ROAD TRAFFIC SAFETY ANALYSIS UNDER RAPID MOTORIZATION OF CHINA

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Abstract: This paper firstly analyzes the general situation of road traffic safety in China, which specifies the key points on improving traffic safety performance. It then analyzes the problems existing in traffic safety, based on large amounts of actual data. Issues have been discussed on traffic safety consciousness of traffic participants including motor drivers, non-motor vehicle users, pedestrians as well as old folks. The relationship between mixed traffic environment and traffic accidents is also well analyzed. An idea to establish the safety association for motor drivers is put forward aiming at helping and educating motor drivers and the related managers timely and effectively. The idea of constructing socialized propagandistic network for transport safety is also put forward to popularize traffic safety knowledge. Finally, a general framework of safety managerial system has been advanced in order to prevent traffic accidents effectively.

Key Words: traffic safety, traffic accident, safety management

1. INTRODUCTION

Economic expansion promotes urbanizing process. However, traffic jam, traffic pollution and traffic accident caused by the accumulation of mass population have become the all-pervading problems hindering the social development both in developed and developing countries. Since 1980's, Chinese road transport has been in the stage with high vehicle increase and poor development of safety guarantee systems. Under the rapid increase of population in urban areas, various vehicles as well as daily traffic volume aggrandize sharply. This thus causes the serious traffic jam in many Chinese big cities. Moreover, the poor facilities in road transport, such as the lag in road construction and safety establishment, the mixed traffic environment and the impertinent but familiar behaviors of traffic participants lead to the frequent and severe road traffic accidents.

2. SITUATION AND CHARACTERISTICS OF TRAFFIC SAFETY IN CHINA

In 1986, Chinese government established its first road traffic management institution, Traffic

Management Bureau (TMB) under the Ministry of Public Security. TMB has the responsibility to manage the national road traffic, including traffic safety, traffic order as well as the management of motor vehicles and drivers. Since then, a lot of measures have been taken to improve the traffic situation. As a result, the death rate per ten thousand kilometers declined year after year as shown in Figure 1 (TMB, 1999). However, like most developing countries in the world, China has tremendous difficulties in satisfying its increasing transport demand because of the instability in road traffic resources. With the rapid increase of motor vehicles, the contradiction between rapid-inflated traffic demand and under-developed road construction has become more and more extruding (Table 1) in recent years. This thus leads to more severe traffic accidents (Figure 2).

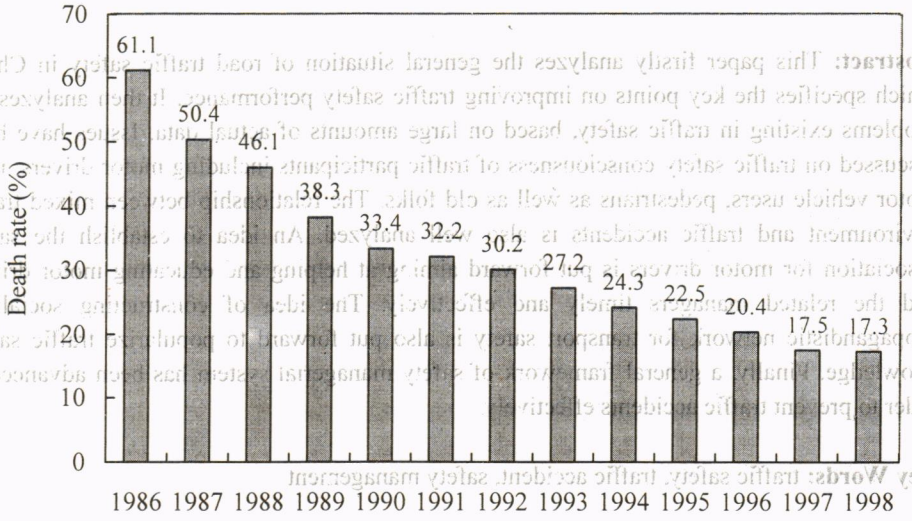

Figure 1. Death rate per ten thousand vehicles, 1986-1998

Table 1. Length of highway, registered motor vehicles and licensed drivers, 1990-1999

Year	1990	1995	1996	1997	1998	1999
Length of highway (Thousands)	1028.3	1157.0	1185.8	1226.4	1278.5	1351.7
Registered motor vehicles (Thousands)	14762.6	31797.8	36096.5	42093.2	45071.0	56743.7
Licensed drivers (Thousands)	16358.5	35015.2	42752.6	52067.9	59916.3	67274.9

