al. (2014) also support in their study the necessity of this strategy regarding public concerns related to distracted driving and the requirement for more public awareness and stronger rules.

The improved enforcement of traffic laws as identified in S1–O6 represents part of the crucial strategy required for bettering road safety and receives substantial support across experts, public opinion, and empirical research. The unanimity across these sources with varying perspectives points to how improved and strong traffic laws contribute strongly towards accident prevention and safer driving conditions.

Following the high-technology infrastructure strategy S6-T4 has been given a higher score of 5.88 on the QSPM analysis. This strategy is about using devices like sensors to deal with road safety issues when the weather is bad. This is to mean that there is

an indication of the expectation of the use of technology by the experts in making the roads safe.

For instance, in a study on infrastructure development, smart transportation systems were utilized through technologies such as sensors. These tech tools facilitate monitoring of the road conditions and acting on the changes, notably adverse weather conditions, hence being instrumental in maintaining road safety. This finding is supported by the research findings on traffic safety (Ma et al., 2022; Zhang et al., 2023).

In addition, if among 200 people in a survey, 28 chose this strategy, it means that more and more people understand that, along with all technological improvements, road safety can be increased. This requires the support of these people for the successful realization of all these tech-based ideas.

Strategy S6-T4 involves integrating the application of new technologies, such as sensors, to aid in promoting better road safety, especially in harsh weather conditions. Among the reasons why this is recommended are the expert views and also the research findings on the area that indicate that technology would be highly influential in road safety programs.

This S6-O3 strategy of harnessing technological advancements in road infrastructure for improved data collection and smart decision-making scored highly, with a 5.78 in the QSPM analysis, placing it third best. This high score is an indication that experts believe in the fact that technology should go hand in hand during the planning and management of road infrastructure.

However, only 20 out of 200 local road users opted for this entry strategy, indicating that it is not as well known or seen as important by the public as some other strategies. This difference can come from most people not having too much direct experience with or knowledge of the advantages that this technology might bring.

After all, the growing demand and intelligence on users and other variables associated with targeting, along with the growing interest in‘smart cities and intelligent transportation systems, certainly support such concepts as bringing an advanced level of technology to road infrastructure. For example, Ma et al. (2022) have discussed how

automated and mixed systems can increase safety on roads by lowering risks. Zhang et al. (2023) announce the latest advancement in state-of-the-art systems of traffic flow prediction as well as for the recognition of accidents, emphasizing the huge role of technology in improving road safety. These studies substantiate the goal of achieving modernization through technological advancements to create better safety conditions on the roads than they are now.

The fourth position scored at 5.76 is Strategy S4-O2, pointing out how all agencies of the government, private industry, and community groups work together for better traffic safety through a collective effort. Through this score, what comes out is that the experts feel it is important to work together towards one cause: enhancing better safety on the roads.

This approach got remarkable support from the public, as it was chosen by 61 out of 200 road users. This is an indication that many people have come to realize the need for working in groups to fight the complex health-related issues regarding road safety.

The importance of this kind of collaboration is underpinned by research. According to studies, improvement in traffic safety involves different areas and entails the joint commitment of diverse parties. Bliss & Breen (2012) identify good organization and partnerships as instrumental in the implementation of road safety strategies. The convergence of all diverse groups leads to a broader approach to trying to make the roads safe, which is what this strategy aims at.

Strategy S4-O2 and Strategy S6-O3 concentrate on important elements of road safety: technology and teaming up. Both of these strategies are considered significant by both experts and the public. Academic studies also focus on these approaches precisely due to the growing concentration on improving the situation of road safety using technology and teamwork.

Another strategy that took the fifth position with a total score of 5.46 in the QSPM analysis was Strategy S2-O4, affordable car import policies, as well as sensible road tax to enable people to purchase cars with better safety features. This shows that experts believe policies that make safer cars more accessible are important for road safety.

This approach was chosen by 51 of the 200 people, which can be considered an impressive level of public awareness of its importance. Many people understand the benefit of the position: they will have more affordable access to cars with advanced safety technologies.

The research supports the idea of safer vehicles being made available to people. Findings by Ma et al. (2022) and Zhang et al. (2023) provide evidence that safety features in a vehicle play an increasing role in reducing traffic risk. Improved import policies and tax systems that make these features more available will help improve road safety.

Strategy S1-T2, which advocated strictly enforcing the traffic laws as a way of curbing driving under the influence, emerges as the 6th in the QSPM analysis with a weighting score of 5.44. This shows that the experts strongly advocate for law enforcement as a way of curtailing risky behaviors such as those occasioned by impaired driving.

The strategy also found notable interest among the public, and 64 out of 200 people who were surveyed agreed to it. This can be understood with the general observation that there is equal apprehensiveness against impaired driving among people, and therefore they are fine with increased enforcement in terms of traffic rules.

Research supports the idea that strictly enforcing traffic laws can reduce incidents of impaired driving. For example, Hjar et al. (2012) underscore the absolute need for not just traffic laws but also the enforcement of active measures to minimize risks that lead to road accidents. This study supports the focus on strong enforcement as a way of utilizing this strategy to enhance road safety, in particular by reducing cases of impaired driving.

Strategy W2-O5, which was ranked seventh with a score of 5.31 in QSPM analysis, insists on the improvement of public transport and persuading walking and cycling. This ranking is an indication that experts are associating sustainable transportation with being very critical to road safety.

53 people out of the 200 agreed on this strategy, which is quite good public opinion regarding it. This helps show that generally there is a good perception of how better

public transport and non-motorized transport can help cut down on traffic and accidents. This approach is also supported by research.

According to Kopits & Cropper (2005) and Jiang et al. (2017) studies, without any measures for further sustainable transport, cities will just grow in numbers of people and vehicles, thus becoming fewer safe places. The authors state that with the promotion of public transport and non-motorized travel, cities can reduce traffic congestion and turn into more secure places simultaneously.

The W3-O1 strategy scored 5.11 in the QSPM analysis as it focuses on ensuring an improvement of road infrastructure using modern technology, thereby reflecting its viewpoints of high-order importance by the experts for making sure that the road safety mechanisms are improved decisively.

The strategy was moderately appreciated amongst the public, with 29 out of 200 road users choosing it, indicating an awareness of the necessity for revitalized road infrastructure, though not as urgently as other strategies.

This strategy has focused research to support it. Jiang et al. (2017) and L. Wang et al. (2019) studies point out that poorly maintained and outdated roads contribute significantly to accidents. They stress the technology's role in making roads much safer by addressing outdated and poor maintenance on them, which is also in line with this strategy’s goals.

