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Comprehensive Traffic Management Strategy Based on Risk and Safety Assessment

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Abstract: *The comprehensive management of urban traffic can be summarized into two parts: traffic system management and traffic demand, and the core problem to be solved by traffic management is traffic safety.The measurement indicators of traffic safety problems are summarized in two aspects: urban traffic risk and urban traffic accidents, and the traffic system and traffic demand management are analyzed in depth, and the corresponding management strategies are obtained. Regarding risks and accidents, first explain the theoretical model of risk generation, based on this, give the model and method of risk management, and finally make the enlightenment of risk management;Summarize the development situation of traffic safety that is most related to accidents, then analyze the main characteristics and problems of traffic accidents, and make enlightenment of accident analysis;When discussing traffic system management and traffic demand management, briefly summarize their connotations, and then summarize the basic content of the two.Finally, draw several strategies of traffic management.*

Keywords: *transportation system, traffic demand, risk, accident*

1. Introduction

The comprehensive and rapid development of urbanization constantly breaking the upper limit of the city's existing road carrying capacity, gradually moving toward the evolution of traffic accidents. It is true that in the face of the above-mentioned contradictions and problems, the continuous expansion of urban space have buffered the problem of traffic saturation,but the disadvantages in the space and time dimensions brought by the excessive urban space have made the traffic planning in big cities cannot blindly be oriented towards outward expansion.

Therefore, relevant strategies of traffic management and control have become the main means to ensure traffic safety.The main problems of traffic management are the traffic accident risks, the traffic accidents and the traffic congestion [1]. In addition, with the principle of "self-contained system and overall planning" in the big city planning [2], the comprehensive management model of the metropolitan transportation system has become a optimized method to solve the main problems. Therefore, this article first briefly introduces urban traffic safety risks and traffic accidents, discusses their respective coping strategies and management methods, and then briefly proposes and summarizes systematic traffic management strategies based on the discussion of traffic safety risks and accidents.

2. Overview of urban traffic risks

2.1. Risk composition

The three concepts of risk, hidden danger, and accident have homogeneity and are manifestations in different time periods. The hidden dangers and risks are at the stage before the accident, which have certain uncertainty.Hidden dangers are potentially unsafe sources that may cause accidents. Risks are the uncertainties that negative traffic incidents may occur, which are specifically expressed in the probability of occurrence. Among them, negative traffic incidents can be reflected as the unsafe state of people, objects, and the environment according to the dominant party. The superposition of the above three manifestations can constitute risk states of different hazard levels, mainly including high-risk states and extremely high-risk states. An accident is a traffic problem that has already occurred and exists, which can be regarded as a macroscopic manifestation of the effect of risk on things [3].

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2.2. Theoretical management method of risk

(1) Domino theory

The main idea explained by this theory is: the emergence of emergencies is not an isolated incident, but the result of the "chain reaction" produced by a series of events. When applied to traffic safety risk avoidance, its positive significance lies in: If you remove any link in the chain event, it can effectively inhibit the subsequent chain reaction and control the generation of adverse accidents.

(2) Unexpected release of energy theory

The core point of the theory is that an accident is an abnormal release of energy, and the transfer of abnormal energy is the inducement of the accident. Therefore, the method to analyze the causes of traffic safety accidents should be to find out the total energy source of a certain traffic system where the accident occurred.Then find the persons who may be subject to abnormal energy release and are vulnerable to injury in the system one by one. Finally find a way to prevent the abnormal release of energy.

2.3. The basic model of urban traffic risk management

According to the basic logic of the time sequence of events, the structure of traffic risk management is decomposed into three modules of "identification, evaluation, and management".

(1) Risk identification

Risk identification is the earliest part of risk management, and its purpose is mainly to determine the source of risk and the evaluation indicators of each risk. The first step is to classify and measure risks. Urban traffic risks can be classified in various ways according to different standards.For example, According to the "Urban Road Intersection Planning Regulations" of the Ministry of Construction, Lu Jian designed a safety diagnosis table to identify the risk sources of road intersections. Qin Liyan uses the data of traffic accidents on the Jinan-Qingdao Expressway to statistically analyze the risk sources that affect the safety of expressway operations from the aspects of people, vehicles, road environment, weather, and traffic volume.

(2) Risk assessment

The core form of risk assessment is a risk assessment matrix, which is obtained after inputting various traffic risk assessment indicators. According to the probability that the risk may occur, it is divided into four levels A, B, C, and D, corresponding to the probability of occurrence of different sizes. The risk assessment matrix is roughly divided into diagonal directions, and traffic safety risks can be roughly divided into three categories: acceptable level, medium level and unacceptable level, so as to formulate corresponding management and control strategies for different risk levels.For example,Abdel-Aty's used the **Ordered probit** model to analyze the accident data of specific road sections, signalized intersections and highway toll plazas in Central Florida to predict the severity of driver injuries. William modeled the impact of severe weather in the road network, and classified the severe weather conditions as the main uncertain component in the road network, and generated the travel time function of the section to reflect the impact of uncertain components.