Source: 2000 Year Book of China Transportation and Communications, 2000

As shown in Table 1, the length of highway was 1028.3 thousand kilometers in 1990 and 1351.7 thousand kilometers in 1999, with an increase of only 31% in the past decade. However, both the registered motor vehicles and the licensed drivers increased about 3 times in the same period. It is noted that China is a country with over 500 million bicycles and other non-motorized vehicles. In urban areas, it is very popular that different kinds of vehicles run on the same roadway without any partitions. It's difficult for Chinese government to improve its traffic safety (Mao, 1999).

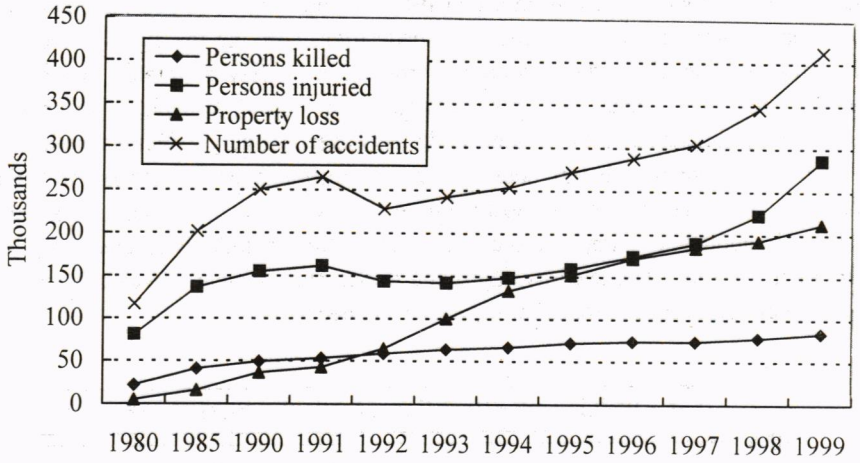

Figure 2. Number of accidents, persons killed or injuried, property loss only, 1980-1999

As shown in Figure 2 (CATC, 2000), the number of accidents, the persons killed or injured and the property loss caused by road traffic accidents increase rapidly in recent years, which shows the severe situation in road traffic safety.

2.1 Worse Traffic Environment for Old Folks

As shown in Table 2 (TMB, 1994-1999), the number of persons killed at and above the age of 60 was over 10% yearly during 1988-1998, which shows that the traffic situation for old folks is becoming more and more serious.

Table 2. No. of persons killed at and above the age of 60, 1988-1998

Year	Killed	%
1988	5876	10.8
1989	5242	10.4
1990	5338	10.8
1991	5960	11.2
1992	6319	10.8
1993	6902	10.8
1994	6815	10.3
1995	7740	10.8
1996	7992	10.9
1997	8441	11.4
1998	9165	11.7

According to the proportion of the number of persons killed at and above the age of 60, China has already been an agedness country. The primary traffic modes for the elderly are bicycling, public transport and walking. As shown in Figure 3, it is easy to see that the leading traffic modes for old folks in Chinese cities are bicycling and walking. With the decline in physical

conditions, old folks become less unresponsive to the outside world. On the other hand, there are neither cab nor cockpit for cyclists and pedestrians. Among the cyclists, most old folks tend to use old bicycle without good performance on safety guarantee under emergency situation. This thus makes old folks vulnerable in traffic, especially in mixed traffic environment. Public transport is a safer mode. However, it's very difficult for old folks to go out by bus because of the bus shortage and its mismanagement. Apparently, the above situation for old folks transport in most Chinese cities will remain the same for a long period. One feasible approach to improve the traffic safety for old folks is to create a good traffic environment for old folks, such as improving traffic management, developing public traffic and constructing the special roads for bicyclists and pedestrians