From a very close perspective, Strategy W3-O1 strongly points towards the dire need for technological developments in upgrading road infrastructure as a necessity for heightened safety, as strongly supported by studies on road safety and urban planning. Public knowledge of this strategy and the support of experts show that it is effective in increasing road safety.

The experts rated the strategy W1-T5 with a 5.05 grade, concerning the perspective of increased strictness in driving licensing procedures as well as in the training process, which means that the experts believed that an easy licensing policy would move towards the recruitment of unqualified drivers on the roads and would ultimately damage the road security measures.

62 out of 200 people that the survey asked chose this strategy, and it stands for massive knowledge that tough license procedures and strict training are needed for competence in driving.

This is according to research that supports the focus of the strategy. For example, studies by Ratna et al. (2017) conclude the need for the adoption of in-depth road safety education that would significantly improve drivers' understanding and application of traffic rules. This is among the objectives that aim at improving driver training and licensing.

Further to this, L. Wang et al. (2019) point out that other measures, such as expanded safety legislation and enforcement, exist that help reduce traffic crashes in such a way that the targets of the strategy are further reinforced.

The strategy refers to driving environments in which strict license granting and effective training can contribute to risk prevention. Along with the expert's opinions, public awareness, and research data supporting this strategy, it defines its probable application in making roads safer through better driver competency.

Strategy S2-T3 ranks tenth with scores of 5.04 in QSPM analysis relating to the increase in traffic, which includes many issues with cheap cars. This reflects the fact that, according to knowledge known by experts, additional transport choices normally result in added volumes of vehicles and more intense congestion, along with an increased danger of accidents.

This strategy was chosen by 47 out of 200 road users in a survey, representing moderate-level public awareness of how traffic may be directly influenced by vehicle affordability. This showed an awakening to the fact that increased access to cars will cause more traffic and its corresponding safety risks.

This view is supported by research. For example, similar studies by Kopits and Cropper (2005) underline the necessity of carrying out an analysis of road users' behavior and traffic conditions based on safety. These authors claim that if more people decide to buy cars, with prices going down, the chances of accidents happening and the number of traffic jams might increase.

Besides, research by Jiang et al. (2017) and L. Wang et al. (2019) further ascertains that the determinant of road accidents is the number of cars on the road. This justifies and supports the focus of Strategy S2-T3 on personal vehicle growth management, influenced by car affordability, for better road safety.

Strategy S2-T3 marks affordable cars as a key relationship factor for more traffic and safer roads. It is significant from expert opinion, public understanding, and research, all proving its potential in addressing issues of road safety that arise from the increased level of personal transport.

One such strategy in this regard, Strategy W1-O2, in an attempt to improve road user skills through a continuous process of education and training, got a score of 4.94 from the QSPM. This is due to the premises that the above are qualities cited by experts for better road safety maintenance.

As an indication that a portion of the public is aware of the importance of continuing education for drivers, this strategy was taken by 33 out of 200 respondents in a survey. This shows that the majority has a general awareness that better training would result in safer roads.

This strategy has been supported by research. For example, Ratna et al. (2017) emphasize the fact that in-depth road safety education is required, wherein such education could help people differently and create a full understanding among them regarding traffic rules. It also supports the fact that users need to be educated continuously according to strategies.

Furthermore, L. Wang et al. (2019) point out that a reduction in traffic fatalities calls for better legislation and reactions to accidents, which hence require enlightened and competent road users. This further underscores the need for continuous education, as captured in Strategy W1-O2.

Strategy W1-O2, hence, focuses on routine or regular training and education that improve the skills and knowledge of the drivers, which are so much-dreaded factors in road safety. It has professional opinions, public awareness, and research to back up this application as its potential safe road-making policy.

Strategy S3-T6 takes twelfth place at 4.62 in QSPM analysis that looks at having insurance that might prompt riskier driving. This shows experts thought that though insurance is meant to protect, it might also make some drivers less careful, a situation called a moral hazard.

This idea was interesting to many, and 61 out of 200 people paying for their car insurance chose this option on a survey. This underlies how much drivers are aware that a feeling of security with their insurance might sometimes lead to more reckless driving activity.

Research gives a better idea of such behavior. Behavioral economic research such as that relating to moral hazards in insurance demonstrates that people who feel protected take more risks, an idea that is highly relevant for road safety (Kopits & Cropper, 2005). This idea matches Strategy S3-T6's focus on how insurance impacts driving behavior. Besides, it is important to consider how the general behavior of people on the road looks.

Shinar (1978) suggested that since driving behavior was found to frequently correspond with a general attitude toward life, thinking about insurance could be reflected in one's driving.

Strategy S3-T6 highlights how insurance contributes to subtly shaping attitudes toward driving safely, most notably through the effect of making people feel overprotected. Its consistency with expert commentary and public understanding, and the fact that it was highlighted by another piece of research, all confirm its importance in tackling this thorny road safety problem.

Strategy W4-T1, poor maintenance, occupies the thirteenth consideration in the QSPM with a score of 4.52 for its negative impacts on driving safety. Poor maintenance tends to increase the risk for motorists, and according to specialists, it is responsible for more accidents.

Since 55 of the 200 people went for this strategy during a survey, the degree of choice shows that the public has a proper understanding that the road should always be kept properly maintained so that it will remain safe. This is because, when one understands, constant repairs can distract drivers and cause accidents on the roads.

Research in road safety, therefore, backs this view. Through studies, road conditions are ensured to be greatly responsible for accident rates. Jiang et al. (2017) and L. Wang et al. (2019) observe that good or bad maintenance of the roads is one of the key contributors to safety.

These findings support Strategy W4-T1's focus on better maintenance to prevent distractions and improve safety. The requirement of proper maintenance of roads to augment safety is stressed by strategy W4-T1. Its conformance to expert consensus, public recognition, and research highlights its relevance to the concerns related to road safety associated with the practice of maintenance. Proper maintenance practice is necessary for mitigating the hazards residing on a road and, at the same time, enhancing road safety.

Strategy W5-O3, which is about making good use of limited budget funds for data-driven road safety decisions, got a score of 4.48 in the QSPM analysis. This shows that experts agree on the need to be resourceful, especially when it comes to how well data can be used to make better decisions about traffic safety.

This approach emerged in a public survey, with 85 out of 200 respondents selecting it. The indication that many people had it as an option on top of their priorities means the challenges emanating from tight budgets and using resources sparingly for road safety are understood by many individuals.

