

Recent Theoretical Researches on Transportation Safety Planning

ABDEL-ATY M

Department of Civil Engineering, California American University, New York, 12201, USA

Abstract: In order to enhance the transportation safety management, basic ideas and a theoretical framework of transportation safety planning were put forward and their features were refined. Then, from the strategic and tactical aspect, a comprehensive review for the state of the art and achievements in TSP in United States was presented, followed by several prominent research topics and technical challenges. Finally, combined with current situation of transportation safety in China, countermeasures for effective improvement in the researches and practice of TSP were put forward. The results show that TSP has been among the cutting-edge fields in transportation researches in the world, which requires the proactive safety measures to be incorporated into both development and operation of transportation system and emphasizes safety prediction and planning from both macroscopic and microscopic level. It is promising for a bi-directional revolution for traditional transportation planning practice, transportation safety engineering and its management.

Keywords: Traffic engineering; Transportation safety planning; Review; Crash prediction model

1. Introduction

The rapid growth of the scale and motorization of road traffic in the United States has brought about severe traffic safety problems. For the new situation and new requirements of road traffic safety development, it is very important to explore advanced traffic safety management theory and establish a scientific traffic safety management system. Traditional traffic safety analysis methods can be divided into 4 stages, namely black spot identification-safety diagnosis- safety improvement -effect evaluation. Its operation is simple and widely used, but there are some defects: ① This method is not predictive. When the traffic accident has caused serious casualties and property losses, and then take corresponding remedial measures, which will lead to higher social and economic costs; ② Its improvement measures have limitations; ③ Even if the corresponding improvement plan is found, but often because the cost of reform is too large to be implemented. In order to overcome the above limitations, it is necessary to make a forward-looking and overall consideration of the safety level of the transportation system in the planning stage. At this stage, the focus of the traffic planning method is to optimize the supply and demand structure and ease traffic congestion, which lacks the key technology for the effective prediction and measurement evaluation of the traffic safety level. However, the effect of road safety level of city planning, land use types, road network layout and travel characteristics and other non-road facilities and micro factors, we must consider the security issues in the planning stages.

Wang Yan and others [1] introduced "The initiative road traffic safety planning" for the first time. He suggested that the security issues should be considered as the main planning objectives and evaluation indicators in such stages as urban planning, land use, integrated transportation planning and road network planning. Lu Huapu and others [2] put forward the definition, compiling principle and compiling process of "road traffic safety management plan". This plan aims to formulate scientific and reasonable road traffic safety management program, in order to improve the road traffic safety management level and improve the road traffic environment.

This paper puts forward the concept and framework of traffic safety planning, and refines its characteristics. It explains the research context and main results of the United States traffic safety planning from two aspects of "strategy" and "tactics". Finally, the research hotspots and technical difficulties of security planning are analyzed.

2. The Concept of Traffic Safety Planning

The principle of traffic safety planning is to take the initiative traffic safety master. The planning of traffic safety level of traffic safety as the main planning objectives and evaluation indicators, and considering the factors of regional characteristics, network characteristics, travel characteristics, traffic organization, traffic characteristics, road conditions, vehicle condition and driving behavior of various safety influence. The traffic safety plan makes and implements the corresponding strategy and the plan around the security

goal, thus reduces the potential risk of the accident in the source. The new traffic safety planning is an important complement and innovation to the existing traffic planning methods, which aims to integrate safety into the existing traffic planning, so as to realize the organic integration of efficiency and safety. In combination with the traditional traffic planning process [3], the traffic safety planning framework process is shown in Figure 1.

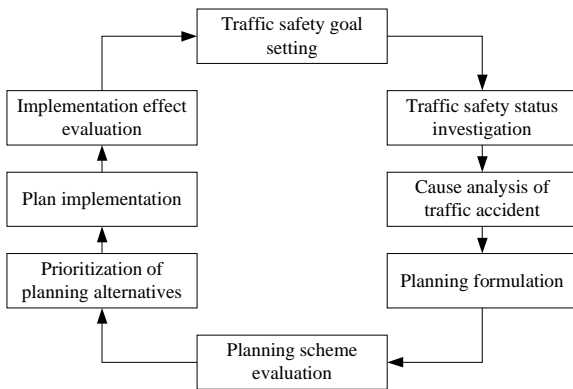


Figure 1. Flowchart for Transportation Safety Planning

Compared with the traditional methods of traffic safety analysis, traffic safety planning has three key characteristics:

Initiative. Active safety is the essential characteristic of traffic safety planning. That is, to prevent accidents from occurring before the accident.

Whole situation. Traffic safety planning runs through the whole process of urban planning, land use, integrated transportation planning, road network planning, road design, traffic design, road construction, road operation and traffic organization management; The traditional traffic safety analysis focuses on the road environment, road conditions, vehicle performance and driving behavior of the micro level factors, and the traffic safety plan emphasizes the prediction from macroscopic to microscopic analysis of the security situation and development trend.

Metrology. Achieve quantitative settings for security goals; Quantitative prediction of safety level during planning period; Cost-effectiveness analysis of safety effects of various planning alternatives.