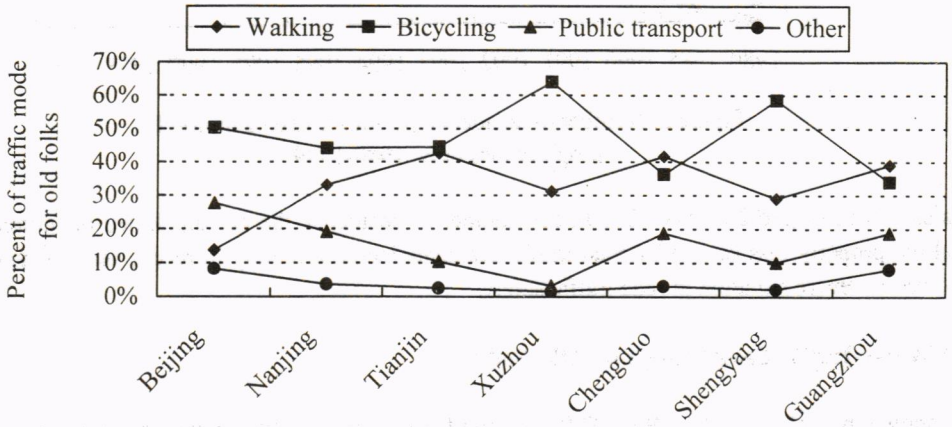

Figure 3. Percent of traffic modes for old folks in typical Chinese cities in 1998

2.2 The Increasing Number of Countrymen Killed in Traffic Accidents

Since 1980's, it has been a new scene that farmers has been seen rolling in big cities from rural areas, because of the large numbers of redundant labor forces. This has caused great traffic volumes in urban areas and also increased the difficulty in traffic management.

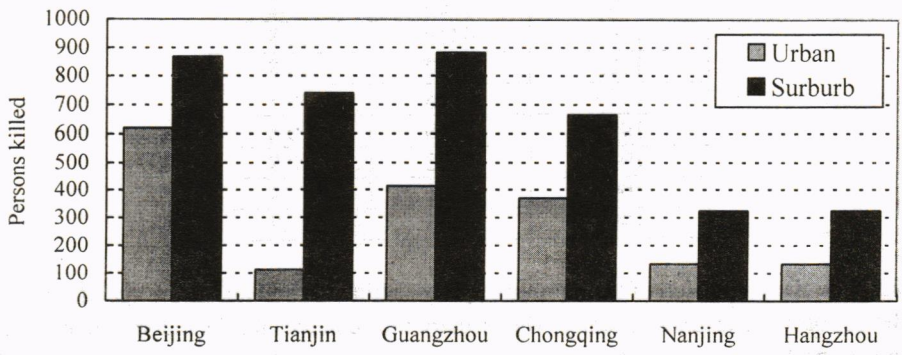

Figure 4. Persons killed in several typical cities, 1998

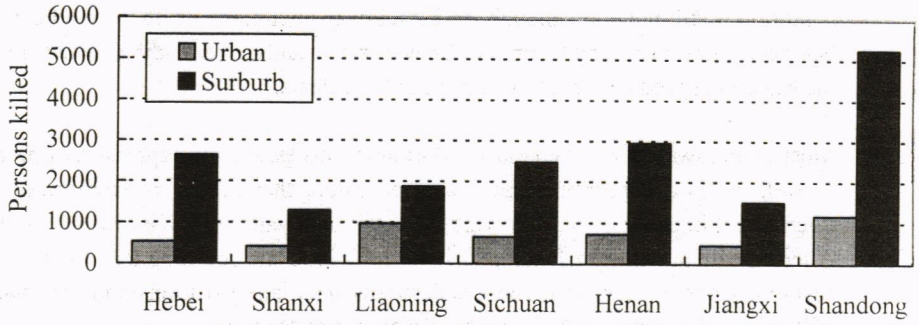

Figure 5. Persons killed in several typical provinces in 1998

As shown in Figure 4 and Figure 5 (TMB, 1999), the number of the persons killed in suburb areas were far more than that in urban area. In China today, most farmers live in the countryside and only deal with cropland cultivation. Their opportunity to participate in urban transport is tiny. However, the number of the peasants killed by traffic accidents is still very tremendous, whether they are in country or in cities. The main reason is that they lack general knowledge of traffic safety and weak in safety sense and legal conception.