This strategic focus was previously enunciated by research. This is reiterated in similar studies, including those by Kopits and Cropper (2005) on the understanding of driver behavior and road condition as a requirement for effective safety measures, most of which involve data collection and analysis.

Similar studies like Jiang et al. (2017) and L. Wang et al. (2019) emphasize that the challenges of road safety, such as infrastructural improvement and policymaking, among several others, need techniques based on data. Also, efficient utilization of limited funds in road safety efforts is a common subject in traffic safety research. This focus on gaining the maximum outcome with available resources to improve safety is in line with the worldwide departure towards more strategic and fact-based approaches in traffic management and safety.

Strategy W5-O3 emphasizes the need to use scarce resources effectively for road safety. Its relevancy is affirmed by expert opinion, knowledge among members of the public, and research, all of which present a way through which it can improve road safety, especially where budgetary constraints are a major issue.

Strategy W6-T5, special action on tackling the risks from tourists and foreign students used to left-hand driving in the areas where the norm is opposite, ranks fifteenth with a score of 4.01 as per QSPM analysis. This score reflects that the experts have an understanding of the unique challenges brought by such different driving habits, especially in places with many tourists.

A public survey on this issue amongst 200 road users found that out of the 200 respondents, 46 had chosen this approach, showing certain degrees of concern and awareness about the safety issues of unfamiliar driving rules. The findings seem to shed light on the nuances that came in the way of maintaining safety in a traffic environment where people belong to different cultures with varied driving practices.

Other works, such as Kopits & Cropper (2005) and Jiang et al. (2017), argue that traffic safety is affected not only by infrastructure and rules but also depends on the comprehension of different natural numbers from cultural and behavioral perspectives. From these studies, there is an emphasis on tailoring road safety measures to target driving behaviors as envisaged within Strategy W6-T5.

L. Wang et al. (2019) also reaffirm the high demand for all-inclusive safety measures that will take into account differences in experiences by drivers.

This would entail increased vigilance, personalized transportation education for different stakeholders, and conceivably a change in traffic management to accommodate drivers from foreign countries. Strategy W6-T5 identifies the imperative nature of paying attention to road safety as international movement and tourism increase.

Expert views and the general public's perception, coupled with research pointing out varying styles of driving by tourists and foreign students whose safety risks need managing, are spawning and supporting its relevance. This approach is key to improving road safety in areas with a lot of tourist activity and varied driving cultures.

The last strategy in the QSPM analysis is strategy W2-T3 because it addresses how a lack of public transport causes more usage of personal vehicles, with a score of 3.98. According to experts, not providing adequate choices in public transportation will cause an increase in the usage of personal cars, which will cause more traffic congestion and safety issues.

In a public poll, 37 out of 200 people have adopted this strategy, which means that there is some recognition of the role of public transport in controlling traffic and making it more secure, though to a lesser degree than other strategies.

Research confirms its correctness. Studies have shown that strong public transportation influences the distance traveled by personal cars. Kopits & Cropper (2005) deduce that there is a considerable effect of transport policies and associated infrastructure on travel behavior. Good public transport can reduce the reliance on personal cars, which helps lessen traffic jams and accidents.

Moreover, Jiang et al. (2017), combined with L. Wang et al. (2019), point out the importance of integrated urban transport planning, including effective public transport systems, particularly in cities characterized by enormous numbers of cars and limited road capacity.

Strategy W2-T3 stipulates efficient and accessible public transport as necessary to manage the use of personal vehicles and improve road safety. This is indicated by relevant expert opinions, little conception by the public, and research that indicates potential prospects for addressing issues concerned with road safety through misuse of public transport.

CHAPTER V

Conclusion and Recommendations

In conclusion, based on the detailed examination of various strategies for road safety based on expertise analysis, public opinion, and extensive research, it is obvious that each strategy has its own unique role in making roads safer, though their recognition may be different between the experts and the public.

One of the top-rated strategies, S1-O6, has put strong traffic laws in focus and insists on underlining applications. Consensus between experts, the public, and research studies exists for strict adherence to the law for safer roads.

Similarly, the strategy concentrating efforts on using advanced technology on roads, especially in bad weather (S6-T4) also scores high, showing technology is taking a central role in road safety. While it receives moderate public support, its capabilities to improve safety are well recognized in the field of intelligent transportation.

Other approaches, like W1-O2 or W4-T1, which stress continued driver background and good maintenance of roads, accent the fact that road safety is not solely attributed to physical modifications but also to alteration of behavior and teaching.

In addition, the strategy related to the improvement of public transportation and walking and biking influence (W2-O5) is also very effective in making urban travel much more sustainable and relieving congestion. This is an approach that gets moderate public support and, with backing from research, points towards the realization that there is an increase in public understanding relating to the significance of public transport for road safety.

Others, like S2-T3 and W6-T5, which discuss the implications of affordable cars on traffic volume and safety challenges in tourist destinations, enjoy a lower rating but discuss crucial aspects of the effects of economic elements on road safety and tourism.

Overall, this comprehensive analysis of strategies for ensuring road safety suggests the necessity of a joint approach that will embrace stringent law enforcement, technological advancements, education, and the enhancement of infrastructure, along with policy reformulation.

The match between these strategies, expert opinions, public views, and research shows to what length they can collaborate in making the roads safe and sustainable. This all-around approach is important while dealing with the different road safety challenges confronting humanity to ensure proper safety for both drivers and pedestrians on the roads.

Recommendations

An exhaustive analysis of various strategies that can be applied to enhance road safety culminates in the following series of recommendations and areas for future exploration.

1. Strengthen Traffic Law Enforcement (Strategy S1-O6): Besides the approach of a comprehensive set of traffic laws, the most important is their enforcement effectively and consistently. It requires a collective effort from the authorities to strictly implement these laws, which are indeed essential for discouraging the violation of traffic rules and thus making the roads safer in general.

2. Investment in Technological Innovations (Strategy S6-T4): It is highly recommended that proper involvement be made with the use of advanced technology such as sensors and intelligent transportation systems on roads, especially in conditions where driving becomes very difficult due to dangerous weather circumstances. High-level technologies can assist more in reducing the risks included in road activities and increasing the level of road safety and its usage.

3. Comprehensive Education and Training Programs (Strategy W1-O2): There is a need to develop and execute education and training initiatives for road users comprehensively. The programs should enhance awareness of various traffic laws, drive home the attitude of responsible driving, and hence reverse into a conscious behavior of responsible road use, resulting in an obvious reduction in road crashes.

