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Bridging the Gap in Traffic Safety via SWOT and TOWS Analysis within QSPM Framework

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Abstract
The main focus of the current study is to enhance traffic safety policies by utilizing SWOT and TOWS analyses and to gain a comprehensive understanding of the challenges within traffic safety management systems. The authors have assessed several safety measures by utilizing the Quantitative Strategic Planning Matrix. This methodology combined expert evaluations with a methodical investigation to determine the best ways to improve traffic safety. According to the QSPM result, the application of sophisticated technologies in infrastructure (S6-T4), with a score of 5.88, is ranked second, behind traffic law enforcement (S1-O6), which has the highest score of 6.51. On the W2-T3 scale, the harmful consequences of inadequate access to public transportation on the usage of private vehicles received the lowest rating of 3.98. The study's findings are significant because urban planners and legislators can use them to determine which traffic safety interventions should be prioritized.
Keywords: Traffic Safety; SWOT Analysis; Tows Matrix; QSPM.

1. Introduction

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 released in 2018 indicates that the death rates in low-income countries are three times higher compared to high-income countries (Organization, 2019). According to a 2019 study by Mohammed et al., traffic accidents are now one of the top three causes of death worldwide, endangering lives as well as economies. By 2030, highway accidents are predicted to rank as the fifth most common cause of death (Rathee et al., 2023). According to a 2019 survey by Chen et al. (based on data from about 166 nations), the global economy would suffer road injury costs of US$1.8 trillion between 2015 and 2030, or 0.12% of GDP (annually) in taxes.

Over the past decade, there has been an increase in the total number of automobiles worldwide (Farooq et al., 2021). The increase in vehicle numbers and growth in urbanization has led to traffic congestion in urban centers (Amen & Nia, 2020; Aziz Amen, 2022) and subsequently to the occurrence of more RTAs. 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).

In a study conducted in Turkey, (Çelik & Oktay, 2014) employed multinomial logit analysis to identify the risk factors that impact the severity of traffic injuries. The findings indicated that the chance of fatal injuries is increased by several factors, including drivers with just primary education, drivers who are older than 65, drivers involved in single-vehicle accidents, accidents that happen on state, provincial, or federal highways, and the presence of pedestrian crosswalks. Additionally, evenings are the most time for traffic accidents involving private vehicles. On nearby city streets, fatal injuries decline when traffic lights are on or when the weather is clear.

According to (Singh et al., 2016), common driving mistakes and careless pedestrian behavior result in RTA-related fatalities or injuries. They did, however, stress the significance of road safety education. On Dry and wet highways, (Kassu & Anderson, 2019) examined RTAs that were classified as severe and non-severe. They made use of crash data from 2010 to 2014. They made use of four distinct sets of crash data that were collected from Alabama's four-lane rural roads and metropolitan highways. Severe crashes on wet pavements, non-severe crashes on wet pavements, severe crashes on dry pavements, and non-severe crashes on dry pavements were included in the four datasets. Except for non-serious collisions that happened on wet pavements, it was discovered that the rate of younger drivers involved in crashes was higher than the rate of older drivers.

The links between driver-related risk factors—also referred to as factors that lead to fatal road traffic crashes—and driving while intoxicated or under the influence of drugs were investigated by Valen et al. (2019). The data was gathered from Norwegian traffic crash reports and forensic toxicology databases. Calculations were made to examine the relationships between substance groups, driver-related risk factors, and associated impairment. The findings demonstrate a strong correlation between drug and alcohol use by drivers of cars or vans and driving while intoxicated, speeding, and not fastening seatbelts. Furthermore, there was a noteworthy correlation found between drivers of motorcycles and mopeds and not donning a helmet and having an expired driver's license. The study of (Brlek et al.,

2020) was on city RTAs involving youthful drivers. The goal of this study was to identify strategies for lowering the proportion of RTAs that are ascribed to inexperienced drivers. The authors suggested that acclimating kids to a world with moving cars at a young age might aid in their development into cautious, wise, and law-abiding adults. Education produces responsible drivers who reduce the number of collisions and injuries, which lowers the number of RTAs.

Wang et al. (2020) investigated the effects of several risk variables on RTAs. In addition to discussing the various similarities, such as the impact of collisions involving pedestrians and non-motor vehicles, the authors sought to determine the effect of various risk variables on RTAs in Shenyang, China. The three most repeated factors were time of year, administrative division, and age. More significantly, there appears to be some relative relevance of the factors' influence when it comes to non-motor vehicle and pedestrian accidents. In this paper, the author's investigation of 1,227 traffic accidents in Shenyang between 2015 and 2017 that resulted in injuries to pedestrians and non-motor vehicle drivers was presented. Age, season, and administrative division were the most prevalent contributing factors. The season was the most significant influencing element for pedestrian accidents, whereas the administrative division was the most significant influencing factor for non-motor vehicle accidents.

