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A STRATEGIC APRROACH FOR SAFETY: PUTTING KNWOLEDGE INTO PRACTICE

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ABSTRACT

By year 2009 Mexico had an approximate population of 110 million inhabitants with a life expectancy of 75 years, covering an area of about 2 million square kilometers, as well as a total fleet of vehicles exceeding 30 million moving along a road network of 360 thousand kilometers.

As a result of traffic accidents in Mexico, 20 thousand persons were killed, 750 thousand were hospitalized and 40 thousand suffered disability during 2009. Traffic accidents are currently the third cause of death in the country, followed by diabetes mellitus (with 70 thousand deceases a year) and heart ischemic diseases (with an annual rate of 55 thousand deaths). Deaths related to traffic accidents have, on the other hand, the most rapidly growing rate of occurrence, with a mean annual rate of 5 per cent.

Because of this, the Federal Government of Mexico set as one of its top priorities, contemplated in its *Visión México 2030* program to guarantee the safety of road and street users. From this vision strategic plans and approaches have evolved from agencies of the Federal Government to cover the period 2007–2012, among them the most important corresponding to the Ministries of Health, and of Communications and Transport. In the ongoing generation and implementation of these strategic plans and approaches both departments keep a close institutional cooperation between them, as well among officers of other government levels and the society as a whole.

This National Report covers the strategic plans and approaches of the two departments referred to above for purposes of improving traffic safety at roads and streets of Mexico as well as the most relevant experiences related to transfer of technology into practice. Some conclusions are presented in the end.

1. INTRODUCTION

Injuries and non-transmissible diseases have prevailed in Mexico during the last decade, associated to an increasingly ageing population and to a rapid development of far-from-healthy risks and living standards. This is worsened by the imminent transition of a rural population to urban dwellers with a consequent increase of the vehicular fleet and of the transportation of commodities and passengers. This problem is inducing high rates of casualties (injuries and deaths) derived from traffic accidents in streets and roads; therefore, the Ministry of Health (SS) and the Ministry of Communications and Transport (SCT) play a leading role in decreasing the correspondingly high rates by focusing on public health issues. As derived from this situation it was intended to foster the development of a long-term multi-sector policy in terms of road safety by joining forces among the three government branches and the civil society, for the purpose of reverting this so-called epidemic of traffic accidents.

In Mexico, among all accidents occurred, traffic mishaps and running over events rank among the highest mortality rates (10.9 and 5.2, respectively), therefore representing a total of 20 thousand deaths in 2009, i.e. the fourth highest rate of death among persons in productive age and the top rate of mortality among youngsters.

In 2009 close to 500 thousand traffic accidents occurred in Mexico (440 thousand in urban zones, 30 thousand in suburban areas and 35 thousand at federal highways) inflicting 190

thousand bodily injuries (155 thousand in urban and suburban zones and 35 thousand in federal highways) as well as 20 thousand deaths (14 thousand in urban and suburban areas and 6 thousand at federal roads). Of the 32 States constituting the Mexican Republic, those evidencing the highest mortality rates from traffic accidents correspond to Nuevo León, Jalisco, Guanajuato and the Federal District. Mention should be made that the ten States with the highest accident rates concentrate 67% of all traffic accidents in the country [INEGI, 2009]. At local level, ten municipalities in the country concentrate one third of all traffic accidents in the whole territory.

In the past six years the number of motor vehicles registered in Mexico increased noticeably from 15.6 million in year 2000 to 30 million by 2009, i.e. more than 86%, whereas the number of accidents also showed an important increase when growing from 312 thousand in 2000 to 500 thousand in 2009.

It has been estimated that total costs derived from traffic accidents in Mexico exceed 110 thousand million pesos a year (1.3% of the Gross Domestic Product). From these costs, 50% correspond to hospitalization expenses and medical services to assist injured persons, 40% of the estimated cost is related to loss of revenue to the society due to the loss of lives in productive age, and the remaining 10% refer to direct costs of the accidents as well as of the pedestrians involved.

Of the 20 thousand deaths recorded in 2009, 78.9% corresponded to male casualties. In what refers to age groups, from 5 to 24 years represents the first cause of death and from 25 to 44 years, the second cause. When considering the total number of deaths, the range of ages from 5 to 14 years accumulates 5.6% of the total; from 15 to 24 years, 22.8%; from 25 to 34 years, 20.2%; and from 35 to 44 years, 15.3%; the average from 5 to 44 years represents 63.9% of deaths related to traffic accidents. Appreciable differences can also be observed at regional level in terms of frequency, because in 10 of the 32 entities in the country 55% of the total number of accidents is concentrated. As far as the mortality of pedestrian injured by motor vehicles is concerned, a national rate of about five deaths per 100 thousand inhabitants was obtained for year 2009.

Strategic plans and approaches applied by SS and SCT are described as follows. The strategic plans and procedures of the SS are contained in the so-called 2007-2012 Specific Program of Action on Road Safety (PROSEV) [SS, 2008] and those for SCT at its Road Safety Program [SCT, 2010a].

2. STRATEGIC PLANS AND APPROACHES

2.1. Ministry of Health

2.1.1 Background

Among the main problems associated to the occurrence of traffic accidents that hinder their prevention and reduction, mention can be made of the following: 1) An inadequate legal framework; 2) Deficiencies supervision, control and compliance with the rules; 3) Insufficient epidemiologic overseeing and monitoring of accidents; 4) Lack of effective coordination mechanisms; 5) Lack of suitable capabilities; 6) Inadequate roadways and deficient use of vehicles; 7) Lack of resources and of equipping; and 8) Deficiencies in human resources for assisting victims.