2.3 Severe Situation of Expressway Accidents

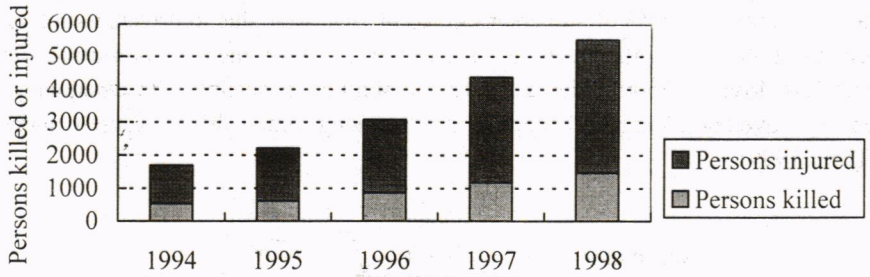

Figure 6. Persons killed or injured in expressway accidents 1994-1998

In recent years, expressway in China has been expanding rapidly. The length of expressway in 1999 is 11,605 kilometer, with an increase of 33% comparing to that in 1998. The rapid development of expressway put forward a new challenge to traffic management. According to the statistics of TMB, the number of traffic accidents occurred on expressway was 10,574 in 1998, with 1,487 persons killed and 4,043 persons injured. The accident rate per kilometer is 3 times more than that of the ordinary highway. Though there is some difference in traffic volume and traveling speed between expressway and highway, it's true that persons killed in expressway traffic accidents rise sharply in recent years as shown in Figure 6 (TMB, 1994-1999). However, in some developed countries like Japan and the United States, expressway is safer than highway though its traffic volume is often larger. The reasons are as follows.

- The technical status of vehicles cannot meet the increasing requirements of

expressway. Because of lack of experiences in expressway construction, the vehicle's condition is still not good enough for expressway operations while the road condition has been improved. Trucks on expressway are usually overloading, which restricts the traveling speed and increases the risk of accidents.

- Most expressway participants lack information necessary for expressway operations as well as legal conception and cannot accustom themselves to expressway. They often travel in expressway following the traditional pattern like in ordinary highway. Altering path at will, overloading, driving-in-fatigue and speeding lead to most of the severe accidents. Moreover, some pedestrians span lane partitions and safeguards at will, which also leads to the increasing death for pedestrians.

2.4 Severity in Drivers' Breaking Traffic Rules

As shown in Figure 7, the primary traffic mode that accounted for about 85% of all persons killed was driving motor vehicles. Approximately 6% people were killed by non-motorized vehicles. Drivers' disobeying traffic regulations is the most important cause of these accidents. As shown in Figure 8, 17.4% of all persons killed was due to drivers without driving licenses, which happened mainly in rural areas. On the other hand, drivers with less than three years of driving cause many accidents. As shown in Figure 9, 18.7% of all persons killed was due to drivers with less than one driving year and 33.4% by drivers with 1-3 driving years. That is to say, approximately 52% of all persons killed in 1998 were due to drivers with less than three driving years. Among the newly licensed drivers in China, most are non-professional drivers with less driving opportunities and lack the abilities in dealing with emergency situations. Besides, overconfidence and running a risk among young drivers caused many accidents (TMB, 1999).

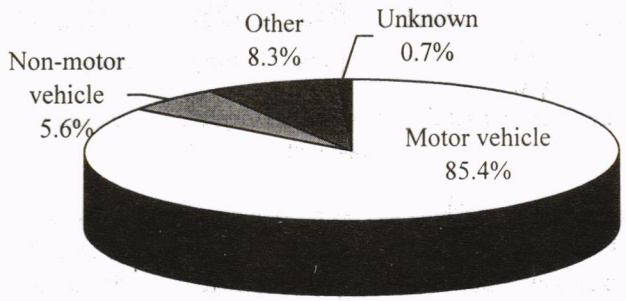

Figure 7. Persons killed as a result of traffic modes in 1998

2.5 Rising in Consequence of Accidents

In 1998, there were 80 major accidents (Here major accident means the accident causing at least 10 persons killed each time) in China with 1,288 persons killed and 1,496 persons injured, an increase of 40.4%, 30.8% and 31.9% comparing to those in 1997 respectively (TMB, 1999). In the second quarter of 2000, there were 14 major accidents with 196 persons

killed and 283 injured, increasing 55.6%, 26.5% and 159.6% comparing to those of the same period last year. In recent years, highway transport occupies the majority of commercial passenger transport market due to its convenience and agility. In 1999, over half of the turnout of passenger traffic were performed by highway transport (CATC, 2000). Meanwhile, the intense competition in highway passenger transport market happens among private transport, collective transport and state transport. Besides, many state transport corporations are virtually privatized. There are many problems in traffic safety management for these private transport corporations, which are inclined towards pursuing profit but ignoring safety.