4. Improvement of Road Maintenance Practices (Strategy W4-T1): Another major recommendation is to render the maintenance of road infrastructure timely and qualitative. Through the application of effective strategies for road maintenance, the country can reduce the number of hazardous spots on roads and accidents thereon while providing everyone with safer and more stable road conditions.

5. Promotion of Public Transportation and Other Alternative Modes of Travel (Strategy W2-O5): The promotion of public transportation as well as any other non-motorized modes of travel should be overemphasizingly encouraged.

Improving the public transit systems and providing a better conducive environment for other forms of travel may lead to a reduction of traffic snarl-ups, emissions reduction, and improved road safety.

Areas that can be considered for further research include:

- Determining the most effective ways and approaches to traffic law enforcement and how they influence a driver's behavior as well as accident rates.
- Examining and determining technical solutions that are efficient in different weather conditions and levels of traffic situations to establish the objects of best practices for road safety improvement.
- For studying the long-term effects of education and training programs on changing driver behavior and reducing accidents.
- To assess the impact of different strategies implemented for road maintenance to improve and enhance road safety and reduce accidents.
- Study the impacts of enhanced public transport systems and alternative travel modes on total traffic dynamics, road safety, and environmental sustainability.

These recommendations and the direction of future research enable a more informed understanding of road safety strategies with the ultimate goal of achieving safer road environments for all.

References

. M. Z. M. E. (2015). Alternative Fundings To Improve Road Safety in Malaysia. *International Journal of Research in Engineering and Technology*, *04*(11), 119–125. https://doi.org/10.15623/ijret.2015.0411023

Aldehayyat, J. S., & Anchor, J. R. (2008). Strategic planning tools and techniques in Jordan: awareness and use. *Strategic Change*, *17*(7–8), 281–293. https://doi.org/10.1002/jsc.833

Alejos, H. (2017). No Title الابتزاز الإلكتروني. جرائم تتغذى على طفرة «التواصل ال.. *Universitas Nusantara PGRI Kediri*, *01*, 1–7. http://www.albayan.ae

Alonso, F., Esteban, C., Montoro, L., & Useche, S. A. (2017). Knowledge, perceived effectiveness, and qualification of traffic rules, police supervision, sanctions and justice. *Cogent Social Sciences*, *3*(1). https://doi.org/10.1080/23311886.2017.1393855

Alshehri, S. Z. (2019). Health-promoting initiatives in Saudi higher education. *Health Education*, *119*(5–6), 366–381. https://doi.org/10.1108/HE-12-2018-0067

Althoff, M., & Dolan, J. M. (2014). Online verification of automated road vehicles using reachability analysis. *IEEE Transactions on Robotics*, *30*(4), 903–918. https://doi.org/10.1109/TRO.2014.2312453

Andrijanto, Itoh, M., & Sianipar, F. S. (2022). Behavioral aspects of safety culture: Identification of critical safety-related behaviors of motorcyclists in Indonesia's urban areas via the application of behavioral-based safety programs. *IATSS Research*, *46*(3), 353–369. https://doi.org/10.1016/j.iatssr.2022.04.001

Angın, M., & Albrka Ali, S. I. (2021). Analysis of Factors Affecting Road Traffic Accidents in North Cyprus. *Engineering, Technology and Applied Science Research*, *11*(6), 7938–7943. https://doi.org/10.48084/etasr.4547

Atchley, P., Atwood, S., & Boulton, A. (2011). The choice to text and drive in younger drivers: Behavior may shape attitude. *Accident Analysis and Prevention*, *43*(1), 134–142. https://doi.org/10.1016/j.aap.2010.08.003

Atchley, P., Hadlock, C., & Lane, S. (2012). Stuck in the 70s: The role of social norms in distracted driving. *Accident Analysis and Prevention*, *48*, 279–284. https://doi.org/10.1016/j.aap.2012.01.026

Atchley, P., Shi, J., & Yamamoto, T. (2014). Cultural foundations of safety culture: A comparison of traffic safety culture in China, Japan and the United States. *Transportation Research Part F: Traffic Psychology and Behaviour*, *26*(PB), 317–325. https://doi.org/10.1016/j.trf.2014.01.004

Austin, M. J., & Hopkins, K. (2004). *Supervision as collaboration in the human services: Building a learning culture*. Sage.

Bank, W. (2020). *Guide for Road Safety Opportunities and Challenges: Low and Middle Income Country Profiles*.

Benzaghta, M. A., Elwalda, A., Mousa, M., Erkan, I., & Rahman, M. (2021). SWOT analysis applications: An integrative literature review. *Journal of Global Business Insights*, *6*(1), 55–73. https://doi.org/10.5038/2640-6489.6.1.1148

Bertoli, P., & Grembi, V. (2021). The political cycle of road traffic accidents. *Journal of Health Economics*, *76*, 102435. https://doi.org/10.1016/j.jhealeco.2021.102435

Bishai, D., Asiimwe, B., Abbas, S., Hyder, A. A., & Bazeyo, W. (2008). Cost-effectiveness of traffic enforcement: Case study from Uganda. *Injury Prevention*, *14*(4), 223–227. https://doi.org/10.1136/ip.2008.018341

Bliss, T., & Breen, J. (2012). Meeting the management challenges of the Decade of Action for Road Safety. *IATSS Research*, *35*(2), 48–55. https://doi.org/10.1016/j.iatssr.2011.12.001

Board, T. R. (2010). *TRB Special Report 300 - Achieving Traffic Safety Goals in the United States: Lessons from Other Nations*. The National Academies Press. https://doi.org/10.17226/13046

Campisi, T., Canale, A., & Tesoriere, G. (2018). SWOT analysis for the implementation of spaces and pedestrian paths at the street markets of Palermo. *AIP Conference Proceedings*, *2040*(November).

https://doi.org/10.1063/1.5079192

Causes of Road Accidents. (1956). In *Bmj* (Vol. 1, Issue 4975, pp. 1098–1099). https://doi.org/10.1136/bmj.1.4975.1098

Chang, O. H., & Chow, C. W. (1999). The Balanced Scorecard: A Potential Tool for Supporting Change and Continuous Improvement in Accounting Education. *Issues in Accounting Education*, *14*(3), 395–412. https://doi.org/10.2308/iace.1999.14.3.395

Chermack, T. J., & Kasshanna, B. K. (2007). The use and misuse of swot analysis and implications for hrd professionals. *Human Resource Development International*, *10*(4), 383–399. https://doi.org/10.1080/13678860701718760

Ciampa, D., & Watkins, M. (1999). The successor's dilemma. *Harvard Business Review*, *77*(6), 161–168.