Road safety can be greatly enhanced by using frameworks like the TOWS matrix and SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis. They assist legislators and organizations dedicated to traffic safety in creating coordinated, targeted strategies to address obstacles and take advantage of possibilities in the country's and cities' transportation networks. These all provide the traffic safety groups with sufficient understanding. In the process, the TOWS matrix provides more development. To address our weaknesses requires a methodical examination of how our strengths might take advantage of opportunities and even neutralize threats Recent research has already shown that the tool may be used in the transportation industry to develop comprehensive strategy solutions in light of environmental and safety regulations (et al., 2023) and (Faturrahman, 2022). Their efficacy can also be assessed using QSPM. With the use of this instrument, a large number of strategy choices will be scored according to their respective viability and potential. QSPM is effective in managing traffic safety because, for example, (Alhassan et al., 2020) used it to assess management strategic choices. This report examines the traffic safety techniques that are currently in use, assesses their efficacy, and proposes new, workable approaches.

The article examines the tactics used in traffic safety today, evaluates their efficacy, and suggests fresh, workable approaches. In light of this, the debate aims to provide insights into the strategic management of traffic safety through current research and case studies, which will help lower accident rates and raise road user safety.

2. Methodology

SWOT and TOWS analyses along with QSPM were used in the current study to enhance traffic safety regulations. To ascertain the general evaluation of the use of traffic safety, questionnaires were distributed. Seven academic institutions' transportation specialists filled out the questionnaire. To rate the use of SWOT factors using the QSPM approach, respondents must provide a number between 1 (very strong) and 5 (very weak). The strategies were assessed from a professional perspective, making this rating significant. The effectiveness of these strategies was then evaluated through QSPM analysis results. This step was key in identifying the most practical and suitable strategies for traffic safety.

Data Collection and Questionnaire Preparation

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 were essential for understanding the different parts of the SWOT Analysis in a detailed way, especially for traffic safety.

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.

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 rus

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 1), it is important to mention that the factors listed were gathered with input from transportation experts in academia and experts in transportation agencies.

Table 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

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 by (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 and experts in transportation agencies. 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 2).

Table 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 increases the number of incompetent road users

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. The total weights for strengths and weaknesses and opportunities and threats each must add up to 1 (Austin & Hopkins, 2004).

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).

3. Results

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 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 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.

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 3 and 4) share reflects the application of this analysis for SO and ST strategies using both internal (IFE) and external (EFE) factors.

Table 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: 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

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 5 and 6) share reflects the application of this analysis for WT and WO strategies using both internal (IFE) and external (EFE) factors.

Table 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 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 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

4. Discussions

The Quantitative Strategic Planning Matrix (QSPM) analysis gave us valuable insights into how effective different strategies are for improving road safety and infrastructure. Through a comprehensive analysis of the total scores obtained in the Internal and External Factor Evaluation (IFE) matrices for each strategy, we were able to compare the effects of approaches categorized under Strengths, Weaknesses, Opportunities, and Threats (TOWS). S1-O6, which aimed to create strict and precise road traffic laws, received the highest score. This indicates that there is a fair amount of agreement regarding the need for strong legal frameworks, which are often important to guarantee increased traffic safety. The aforementioned rules, when appropriately implemented, have the potential to positively impact drivers' behavior patterns and potentially decrease the number of accidents that occur on the roads. S6–T4 is another highly effective measure, scoring 5.88. It involved utilizing modern technology, such as sensors, to improve road safety even in the presence of bad weather. This demonstrates the necessity of utilizing technology to prevent accidents caused by poor road conditions. Collaborative strategies, like S4-O2, have a very high score of 5.76, and their major actors concentrate on fostering relationships between the government, corporate sector, and community organizations. This implies that to address the issues related to road safety, all relevant parties—not just the government—will need to pool their resources. The tactics that received the lowest ratings were W6-T5, which deals with issues brought up by visitors and international students who are unfamiliar with local traffic laws. It received an average score of 4.01. This indicates that while this is an important issue, it might not have as much of an impact as alternative approaches that center on more extensive technology or governmental interventions. QSPM shows that establishing robust legislative frameworks and utilizing technology together have made a significant contribution to improving traffic conditions. Collaboration techniques receive higher scores, and all other social sectors must be involved for road safety to be effective. Based on these findings, policymakers and road safety stakeholders should prioritize funding for technology and legislative changes. Such strategies are likely to have the highest overall impact. Moreover, encouraging collaboration among various stakeholders could enhance the success of these safety measures.

The analysis provides a quantitative foundation for strategic decision-making in road safety, offering a guide for future initiatives. However, ongoing assessment and adjustment of these strategies will be necessary to ensure they remain effective under changing conditions. This simplified discussion translates the analytical findings into straightforward academic language, focusing on clear explanations and direct implications for policy and practices.

5. Conclusions

Our study emphasizes the need for a diverse set of strategies to enhance road safety, with strong support for robust traffic laws (S1-O6) and the growing recognition of the importance of advanced technology (S6-T4).

Strategies targeting driver education, road maintenance, and public transportation (W1-O2, W4-T1, W2-O5) contribute significantly, while economic and tourism-related factors (S2-T3, W6-T5) play crucial roles despite receiving less attention.

In conclusion, a holistic approach, combining law enforcement, technology, education, and infrastructure improvements, is essential for effective road safety.

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Conflict of Interests

The Author(s) declare(s) that there is no conflict of interest.

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