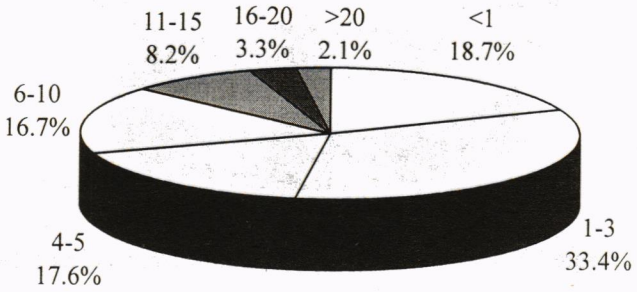

Figure 9. Persons killed by driving year in 1998

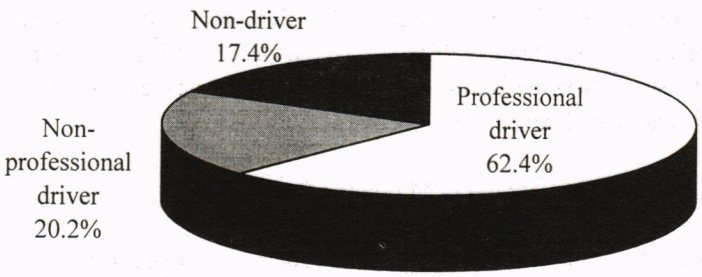

Figure 8. Persons killed by driver type in 1998

3. PROBLEMS EXISTING IN ROAD TRAFFIC SAFETY

3.1 Poor Traffic Safety Sense of Road Traffic Participants

Because of the poor safety sense, some owners of motor vehicles and administrators of highway transport corporations usually pay more attention to economic profit but neglect safety. On the other hand, the drivers unilaterally pursue carrying more passengers and freights, ignoring the maintenance to vehicles. Besides, many transport vehicles were overloaded in order to earn more money. The phenomena of disobeying traffic rules are ubiquitous, such as speeding, overloading, inattention, failure to keep in proper lane and failure to obey traffic signs and signals, etc.

Pedestrians and pedal cyclists are poor in traffic safety sense. Many non-motorists in the cities of China are accustomed to ignoring traffic signs, crossing roadway and intersection improperly, darting or running into road with motor vehicles and failure to yield right of way, due to the blindfold safety sense and the fluke not to be punished. Accordingly, many accidents are caused involving non-motorists. In 1998, more than 30,000 pedestrians and pedal cyclists died in crashes involving motor vehicles. This accounted for 45.9% of all traffic fatalities in that year as shown in Figure 10 (TMB, 1999).

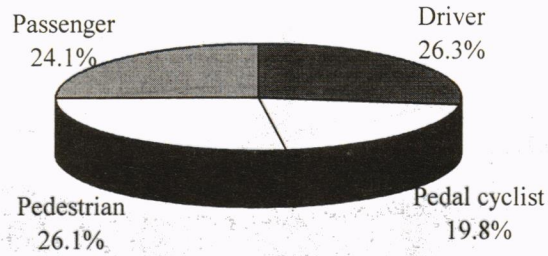

Figure 10. Persons killed by type of traffic participant in1998

Because of poor traffic safety sense and lack of basic knowledge of traffic code, the number of traffic accidents in rural areas was greater than that in urban areas. In 1997, there were 194,209 accidents in rural areas and 57,685 persons killed accordingly, which occupied 63.9% and 78.1% respectively of the total number of fatality of that year (TMB, 1998). Apparantly, it is urgently needed to strengthen the traffic safety propagandism and education as well as management in rural areas and along the highway lines.

3.2 Mixed Traffic Environment Leading to Majority of Accidents

Most side roads in big Cities and the roadways in middle and small cities site belong to mixed traffic environment, scilicet, all motor vehicles and non-motor vehicles as well as pedestrians running and walking on the same road without any partitions. As shown in Figure 11, 67.2% of all persons killed was due to the mixed traffic environment in 1998 (TMB, 1999).