Dalal, S., Seth, B., Radulescu, M., Cilan, T. F., & Serbanescu, L. (2023). Optimized Deep Learning with Learning without Forgetting (LwF) for Weather Classification for Sustainable Transportation and Traffic Safety. *Sustainability (Switzerland)*, *15*(7). https://doi.org/10.3390/su15076070

DeNicola, E., Aburizaize, O. S., Siddique, A., Khwaja, H., & Carpenter, D. O. (2016). Road traffic injury as a major public health issue in the Kingdom of Saudi Arabia: A review. *Frontiers in Public Health*, *4*(SEP). https://doi.org/10.3389/FPUBH.2016.00215

Doolittle, P. E., & Camp, W. G. (1995). Journal of vocational and technical education. *Journal of Vocational and Technical Education*, *16*(1).

Dupont, E., Muhlrad, N., Buttler, I., Gitelman, V., Giustiniani, G., Jähi, H., Machata, K., Martensen, H., Papadimitriou, E., Persia, L., Talbot, R., Vallet, G., Wijnen, W., & Yannis, G. (2012). Needs for Evidence-Based Road Safety Decision Making in Europe. *Procedia - Social and Behavioral Sciences*, *48*, 2513–2522. https://doi.org/10.1016/j.sbspro.2012.06.1222

Ecola, L., Popper, S. W., Silberglitt, R., & Fraade-Blanar, L. (2018). The road to zero: A vision for achieving zero roadway deaths by 2050. *Rand Health*

Quarterly, *8*(2).

Fanai, S., Mohammadnezhad, M., & Salusalu, M. (2021). Perception of Law Enforcement Officers on Preventing Road Traffic Injury in Vanuatu: A Qualitative Study. *Frontiers in Public Health*, *9*(December), 1–11. https://doi.org/10.3389/fpubh.2021.759654

Farooq, M. U., Ahmed, A., Khan, S. M., & Nawaz, M. B. (2021). Estimation of Traffic Occupancy using Image Segmentation. *Engineering, Technology & Applied Science Research*, *11*(4), 7291–7295.

Fleisher, C., & Bensoussan, B. (2003). *Strategic and competitive analysis: methods and techniques for analyzing business competition*. 1–5. http://94.23.146.173/ficheros/74b583c108e6118acc3543f7604eb329.pdf

GAİRE, M., THAPA, T., & JOSHİ, A. (2022). Awareness on Traffic Rules and Safety Measures among Bachelor Level Students in Selected Colleges. *Black Sea Journal of Health Science*, *5*(1), 24–30. https://doi.org/10.19127/bshealthscience.1005294

Gettman, D., & Head, L. (2003). Surrogate Safety Measures from Traffic Simulation Modelsfile:///C:/Users/sfwang/Desktop/1-s2.0-S0968090X11000179-main.pdf. *Transportation Research Record: Journal of the Transportation Research Board*, *1840*(03), 104–115. https://trrjournalonline.trb.org/doi/pdf/10.3141/1840-12%0Ahttp://trrjournalonline.trb.org/doi/10.3141/1840-12

Gopalakrishnan, S. (2012). A Public Health Perspective of Road Traffic Accidents. *Journal of Family Medicine and Primary Care*, *1*(2), 144. https://doi.org/10.4103/2249-4863.104987

Hammad, H. M., Ashraf, M., Abbas, F., Bakhat, H. F., Qaisrani, S. A., Mubeen, M., Fahad, S., & Awais, M. (2019). Environmental factors affecting the frequency of road traffic accidents: a case study of sub-urban area of Pakistan. *Environmental Science and Pollution Research*, 11674–11685. https://doi.org/10.1007/s11356-019-04752-8

Helms, M. M., & Nixon, J. (2010). Exploring SWOT analysis – where are we now?:

A review of academic research from the last decade. In *Journal of Strategy and Management* (Vol. 3, Issue 3). https://doi.org/10.1108/17554251011064837

Heydari, S., Hickford, A., McIlroy, R., Turner, J., & Bachani, A. M. (2019). Road safety in low-income countries: State of knowledge and future directions. *Sustainability (Switzerland)*, *11*(22), 1–29. https://doi.org/10.3390/su11226249

Híjar, M., Pérez-Núñez, R., Inclán-Valadez, C., & Silveira-Rodrigues, E. M. (2012). Road safety legislation in the Americas. *Revista Panamericana de Salud Publica/Pan American Journal of Public Health*, *32*(1), 70–76. https://doi.org/10.1590/S1020-49892012000700011

Hill, T., & Westbrook, R. (1997). SWOT Analysis: It's Time for a Product Recall. *Long Range Planning*, *30*(1), 46–52. https://doi.org/10.1016/S0024-6301(96)00095-7

Huang, H., Wang, X., & Hu, G. (2016). Traffic safety in China: Challenges and countermeasures. *Accident Analysis and Prevention*, *95*, 305–307. https://doi.org/10.1016/j.aap.2016.07.040

Hyder, A. A., Hoe, C., Hijar, M., & Peden, M. (2022). The political and social contexts of global road safety: challenges for the next decade. *The Lancet*, *400*(10346), 127–136.

Hyder, A. A., Paichadze, N., Toroyan, T., & Peden, M. M. (2017). Monitoring the Decade of Action for Global Road Safety 2011–2020: An update. *Global Public Health*, *12*(12), 1492–1505. https://doi.org/10.1080/17441692.2016.1169306

Igboanugo, A. C., & Ekhuemelo, E. F. (2007). Intervention Analysis of Road Traffic Accidents in Nigeria. *Advanced Materials Research*, *18*, 375–382.