(3) Risk management

The main body of risk management lies in the policy-making managers, mastering certain theoretical analysis methods and calculating risk models. Therefore, the goal of managing and controlling risks is to reduce losses from the source as much as possible, in order to reduce the actual losses caused by risks.

(4) Enlightenment of risk management and control

Firstly, starting from a more abstract concept.Through the use of existing theories to identify and recognize risks qualitatively, and then quantitatively build models to predict risks from risk assessment, finally formulate management methods and determine management objectives, providing more diversified ideas and more specialized guiding ideology for the initial stage of systematic traffic management.

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3. Problem analysis and main characteristics of traffic accidents

3.1. Spatial and temporal distribution of accidents

In terms of time dimension, the coldest months in the big cities (February in the northern hemisphere) have the lowest number of traffic accidents throughout the year. It is speculated that the overall traffic demand may be affected by the temperature and the overall traffic demand is the lowest.Judging from the severity of the accident, the fatality rate of traffic accidents is the highest during the period from 0:00 to 7:00 in a day.

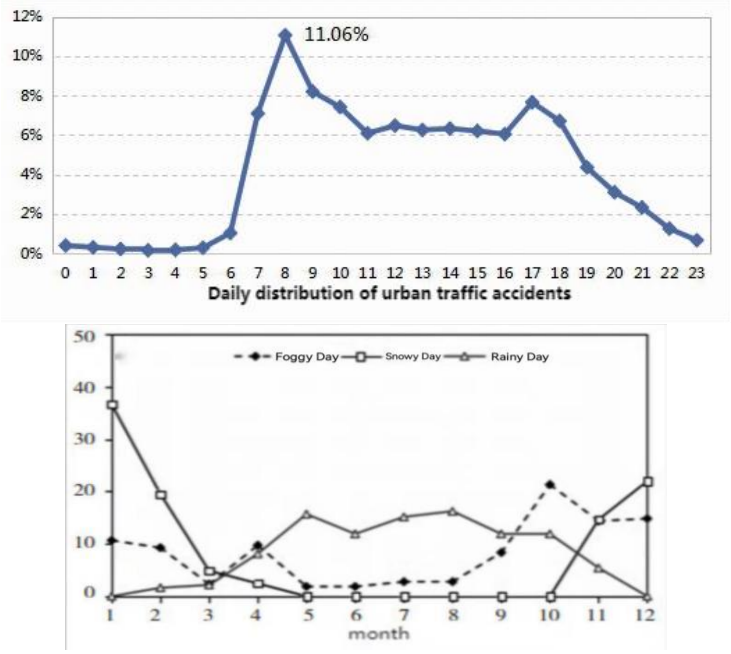

Figure 1: Annual distribution of traffic accidents under different weather conditions

In terms of spatial dimensions, the road safety pattern in areas with poorer facility construction and management is more severe in general, and the number of traffic accidents is also higher; Moreover, in the distribution of road sections, the main road has a higher fatality rate than the secondary road.

3.2. Causes and main distribution of traffic accidents

According to the investigation, the main execution subject of large-scale urban traffic accidents is motor vehicle drivers, and the main body of injury is pedestrian or non-motor vehicle drivers. The corresponding main accident is motor vehicle colliding with pedestrian or non-motor vehicle.

3.3. Analysis and Enlightenment of Traffic Accidents

According to the investigation and analysis of the above phenomenon, the core problem of traffic accidents is **motor vehicle overspeed**. According to the power model, the average speed increases by 5%, and the total number of accidents and fatalities increase by 10% and 20% respectively.

The issues worthy of increased attention include paying attention to vulnerable groups and minimizing their vulnerability to injury as much as possible.Reducing the frequency of accidents in local locations. Controlling driver behavior and improving vehicle active safety technology.

The fundamental reason for the frequent occurrence of traffic accidents lies in the insufficient guarantee of the system and mechanism, including the coordination and control of various departments, the initial safety planning and construction, the optimization of accident record tracking.

From the simple analysis of the above-mentioned safety accidents, the enlightenment we can get is to strengthen the speed limit management of motor vehicles and optimize the fault-tolerant design of the road environment, and cooperate with the related measures of systematic traffic control, in order to manage traffic safety issues more effective.