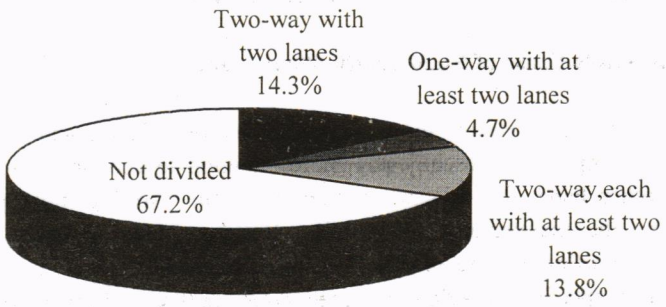

Figure 11. Persons killed by trafficway flow, 1998

China is a country with the biggest bicycle production and ownership due to its economic and social development level. As shown in Table 3, bicycle is an important travel mode in most China cities (Mao, 1999). Because of lacking bicycle lane system, the large amount of bicycling traffic in urban areas not only pricks up traffic jam and delay, but also brings about many safety problems under mixed traffic environment. For example, it's very often that bicyclists enter illicitly the space of motor vehicles in order to overtake and turn left. Many accidents occur in this situation. Moreover, motor vehicles often occupy the space of bicycles when parking or entering into the main lines from spur track, which leads to many traffic accidents involving bicyclists. As shown in Figure 12, the bicyclists killed each year occupied over 17 percent of the total fatalities in traffic accidents from 1994 to 1998. The situation is still serious though the total trend is turning better year after year.

Table 3. Proportion of mobility of bicycle in typical cities in 1992 (%)

City	%	City	%	City	%
Beijing	54.1	Zhengzhou	63.1	Chengdu	54.6
Tianjin	44.6	Shenyang	58.7	Shaoxing	72.0
Shanghai	25.6	Wuhan	35.3	Changsha	31.4
Guangzhou	34.0	Changchun	37.0	Dalian	23.6

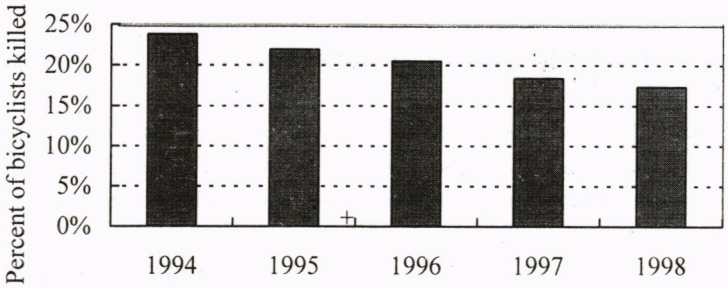

Figure 12. Percent of bicyclists killed in road traffic accidents 1994-1998

3.3 Poor Road Conditions

It is easy to see that most road traffic accidents are caused directly by traffic participants, such as motor drivers, bicyclists, pedestrians and passengers, and a few accidents are caused directly by road condition. In fact, the road conditions constitute the indirect cause of many accidents. As shown in Table 4 (TMB, 1999), 62.4% of all persons killed in 1998 were due to the poor road condition without any traffic control measures, while only 0.58%, 0.91%, 0.35% and 1.31% of all persons were killed on the road with traffic signals, traffic signals and signs, traffic signals and officers, traffic officers respectively. Most roads with frequent accidents are dated with deficient maintenance and lacking necessary safety establishment, such as poor geometry, lack of traffic signs and signals, etc. Furthermore, Many roads in mountain areas are poor in driving condition such as poor road line type and visibility, thus leading to the occurrence of many fatal accidents.

Table 4. Proportion of persons killed by traffic control mode, 1998

Traffic control mode	%
None	62.39
Traffic officer	1.31
Traffic signs	28.61
Traffic signals	0.58
Traffic signals and signs	0.91
Traffic signals and officer	0.35
Other	5.85

3.4 Lagging in Road Traffic Safety Management

With the reform of marketing economy, private transport corporations increase at a faster speed. The new transport modes such as private transport, leasehold and contract transport are developed very often. The practical orientation to pay more attention to profit but look down on safety management becomes more and more serious. This thus leads to more opportunity to break traffic rules, such as overloading, schlepping danger, etc. Meanwhile, the insufficient traffic policemen, conflicting traffic rules as well as the poor facilities make urban road surface absence of management.

4. ESTABLISHING THE SAFETY ASSOCIATION FOR MOTOR DRIVERS

With the rapid increase in motor vehicles and drivers, most road traffic accidents are caused by drivers especially under 3 driving years. As shown in Figure, 13.73% of all persons killed in 1998 were due to motor drivers (TMB, 1999). According to the experience of Chongqing city in the southwest of China, an association organized for motor drivers aiming at helping, educating and serving motor drivers is conducive to improving their safe quality.