In a word, the change from the traditional traffic safety engineering to the traffic safety planning is to realize the following goals: Let each stage of transportation planning include quantitative indicators of safety level and safety improvement process; Let traffic managers fully understand the level of safety and safety improvement effect at all levels; Let each traveler know the accident risk of each alternative path in advance.

3. Present Situation of Traffic Safety Planning Research in the United States

This section mainly explains the research context and main results of the United States in the field of traffic safety planning from two aspects of strategic planning and technical support. In order to effectively improve the road traffic safety situation, the United States has formulated a series of traffic safety strategic plans, the specific contents are shown in table 1.

Table 1. Strategies for Traffic Safety Improvement in USA

Strategic planning name	Brief description
Strategic Highway Safety Plan, SHSP[4]	From late 1996 to early 1997, plans were made to reduce the number of deaths caused by accidents from 5000 to 7000; in 2003, a new safety improvement target was put forward; By 2008, the mortality rate of vehicles per million kilometers should not exceed 1.
The Transportation Equity Act for the 21st Century, TEA-21[5]	Promulgated at the end of twentieth Century, and for the first time expressly required the Ministry of communications and the Urban Planning Bureau to take road traffic safety as an important factor into the whole process of traffic planning"
Safety, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users, SAFETY-LU[6]	2005 approved road safety improvement item (Highway Safety Improvement Program, HSIP). The provisions of each state shall be combined with the establishment of the state road safety strategic plan for SHSP research results and their own situation, and mandatory traffic planning of various departments will consider each security level and step into the planning of the traffic

4. Research Hotspots of Traffic Safety Planning

Reducing the risk of accidents and reducing the severity of accidents are the two core objectives of traffic safety research. Accident prediction model to various risk factors and the safety level of human - vehicle - road traffic related facilities in, and predict the safety level of various factors in the different values and combination conditions, thus effectively improve the safety level of the improvement measures. The commonly used traffic accident prediction methods include regression analysis, time series forecasting, grey prediction and neural network prediction, and so on [7]. In contrast, the statistical regression model has always been the dominant factor in traffic safety analysis, because the accident prediction model requires a clear evaluation and correction of the safety effects of the various factors. The research of accident prediction model has been carried out in many ways, as shown in table 2.

Table 2. Research Reports, Manuals and Tools for Traffic Safety Improvement in USA

type	Main outcome	Brief description
Research Report	Integrated Safety Management Process.NCHRP 501[6]	Guidance on integrated management of traffic safety plans for implementing agencies.

	Incorporating Safety into Long-rang Transportation Planning, NCHRP	It was first proposed how to integrate traffic safety into the long-term transportation planning process.
Guide stan- dard	Highway Safety Manual,HSM[7]	Road design guidelines are the main basis for evaluating and predicting the safety effects of various road facilities.
	Model Minimum Uniform Crash Criteria.MMUCC[8]	United Nations standardized guidelines for incident data logging and management.

However, the traditional accident prediction models are aimed at single road elements, that is to say, which can only reflect the security characteristics of a single type. Which mainly due to the limitations of typical regression models for modeling similar objects. Traffic safety planning puts forward the requirement of effective prediction of the safety level of the area or road network during the planning stage.

5 . Conclusions

This paper systematically expounds the basic concept and development framework of traffic safety planning; This paper explains the research context and main results of the United States traffic safety planning from two aspects of strategy and tactics; Finally, this paper summarizes the research hotspots and technical difficulties of traffic safety planning at the present stage. The new concept of traffic safety planning has made rapid progress, but it is still in the preparatory stage. On

the one hand, there are still some key scientific problems to be solved for road traffic safety. On the other hand, there are many problems that need to be solved from theoretical research to practical application.

References

- [1] WANG Yan, YANG Xiao-guang. System Framework of Safety Conscious Planning[J].System Engineering,2006, 24(1):30-35.
- [2] LU Hua-pu, ZHOU Qian, XU Wei. Research on the Theory and Its Application for Road Traffic Safety Management Planning[J].Central South Highway Engineering,2006 , 31(3):67-70.
- [3] American Association of State Highway and Transportation Officials. Strategic Highway Safety Plan[R].Washington DC; AASHTO, 1998.
- [4] BAHAR G,MASLIAH M,MOLLETT C, et al, Integrated Safety Management Process[R].Washington DC: Transportation Research Board , 2003.
- [5] WASHINGTON S, SCHAI_KWYK I A , MITRA S,et al. Incorporating Safety into Long-range Transportation Planning[R].Washington DC:" Thrsportation Research Board .2006.
- [6] HERBEL S, MEYER M D, KLEINER B, et al. A Primer on Safety Performance Measures for the Transportation Planning Process[R].Washington DC: Transportation Safety Planning Working Group, 2009.
- [7] WASHINUTON S, SCHALKWYK I V, YOU D, et al. PLANSAFE: Forecasting the Safety impacts of Sociodemographic Changes and Safety Countermeasures[R].Washington DC: Transportation Research Board , 2010.
- [8] GUO Zhong-yin, FANU Shou-en. Road Safety Engineering[M].Beijing: China Communications Press 2003.