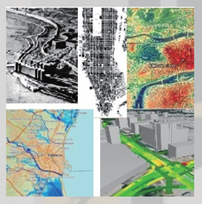
The Impact of Advertising Signage and Street Configurations on Traffic Safety

Authors：WAN-JU WU 1, CHIA-YING LU 2 and YUNG-CHUNG CHUANG
Affiliation：Feng Chia University



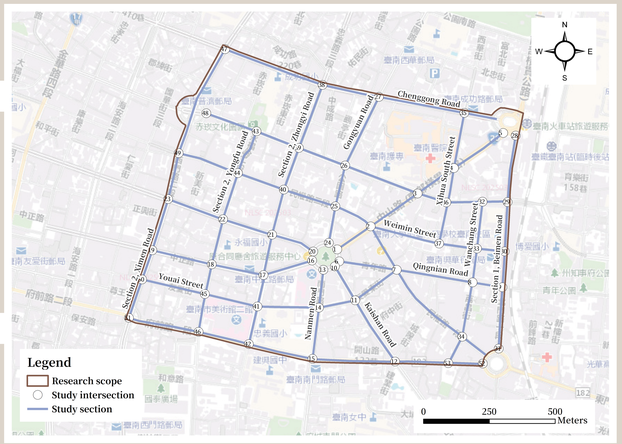
Introduction

Street configuration, as an essential component of urban space, influences not only the quality of the urban environment but also has a direct impact on traffic safety and public order. Among these elements, advertising signage has become a widely used type of streetscape feature due to the rapid growth of commercial activities. However, dense or poorly designed signage can create various problems, such as visual pollution, a sense of spatial congestion, and distractions for drivers and pedestrians, thereby increasing the potential risk of traffic accidents.

Therefore, this study examines how advertising signage and street configuration af-fect traffic safety. By establishing evaluation indicators and applying quantitative scoring methods, the study compares differences among various road segments and intersections within the research area. Both experts and the general public participate in the scoring process, and the results are spatially visualized to identify locations that may pose higher risks. These analytical findings serve as a basis for future improvement strategies.

Area of Study

This study focuses on the West Central District of Tainan City as the research area, which features a complex street layout and a high density of advertising signage. The study targets the district's most commercially active sections and selects 20 representative street segments as the research road sections, along with 53 intersections formed by these segments as the research intersections. Through the three analytical dimensions of points, lines, and areas, this study examines the intersections, road segments, and road network within the research area, aiming to provide assessment indicators and recommendations regarding the impacts of advertising signage and road characteristics on traffic safety.



Indicator Quantification and Methods

This study further divides the roadway network, road segments, and intersections into multiple detailed indicators.

road network	Intersection Density	The designated road segments and intersections defined in this study are used as the basis for calculating intersection density.
	Traffic Efficiency	
Intersec-tions	Signalization Rate	Intersection signalization is classified into four types: fully signalized, time-restriced signalization, flashing yellow/red lights, and no signalization. Data from the "Tainan City Public Pipeline GIS – Traffic Signal Sys-tem" are used to identify the signal types for each intersection.
	Accident Rate	Accident hotspot data from the "Traffic Safety Dash-board" are used to collect accident records for each intersection from 2021 to 2025, and their average value is calculated..
Road Segments	Signage Density	Field surveys are conducted to count the number of signs along each road segment, while ArcGIS is used to calculate the length of each segment.
	Visual Impact Ratio	Field surveys are conducted using a motorcycle dashcam, riding each road segment at 30–40 km/h and capturing one image per minute. Advertising signs are marked in red in Adobe Illustrator, and ImageJ is used to calculate their area ratio. The average value for each road segment is then used as the baseline for later analyses.
	Visual Variability	Using the images generated during the visual impact analysis, variance calculations are performed to assess the degree of variability in the distribution of advertising signage along each road segment.
	Road Markings	Field surveys are conducted to document and classify the different types of road markings.
	Road Width	ArcGIS is used to calculate the width of each research road segment.

Subsequent steps and methods

Questionnaire Survey	A questionnaire survey is conducted with experts, scholars, and the general public to obtain quantitative evaluations of each indicator, ranging from "very low impact" to "very high impact." These scores serve as reference data for the subsequent analysis.
Indicator Classification and Mapping of Scores	The quantitative indicator scores provided by the researcher, experts, and the public are compiled and classified to evaluate the research area, road segments, and intersections. ArcGIS is then used to map the scoring results from each respondent group.
Questionnaire Survey	combines the scores from the researcher, experts, and the public, and uses ArcGIS to create total score maps for the study area, road segments, and intersections, showing the spatial distribution of overall results.