Islam, M. T., Thue, L., & Grekul, J. (2017). Understanding traffic safety culture implications for increasing traffic safety. *Transportation Research Record*, *2635*(1), 79–89. https://doi.org/10.3141/2635-10

Jiang, B., Liang, S., Peng, Z. R., Cong, H., Levy, M., Cheng, Q., Wang, T., & Remais, J. V. (2017). Transport and public health in China: the road to a healthy future. *The Lancet*, *390*(10104), 1781–1791. https://doi.org/10.1016/S0140-

6736(17)31958-X

Job, R. F. S. (2020). Policies and Interventions to Provide Safety for Pedestrians and Overcome the Systematic Biases Underlying the Failures. *Frontiers in Sustainable Cities*, *2*(June), 1–8. https://doi.org/10.3389/frsc.2020.00030

Khan, A., & Gajbhiye, N. (2022). Survey Based Road Safety Analysis to Understand the Perspective of the General Public. *International Journal of Pharma and Bio Sciences*, *12*(1), 32–37. https://doi.org/10.22376/ijpbs/lpr.2022.12.1.l32-37

King, R. K. (2004). Enhancing SWOT analysis using triz and the bipolar conflict graph: a case study on the Microsoft Corporation. *Proceedings of TRIZCON2004, 6th Annual Altshuller Institute*, *april*, 25–27. http://goo.gl/JbP4ia

Kopits, E., & Cropper, M. (2005). Traffic fatalities and economic growth. *Accident Analysis and Prevention*, *37*(1), 169–178. https://doi.org/10.1016/j.aap.2004.04.006

Koprulu, K. (2010). Northern Cyprus. *Economist*, *397*(8710).

Kulshrestha, S. (2017). Tows Analysis for Strategic Choice of Business Opportunity and Sustainable Growth of Small Businesses. *Pacific Business Review International*, *10*(5), 144–152.

Lankarani, K. B., Heydari, S. T., Aghabeigi, M. R., Moafian, G., Hoseinzadeh, A., & Vossoughi, M. (2014). The impact of environmental factors on traffic accidents in Iran. *Journal of Injury and Violence Research*, *6*(2), 64–71. https://doi.org/10.5249/jivr.v6i2.318

Li, W., Gkritza, K., & Albrecht, C. (2014). The culture of distracted driving: Evidence from a public opinion survey in Iowa. *Transportation Research Part F: Traffic Psychology and Behaviour*, *26*(PB), 337–347. https://doi.org/10.1016/j.trf.2014.01.002

Ma, Y., Xu, J., Gao, C., Mu, M., Guangxun, E., & Gu, C. (2022). Review of Research on Road Traffic Operation Risk Prevention and Control. *International Journal of Environmental Research and Public Health*, *19*(19).

https://doi.org/10.3390/ijerph191912115

Mahdavi, I. (2012). *c r v i h o e f c r v i h o e f*.

Management, E. (2014). *Public Participation Role in Sustainable Urban Management by Quantitative Strategic Planning Matrix (QSPM)*. *8*(4), 1309–1314.

Muthusamy, A. P., Rajendran, M., Ramesh, K., & Sivaprakash, P. (2015). A review on road traffic accident and related factors. *International Journal of Applied Engineering Research*, *10*(11), 28177–28183.

Namugenyi, C., Nimmagadda, S. L., & Reiners, T. (2019). Design of a SWOT analysis model and its evaluation in diverse digital business ecosystem contexts. *Procedia Computer Science*, *159*, 1145–1154. https://doi.org/10.1016/j.procs.2019.09.283

Nordfjærn, T., Şimşekoğlu, Ö., & Rundmo, T. (2014). Culture related to road traffic safety: A comparison of eight countries using two conceptualizations of culture. *Accident Analysis and Prevention*, *62*, 319–328. https://doi.org/10.1016/j.aap.2013.10.018

Nur, A., Rozmi, A., Nordin, A., Izhar, M., & Bakar, A. (2018). The Perception of ICT Adoption in Small Medium Enterprise: A SWOT Analysis. *International Journal of Innovation and Business Strategy (IJIBS)*, *9*(1), 69–79.

Nyarku, K. M., & Agyapong, G. K. Q. (2011). Rediscovering SWOT analysis: The extended version. *Academic Leadership*, *9*(2). https://doi.org/10.58809/kiql1002

Ofosu-Boateng, N. R. L. (2017). A SWOT Analysis of Maritime Transportation and Security in the Gulf of Guinea. *Open Journal of Social Sciences*, *05*(08), 14–34. https://doi.org/10.4236/jss.2017.58002

Oivind Madsen, D. (2016). SWOT Analyses: A Management Fashion Perspective. *International Journal of Business Research*, *16*(1), 39–56. http://ssrn.com/abstract=2615722

Organization, W. H. (2009). Global status report on road safety : time for action. In *TA - TT -*. World Health Organization Geneva. https://doi.org/LK -

https://worldcat.org/title/425820302

Organization, W. H. (2019). *Global status report on road safety; 2018. Geneva, Switzerland: World Health Organization*.

Osuret, J., Namatovu, S., Biribawa, C., Balugaba, B. E., Zziwa, E. B., Muni, K., Ningwa, A., Oporia, F., Mutto, M., Kyamanywa, P., Guwatudde, D., & Kobusingye, O. (2021). State of pedestrian road safety in Uganda: A qualitative study of existing interventions. *African Health Sciences*, *21*(3), 1498–1506. https://doi.org/10.4314/ahs.v21i3.62

Otto, J., Ward, N., Finley, K., Baldwin, S. T., & Alonzo, W. (2022). Increasing Readiness to Grow Traffic Safety Culture and Adopt the Safe System Approach: A Story of the Washington Traffic Safety Commission. *Frontiers in Future Transportation*, *3*(July), 1–5. https://doi.org/10.3389/ffutr.2022.964630

Panagiotou, G. (2003). Bringing SWOT into focus. *Business Strategy Review*, *14*(2), 8–10.

Peden, M., Peden, M. M., Organization, W. H., & -, W. H. O. T. A.-T. T. (2004). *World report on road traffic injury prevention* (NV-1 o). World Health Organization [Place of publication not identified]. https://doi.org/LK - https://worldcat.org/title/1010668273

Peden, M., & Sminkey, L. (2004). World Health Organization dedicates World Health Day to road safety. *Injury Prevention*, *10*(2), 67. https://doi.org/10.1136/ip.2004.005405

Petridou, E., & Moustaki, M. (2000a). Human factors in the causation of road traffic crashes. *European Journal of Epidemiology*, *16*(9), 819–826. https://doi.org/10.1023/A:1007649804201

Petridou, E., & Moustaki, M. (2000b). *Human Factors in the Causation of Road Traffic Crashes Author (s): Eleni Petridou and Maria Moustaki Published by : Springer Stable URL : http://www.jstor.org/stable/3581952 Accessed : 06-04-2016 04 : 58 UTC Human factors in the causation of road traffi*. *16*(9), 819–826.

Prasad, V. B. (1987). *Connection Assignment for Maximum Fault Detection. 25*(3), 551–554.