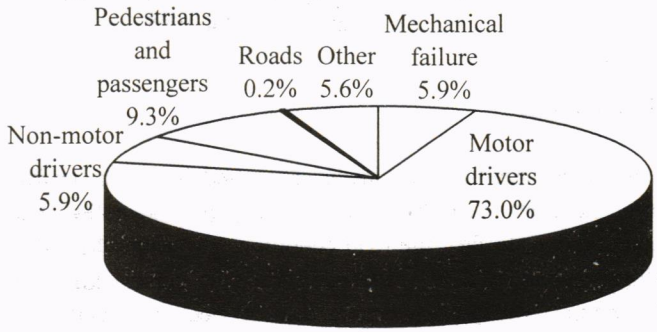

Figure 13. Persons killed by reason in 1998

The Chongqing Association of Motor Drivers (CAMD) came into existence in 1993, aiming at educating, managing and helping the local motor drivers. It was under the leadership of City Bureau of Civil Administration (CBCA), City Bureau of Public Security (CBPS) and its affiliated General Team of Traffic Police (GTTP). There are 44 sub-associations including

1,326 member's group and 210,000 members distributing in different sections and counties. The experiences are as follows.

- Led by CBCA, CBPS and GTTP, CAMD is made up of not only drivers, but also leaders and managers of different departments including traffic police, armed police, army, traffic and transportation administrators. It is propitious to urging the leaders to pay more attention to safety.

- In order to standardize the daily activity, CAMD invites about 1000 full-time and part-time employees familiar with road traffic safety to deliver lectures on safety education. There are special offices for each group that offers over three office days per week.

- Since its foundation, CAMD has been focused on the following three kinds of work: ①Organizing and absorbing members actively; ②Organizing members to take part in traffic safety study agilely; ③Enriching the form and content of traffic safety education. As a result, the training rate for drivers to attend safety education increased from 56% in 1993 to 85% in 1999.

In the past, the drivers' daily safety education was performed only by Vehicle Administration Departments. Both content and form of safety education are inanimate and boring. In recent years, the old management system based on planning economy cannot fit the current situation with the rapid increase of motor vehicles and the appearance of large amount of private transport corporations. Traffic safety education is in an emergent need of social development. By Sub-associations and its affiliated activity group, the Safety Association organized for motor drivers can easily mobilize the enthusiasm of vehicle managerial departments, governing bodies as well as drivers to attach themselves to traffic safety education and improve traffic safety.

5. CONSTRUCTING SOCIALIZING PROPAGANDISTIC NETWORK FOR TRAFFIC SAFETY

Influenced by poor transport facilities, traffic participants often overlook traffic rules and regulations, thus leading to descending of traveling speed, severity in traffic jam and increasing in traffic accidents. Therefore, it's necessary to launch propaganda and education for traffic safety widely.

In inter-city transport, there are two kinds of roads. One is the main road such as national highway and provincial highway with a quantity of traffic volume but lacking safeguard system. The other is the county road and branch with poor infrastructure. Besides, in rural areas, the ownership for television is comparatively low, and there are few people to subscribe newspapers and magazines. Therefore, it's difficult to promulgate information on traffic laws in Chinese rural areas today. As mentioned above, the safety consciousness of most

countrymen is poor due to their lower educational level. Therefore, a propagandistic network for traffic safety education in rural areas may mobilize adequately the enthusiasm of traffic policemen, alcaldes and village heads along the road line. It is beneficial to propagandize the general knowledge on safety with various forms such as calling together the mass by projecting movies, broadcasting, delivering lectures at school, literary advertisements, and developing competition on safety knowledge, etc.

In city areas, the situation is different. It is easier to disseminate traffic information. Therefore, the socialized propagandistic network may make full use of the existing organizations and news channels to propagandize traffic safety in city areas.

6. A GENERAL FRAMEWORK OF TRAFFIC SAFETY MANAGEMENT SYSTEM

At present, the tasks for traffic safety management department are to investigate and deal with traffic accidents and peccancy. An effective traffic accident preventing system has not yet been established. Of course, one possible way is to construct a highly modernized traffic safety management system as has been done in some developed countries. As a developing country with less ownership of resources per capita, China needs to consider more factors in the design of traffic safety management system. According to the practice of traffic safety in China, this paper constructed a feasible traffic safety management system aiming at accident prevention.