Indicator Calculation Results

Road Segments

road name	Signage Density (pcs/100m)	Visual Impact Ratio(%)	Visual Variability (%)	Road Markings	Road Width(m)
Zhongshan Road	14.93	10.63	46.52	Equipped with motorway	19
Zhongzheng Road	15.98	20.66	43.17	Two or more lanes without separate lane markings for fast and slow lanes	21
Gongyuan Road	10.49	14.99	20.26	Two or more lanes without separate lane markings for fast and slow lanes	15
Youai Street	6.27	7.73	32.13	Roads with lane dividers or lane restriction lines	7
Section 1, Beimen Road	20.42	23.80	18.51	Two or more lanes without separate lane markings for fast and slow lanes	16
Section 1,Minsheng Road	16.48	12.78	38.74	Two or more lanes without separate lane markings for fast and slow lanes	21
Section 2, Minzu Road	12.10	19.57	4.46	Two or more lanes without separate lane markings for fast and slow lanes	13
Section 1, Minquan Road	22.62	20.12	16.31	Equipped with motorway	11
Section 2, Minquan Road	18.21	20.22	33.45	Roads with lane dividers or lane restriction lines	14
Section 2, Yongfu Road	11.90	14.07	5.15	Equipped with motorway	14
Chenggong Road	14.49	16.63	69.34	Lanes with separate lane markings for fast and slow lanes	21
Section 2, Ximen Road	18.91	23.10	67.24	Lanes with separate lane markings for fast and slow lanes	22
Xihua South Street	7.12	10.30	69.63	Roads without lane markings, lane separation lines, or lane separation restriction lines	16
Section 1, Fucian Road	14.25	12.88	44.94	Roads without lane markings, lane separation lines, or lane separation restriction lines	21
Section 2, Zhongyi Road	14.41	11.64	41.19	Two or more lanes without separate lane markings for fast and slow lanes	13
Qingnian Road	22.78	16.17	22.88	Equipped with motorway	11
Nanmen Road	7.63	6.70	27.36	Equipped with motorway	14
Kaishan Road	17.97	17.07	41.12	Equipped with motorway	14
Wanchang Street	8.41	4.96	18.88	Roads with lane dividers or lane restriction lines	21
Weimin Street	7.51	6.59	35.80	Roads with lane dividers or lane restriction lines	22

Road Segments

intersection number	Signalization Rate	Accident Rate (Number of accidents per year/365)
1-3,5-7,9-11,13,14,16,17,19-22,24,25,27-41,43-45,47,50,52,53	Three-color light signal or flashing light signal (In the past, multiple traffic accidents occurred in the study area, prompting the local government to strengthen signal installations on major and minor roads. According to the "Tainan City Utility Mapping—Traffic Signal System" data, all 53 intersections in the study area are equipped with complete signal systems—using three-color signals during the day and switching to flashing mode at night.)	0.00
4		0.04
8		0.02
12		0.07
15		0.04
18		0.02
23		0.06
26		0.05
42		0.04
46		0.03
48		0.07
49		0.05
51		0.08

Road Network

Intersection Density (Number of intersections /km²)	37.78
Traffic Efficiency (Number of intersections / Number of road segments studied)	2.55

After completing the above calculations, the results will be evaluated by the researcher, experts, and the public to assess the hazard levels of the road network, road segments, and intersections.

Results and Conclusions

After integrating the evaluations from the researcher, experts, and the general public, clear differences in risk distribution within the study area were observed. Among the road segments, Section 1 of Beimen Road showed the highest risk score (20.8), mainly due to its dense signage and strong visual distraction. In contrast, Nanmen Road received the lowest score (11.6), reflecting its simpler environment and lower visual pressure.

For intersections, higher-risk locations were concentrated along Section 2 of Ximen Road, where accident records are also more frequent. The intersection of Section 1 of Beimen Road and Kaishan Road showed the highest perceived risk, likely due to heavy traffic or complex geometry.

Overall, the study area received a composite score of 13.8 out of 40. Although many road segments have high signage density, the overall score remained relatively low because most intersections had full signalization and very few recent accidents, reducing the risk level in the intersection category. As a result, road-segment visual factors contribute more to perceived risk, while intersection safety conditions are generally adequate.

Based on these findings, improvements should prioritize road-segment issues such as signage management and road-marking enhancement—particularly along high-scoring segments like Section 1 of Beimen Road. Potential strategies include reducing signage density, standardizing sign heights, or limiting oversized signboards to lessen visual impact.

For Section 2 of Ximen Road and the high-risk Beimen–Kaishan intersection, targeted reviews of sight lines, signal phases, and turning-lane design are recommended, followed by appropriate adjustments such as signal timing optimization.