Puyt, R. W., Lie, F. B., & Wilderom, C. P. M. (2023). The origins of SWOT analysis. *Long Range Planning*, *56*(3), 102304. https://doi.org/10.1016/j.lrp.2023.102304

Rahmani, K., & Baghbani, M. (2015). An analysis of public transportation system in Saqqez city using swot technique. *JIMS8M: The Journal of Indian Management & Strategy*, *20*(4), 55. https://doi.org/10.5958/0973-9343.2015.00032.0

Ratna, H. V. K., S. S., R., Jayaram, A., M. S., R., P., V., & Iyengar, K. (2017). Awareness and behaviour patterns regarding road safety measures among undergraduate students. *International Journal Of Community Medicine And Public Health*, *4*(4), 944. https://doi.org/10.18203/2394-6040.ijcmph20170947

Ravanavar, G. M., & Charantimath, P. M. (2012). Strategic formulation using tows matrix–A Case Study. *International Journal of Research and Development*, *1*(1), 87–90.

Rolison, J. J., Regev, S., Moutari, S., & Feeney, A. (2018). What are the factors that contribute to road accidents? An assessment of law enforcement views, ordinary drivers' opinions, and road accident records. *Accident Analysis and Prevention*, *115*(March), 11–24. https://doi.org/10.1016/j.aap.2018.02.025

Satria, R., & Shahbana, E. B. (2020). The SWOT Analysis of Strengthening Character Education In Junior High School. *Jurnal Iqra' : Kajian Ilmu Pendidikan*, *5*(2), 56–67. https://doi.org/10.25217/ji.v5i2.827

Sebt, M. H., Khalilianpoor, A. H., Bagheri, Q., & Dehkordi, E. R. (2018). SWOT Analysis on Marine Transport Companies of Iran. *AUT Journal of Civil Engineering*, *c*(December), 153–160. https://doi.org/10.22060/AJCE.2018.12319.5167

Shinar, D. (1978). *Psychology on the road. The human factor in traffic safety*. John Wiley & Sons Inc.

Shrestha, R. K., Alavalapati, J. R. R., & Kalmbacher, R. S. (2004). Exploring the

potential for silvopasture adoption in south-central Florida: An application of SWOT-AHP method. *Agricultural Systems*, *81*(3), 185–199. https://doi.org/10.1016/j.agsy.2003.09.004

Sleet, D. A., Baldwin, G., Dellinger, A., & Dinh-Zarr, B. (2011). The decade of action for global road safety. *Journal of Safety Research*, *42*(2), 147–148. https://doi.org/10.1016/j.jsr.2011.02.001

Sleet, D. A., Dellinger, A. M., & Naumann, R. B. (2011). The Intersection of Road Traffic Safety and Public Health. *Handbook of Traffic Psychology*, *April 2007*, 457–470. https://doi.org/10.1016/B978-0-12-381984-0.10032-3

Sleet, D. A., & Lonero, L. (2002). Behavioral strategies for reducing traffic crashes. *Encyclopedia of Public Health. New York: Macmillan Reference USA*.

Sohail, A., Cheema, M. A., Ali, M. E., Toosi, A. N., & Rakha, H. A. (2023). Data-driven approaches for road safety: A comprehensive systematic literature review. *Safety Science*, *158*. https://doi.org/10.1016/j.ssci.2022.105949

Stec, S. (2019). Procesy innowacyjne w transporcie pasażerskim w Polsce i Europie. *Ekonomika i Organizacja Logistyki*, *4*(3 SE-Articles), 41–53. https://doi.org/10.22630/EIOL.2019.4.3.22

Sun, L. L., Liu, D., Chen, T., & He, M. T. (2019). Road traffic safety: An analysis of the cross-effects of economic, road and population factors. *Chinese Journal of Traumatology - English Edition*, *22*(5), 290–295. https://doi.org/10.1016/j.cjtee.2019.07.004

Szeliga-Duchnowska, A., & Goranczewski, B. (2017). Use of Tows Analysis in Tourism and Recreation Strategy Planning by a Commune Governing the Hosting Area. *Ekonomiczne Problemy Turystyki*, *40*(40), 103–114. https://doi.org/10.18276/ept.2017.4.40-09

Touahmia, M. (2018). Identification of risk factors influencing road traffic accidents. *Engineering, Technology & Applied Science Research*, *8*(1), 2417–2421.

Traffic, T. H. E., Culture, S., & Process, D. (2018). *The traffic safety culture development process*. *October*, 1–6.

U.S. Department of Transportation, & Federal Highway Administration. (2014). *Behavioral safety strategies for divers on rural roads*. http://safety.fhwa.dot.gov

United Nations Road Safety Collaboration. (2011). Global plan for the Decade of Action for Road Safety 2011–2020. *Geneva: WHO*, 25. http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Global+Plan+for+the+Decade+of+Action+for+Road+Safety+2011-2020#0

Vance, C. M. (2012). The re-source-based view of the firm. *Journal of Management Inquiry*, *21*(1), 124. https://doi.org/10.1177/1056492611436225

Vlados, C. (2019). On a correlative and evolutionary SWOT analysis. *Journal of Strategy and Management*, *12*(3), 347–363.

Wang, L., Ning, P., Yin, P., Cheng, P., Schwebel, D. C., Liu, J., Wu, Y., Liu, Y., Qi, J., Zeng, X., Zhou, M., & Hu, G. (2019). Road traffic mortality in China: analysis of national surveillance data from 2006 to 2016. *The Lancet Public Health*, *4*(5), e245–e255. https://doi.org/10.1016/S2468-2667(19)30057-X

Wang, Y., & Zhang, W. (2017). Analysis of Roadway and Environmental Factors Affecting Traffic Crash Severities. *Transportation Research Procedia*, *25*, 2119–2125. https://doi.org/10.1016/j.trpro.2017.05.407

Ward, N. J., Otto, J., & Finley, K. (2019). Ten Principles of Traffic Safety Culture. In N. J. Ward, B. Watson, & K. Fleming-Vogl (Eds.), *Traffic Safety Culture* (pp. 21–39). Emerald Publishing Limited. https://doi.org/10.1108/978-1-78714-617-420191004

Weber, M. (2006). Some Safety Aspects on the Design of Sparger Systems for the. *Process Safety Progress*, *25*(4), 326–330. https://doi.org/10.1002/prs

Weihrich, H. (1982). The TOWS matrix—A tool for situational analysis. *Long Range Planning*, *15*(2), 54–66.