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4. Overview of comprehensive traffic management

Taking into account the long-term nature of traffic management, which is a complex system project. It draws on the long-term practical experience of traffic management at home and abroad,and proves that starting from the overall traffic system, based on the overall safety and efficiency to coordinate the conflict between control measures and traffic resources such as people, vehicles, roads, etc.However, from the perspective of the four development stages of traffic management, the introduction of traffic demand management has caused a fundamental change in the entire traffic management system and concept.In short, the traffic system management is the management of the traffic that has occurred; the traffic demand management is the management of the traffic that will occur[4]. Therefore, based on the traffic accidents that have occurred and the potential traffic risks that haven't occurred before, separately discussed the research strategies of the comprehensive management of the metropolitan transportation system and the coordinated demand of traffic management.

4.1. Transportation system management

(1) Connotation of comprehensive management of transportation system

The core of the comprehensive management of the transportation system is multi-level and overall planning and management.The two meanings of the comprehensive management of the transportation system are the comprehensive in the time dimension and the comprehensive in the space dimension. The former is to do a good job of management comprehensive under the entire complete process system of planning, construction, and operation. The latter is to coordinate the unified operation and management of the primary and secondary areas of the city, so as to give play to the scale effect of the system and achieve standardization.

(2) Contents of comprehensive management of transportation system

Traditional domestic and foreign transportation system comprehensive management experience models are mainly divided into the following categories: standardized management using advanced concepts and science and technology; allocation by various departments coordinated large-scale management; economic management based on toll levers.

4.2. Collaborative demand management of urban transportation

The expansion of urban scale and the increasing complexity of its internal structure have made diversified new transportation methods, management concepts and technical means gradually integrated into the urban transportation system. In fact, "comprehensive" is not the same as linear superposition. Therefore, the urban transportation system management structure in the era of big transportation should be characterized by the goal of achieving "coordination" of system elements. Under this goal, there are three main requirements for collaborative management of urban traffic: the coordination between the transportation system and urban land, the coordination between different transportation subsystems, and the coordination between traffic management and construction goals.

5. Comprehensive development strategy of urban traffic management

Comprehensively considering the specific problems and management concepts of the above-mentioned traffic management, the following development strategies for traffic management are derived:

5.1. Fully implement vehicle speed limit management

Overspeed is the primary cause of urban road traffic safety problems. Based on speed limit management, it can effectively avoid a large number of urban traffic risks and make urban traffic management effective at the safety level. The key to the speed limit problem is the balance of transportation timeliness. Do a good job in the study of the relationship between speed limit and traffic flow rate and driving speed, determine the relationship between speed limit and transportation timeliness, speed and road linearity and energy consumption pollution, so as to determine the specific speed limit value. Then select appropriate indicators for the speed limit policy for safety evaluation, generally taking transportation timeliness and transportation safety as indicators, breaking through and adopting new speed control technologies [5].

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5.2. Emergency evacuation management for emergencies

One of the typical characteristics of emergencies is the incompleteness of information.From the perspective of risk analysis, potential harm is large, and the probability of occurrence is also uncertain. Therefore, separate the emergencies from the typical traffic risks and accidents and specifically analyze the corresponding research strategies, which can alleviate the heavy losses suffered in the traffic management problem to a certain extent.

There is a certain difference between traffic flow in emergencies and traffic flow under normal conditions. The short-term traffic demand in the traffic flow is large, and the entire evacuation process is in a state of over saturation. The driver is more likely to have negative effects.Emotions and fatigue state, which lead to extremely unstable traffic flow in this situation, and accidents may continue to occur during the evacuation process, causing a chain reaction [6].

Based on the characteristics of the above-mentioned traffic flow, emergency traffic demand management needs to start with the control of traffic demand and take measures to manage traffic under special circumstances. The first is the strategy of directional evacuation. Secondly, we should adopt a public transportation priority evacuation strategy. The last is the system management strategy, including three dimensions: point, line and surface.

5.3. Collaborative demand management for public transport priority

Public transport priority is a systematic overall planning, from transportation system planning, road network design, construction and operation management, use cost control and other aspects to enhance the competitive advantage of public transportation relative to cars.

The two major problems that currently exist in the public transportation system are the low operating efficiency and service level. Therefore, the improvement of the attractiveness of public transportation needs to aim at improving the efficiency of transit and improving the service level. For example, optimizing the public transportation network and constructing dedicated bus rapid transit roads. Improving the infrastructure construction of bus stations to large-scale destinations, and the fare system and fee subsidies [7]. In turn, comprehensively improve the service level of the public transportation system. In addition, formulate and implement suppression strategies for cars so as to proactively realize cars.

6. Conclusion

The development of modern transportation systems is more complex and comprehensive, a large number of transportation methods and problems coexist, and traffic monitoring technology and management concepts are becoming more advanced and mature. Simple separation of management is no longer applicable. Systematic traffic management is to pay full attention to the continuity and integrity of the traffic system in time and space. All links are interconnected and affect each other. After determining the overall development and management goals, coordinate the development of management strategies for each part of the link based on long-term goals, in order to optimize the operation of the transportation system and maximize the realization of overall benefits.

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