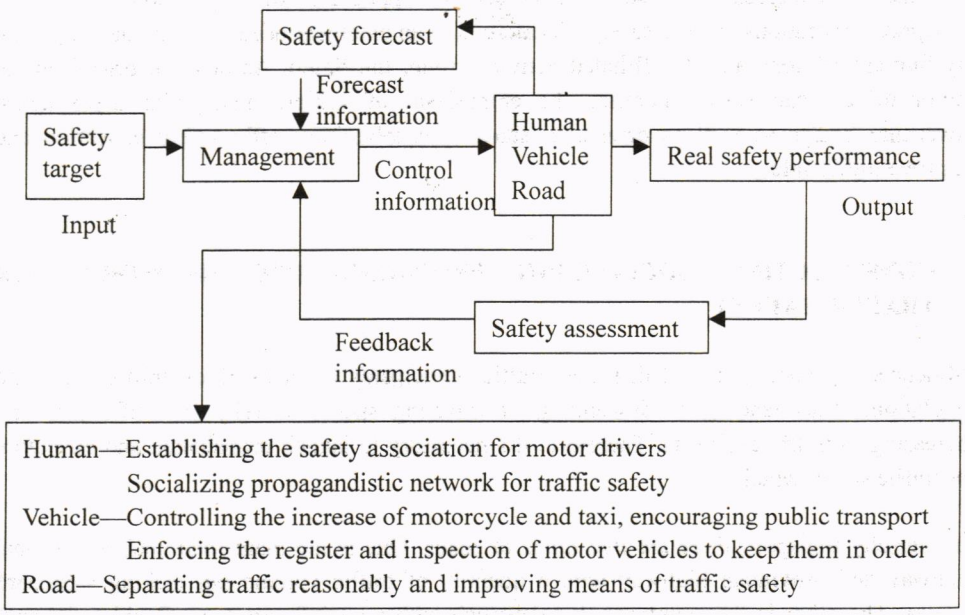

Figure 14. A general framework of traffic safety management system

As shown in Figure14, the traffic safety management system is composed of a series of

feedback and advance controls. As a feedback control system, it transmits the information from output end to input end by feedback circuit. Compared with safety targets to find out the difference between the two ends, it may help people to take measures to correct deviation and realize the expected target of the system. However, this kind of control has some limitations because deviations can get corrected only after their being produced. Therefore, advance control is necessary to make the deviation foreseeable. In other words, suitable measures should be taken according to forecast information, before deviation is produced(Xiao, 1998).

In order to reduce accidents effectively, the traffic safety managers must be aware of various factors related to safety assessment. On the other hand, it is necessary for traffic managers to forecast the possible change of potential accidents, and then control measures could be put into practice according to the result of safety assessment and safety forecast.

7. CONCLUSIONS AND SUGGESTIONS

As mentioned above, the situation for traffic safety becomes more and more rigorous as the accelerating motorization. It's a hard and long-term task to establish a consummate traffic safety management system. At present, China needs to pay more attention to priori safety (i.e., taking precautions against accidents before its occurring) instead of posteriori safety (i.e., allowing accidents occurring, then investigating the causes and taking measures to prevent the re-occurrence of similar accidents). As there are many potential dangerous factors in road traffic systems, it is essential to establish a traffic safety management system based on assessment and forecast. This may prevent accidents effectively. Accordingly, the following work needs to be done.

- Before accidents happen, take measures to prevent accidents by coordinating the relationships among participants, vehicles and roads.

- Once an accident occurs, make out possible consequence and right responses immediately. In these cases, a living traffic accident rescue system is necessary to lighten seriousness of accidents.

- After the occurring of accidents, analyze the cause of accidents in details, find the exterior direct reasons and dig out the essential causes. Take measures to prevent the similar accident occurring time after time.

It is fortunate that the departments of traffic management in China have well recognized the importance of traffic safety and taken many effective measures to improve safety. In 1999, the Ministry of Public Security put forward to establish "the Safe Way Engineering" in many big cities. In 2000, the Ministry of Public Security, together with the Ministry of Construction began to implement "the Speedy Engineering" to insure safety and efficiency for road transport. It is likely that safety management in China will be improved

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