Weijermars, W., & Wegman, F. (2011). Ten years of sustainable safety in the netherlands an assessment. *Transportation Research Record*, *2213*, 1–8. https://doi.org/10.3141/2213-01

Williams, A. F., & Neill, B. O. (1972). Driving Records of Licensed. *Traffic Safety*.

Yang, C. Y. D., & Fisher, D. L. (2021). Safety impacts and benefits of connected and automated vehicles: How real are they? *Journal of Intelligent Transportation Systems: Technology, Planning, and Operations*, *25*(2), 135–138. https://doi.org/10.1080/15472450.2021.1872143

Yuan, Q., Peng, Y., Xu, X., & Wang, X. (2021). Key points of investigation and analysis on traffic accidents involving intelligent vehicles. *Transportation Safety and Environment*, *3*(4). https://doi.org/10.1093/tse/tdab020

Yuan, X., Zhou, C., & Zhang, H. (2021). *Development Strategies of Drop and Pull Transportation Based on SWOT Analysis Development Strategies of Drop and Pull Transportation Based on SWOT Analysis*. https://doi.org/10.1088/1742-6596/1972/1/012063

Zhang, Y., Liu, F., Yue, S., Li, Y., & Dong, Q. (2023). Accident Detection and Flow Prediction for Connected and Automated Transport Systems. *Journal of Advanced Transportation*, *2023*. https://doi.org/10.1155/2023/5041509

Appendix

Appendix A Ethics Certificate

NEAR EAST UNIVERSITY

SCIENTIFIC RESEARCH ETHICS COMMITTEE

06.11.2023

Dear Sakariye Adam Farah

Your application titled **"Bridging the Gap in Traffic Safety by Using SWOT and TOWS Analysis: A Case Study of Northern Cyprus"** with the application number NEU/AS/2023/201 has beenevaluated by the Scientific Research Ethics Committee and granted approval. You can start your research on the condition that you will abide by the information provided in your application form.

Prof. Dr. Aşkın KİRAZ

The Coordinator of the Scientific Research Ethics Committee

Appendix B Turnitin Similarity Report

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Appendix C SWOT and TOWS Questionnaire Experts

Dear respondent,

This questionnaire is prepared for the master's thesis titled " Bridging the gap in traffic safety by using SWOT and TOWS analysis: A case study of Northern Cyprus " under the supervision of Dr. Mustafa Alas. Please select the items below according to their strength (1 = very strong to 5 = very weak) in the tables below

Strength	**1**	**2**	**3**	**4**	**5**
How much is "well prepared and up to date regulations and effective enforcement" considered a strength?					
How much is "cheap vehicle import and rational road tax regulations" considered a strength?					
How much is "efficient insurance policies" considered a strength?					
How much is "public awareness and education programs" considered a strength?					
How much is "sufficient traffic signs and signals" considered a strength?					
How much is "advanced technology and infrastructure" considered a strength?					

Weakness	**1**	**2**	**3**	**4**	**5**
How much is "easy training and exam practices for driving license" considered a weakness?					
How much is "poor public transportation" considered a weakness?					
How much is "poor road infrastructure" considered a weakness?					
How much is "inadequate maintenance strategies" considered a weakness?					
How much is a "low budget for research and investment" considered a weakness?					
How much is "right-hand driving" considered a weakness?					

Opportunities	**1**	**2**	**3**	**4**	**5**
How much is "modern and technological road infrastructure" considered an opportunity?					
How much is "partnerships and collaboration between stakeholders" considered an opportunity?					
How much is "data-driven decision-making" considered an opportunity?					

How much is "enhanced vehicle safety systems" considered an opportunity?					
How much is "sustainable transportation initiatives (non-motorized modes of transport)" considered an opportunity?					
How much is "compliance to traffic rules and regulations" considered an opportunity?					

Threads	**1**	**2**	**3**	**4**	**5**
How much is "distracted driving" considered a thread?					
How much is "impaired driving" considered a thread?					
How much is "increase in traffic volume" considered a thread?					
How much is "adverse weather conditions" considered a thread?					
How much is "incompetent road users" considered a thread?					
How much is the "physiological feeling of safety and security" considered a thread?					

Thank you so much for your time!

Appendix D SWOT and TOWS Questionnaire Local Road Users

Dear respondent,

This questionnaire is prepared for the master's thesis titled "Bridging the gap in traffic safety by using SWOT and TOWS analysis: A case study of Northern Cyprus" under the supervision of Dr. Mustafa Alas. **Please select only one item based on the most importance in each of the strategy groups in the tables below.**

Strategy No.	Strength – Opportunities Strategies	Selection
S1-O6	Well-established and effectively enforced traffic laws and regulations encourage road users to comply with the rules and regulations.	
S2-O4	Cheap car import policies and rational road tax implementation enable road users to purchase vehicles equipped with enhanced vehicle safety systems.	
S4-O3	Collaboration between government entities, private companies, and community organizations can enhance efforts to promote traffic safety, awareness, and consciousness.	
S6-O3	Technological advancements in road infrastructure enable efficient data collection which aids in developing data-driven decision-making systems.	

Strategy No.	Strength – Threats Strategies	Selection
S2-T3	Cheap vehicle purchases encourage the possession of personal vehicles which increases the volume of traffic.	
S3-T6	The psychological feeling of security due to coverage by insurance policy can cause road users to drive carelessly.	
S1-T2	Efficient enforcement of traffic regulations prohibits impaired driving.	
S6-T4	Utilizing advanced technological infrastructure such as sensors can help overcome dangerous road surface states due to adverse weather conditions.	

Strategy No.	Weakness – Opportunities Strategies	Selection
W2-O4	Improving public transportation and promoting non-motorized modes can enhance sustainable transportation.	
W5-O3	Low budget investment raises the necessity for the efficient use of limited sources which can only be performed by data-driven decision making.	
W1-O2	The qualification of road users can be improved through continuous training and education conducted by relevant authorities and joint stakeholders.	
W3-O1	Poor road infrastructure can be improved by incorporating innovative and modern technological solutions.	

Strategy No.	Weakness – Threats Strategies	Selection
W4-T1	Poor maintenance strategies result in ongoing repairs, leading to distracted driving.	
W6-T5	A high number of tourists and foreign students, accustomed to left-hand driving, pose a danger in areas with opposite driving directions.	
W2-T3	The unavailability of public transportation forces road users to use personal vehicles.	
W1-T5	Easy procedures and poor training practices for obtaining a driving license increase the number of incompetent road users.	

Thank you so much for your time!