When dealing with prevention of traffic accidents, the conceptual framework contemplated by the PROSEV program refers to the “systemic model”, intended to identify and correct

the main sources of error or design deficiencies that contribute to fatal collisions or cause serious injuries, as well as to mitigate the seriousness and the consequences with measures such as: 1) Reduction of risk exposure; 2) Preventing the occurrence of traffic accidents; 3) Reducing the seriousness of traumatisms in case of collisions; 4) Mitigation of the consequences of traumatisms through an improved attention following a collision. The challenge involves the achievement of an important decrease in terms of lost years of living, the reduction of costs related to medical attention and particularly, to succeed in developing a social environment where Mexicans are expected to spend safe and healthy lives. The basic elements of the PROSEV are described as follows.

2.1.2 Mission

Reduce the mortality derived from traffic accidents involving motor vehicles based on scientific and technical findings, through the coordination of steering actions in the areas of promotion of road safety, prevention of risks and timely and qualified medical assistance.

2.1.3 Vision

For year 2012 the program should have contributed to decrease the number of traffic accidents by strengthening a road safety culture within the Mexican society, with citizens convinced that their daily living habits may potentially help to reduce the risk factors associated to traffic accidents, therefore expanding the opportunity and quality of timely assistance to the victims, saving lives and improving the standards of living of the Mexicans so as to survive in a safer and healthier environment. The main identified risk factors are: 1) Deficient training and evaluation of drivers; 2) Deficiencies in the issuance of driving permits; 3) Consumption of alcohol and drugs among drivers; 4) Speeding; 5) Failure to use safety devices; 6) Lack of vehicular mechanical revision; and 7) Lack of road safety in infrastructure projects.

2.1.4 General Objective and Specific Objectives

In compliance with the 2007-2012 Health Sector Program (PROSESA), the PROSEV sets as general objective the reduction by 15% the number of deaths caused by traffic accidents involving motor vehicles in the population sector ranging from 15 to 29 years old, by means of promoting road safety, accident prevention and improved assistance to victims.

The specific objectives are:

- Objective 1. Strengthen and modernizing the legal and regulatory framework.
- Objective 2. Strengthen and integrate the actions for promoting road safety and accident prevention.
- Objective 3. Improve the opportunity and quality of assistance to victims.

2.1.5 Strategies and Lines of Action

Table 1 shows the strategies and lines of action of the PROSEV. The responsible party to implement the program is the *Centro Nacional para la Prevención de Accidentes* (CENAPRA) or National Center for Accident Prevention. It is the administrative branch of the SS in charge of steering the national policy in the area of prevention of injuries caused by accidents; manage the necessary actions before public, private and social institutions associated to accident issues; coordinate the operation of State Councils for Accident Prevention (COEPRAS) in the various States; and implement strategies and actions

leading to a decrease in the injury and fatality rates generated by accidents, for the benefit of the Mexican population.

Table 1. Strategies and Lines of Action contemplated by PROSEV

	STRATEGY	LINE OF ACTION
1	Renew and improve efficiency of the regulatory framework regarding prevention of traffic accidents	Promote the passage of federal and state laws and regulations in matters of traffic, transportation and road engineering
		Participate in the development of an Official Mexican Standard (NOM) for the use of kinemometers (speed radars)
		Participate in the development of an Official Mexican Standard related to the use of alcohol breathing meters
		Promote before state traffic legislations the binding effect of liability car insurance
2	Strengthen the supervision of, control of and compliance with the legislation enforced	Prepare the rules and regulations for the performance of psychic and physical examinations for the issuance of driving licenses and permits
		Evaluate the structure, processes and results of the Regulating Centers for Pre-Hospitalization Attention of Medical Emergencies at federal state level
		Verify and certify mobile units for emergencies and intensive care in their three modes
3	Facilitate access to reliable and timely information as well as to the development of indicators of accident potential	Promote the creation of State Monitoring Units for Road Safety
		Disseminate documents related to training and to scientific and technical investigation in the matter of road safety
		Document the spatial analysis of the occurrence of accidents by means of cartographic publications
4	Promote the inter-sectorial, inter-government and international coordination to enhance the efficiency of processes for preventing road accidents	Reactivate the activities of the National Council for Accident Prevention
		Foster the creation of an Inter-Sectorial Commission for Road Safety in each State of the Federation
		Incorporate non government organizations and those of the civil society in the activities of the CENAPRA and of the Program of Road Safety
		Increase the exchange of information and the number of joint projects with international agencies and with local and foreign organizations
5	Foster the promotion of safety of road safety and of prevention of road accidents to build up a new culture favoring the reduction of risk factors	Incorporate road safety contents into the formal educational system
		Promote community interaction for the development of healthy environments
		Train promoters of accident prevention
		Organize campaigns of social communication in the area of road safety to enhance the use of safety systems and to improve road driving behavior
6	Opportune attention to victims	Promote the installation of a Regulating Congress for Medical Emergencies at each State of the Federation
		Regionalize the emergency services in terms of level of attention
		Advertise a hot telephone line for the attention of medical emergencies
7	Training and instruction	Professionalize Technicians on Medical Emergencies
		Promote the utilization of guides of practice and protocols of medical attention
		Incorporate quality assurance programs in the academic development of professionals, technicians and citizens

An influence factor in the execution of actions is also the so-called Mexican Initiative on Road Safety (IMESEVI), which is integrated as the source for the implementation of some of the strategies outlined by the PROSEV, therefore making it possible to have available scientific evidence resulting from the design, training, execution, control and evaluation of

successful applications that can be replicated in the country. The IMESEVI is a multi-sectorial program that amalgamates the endeavors made by the CENAPRA of the SS, the Pan-American Health Organization and the State governments with the Civil Society. Its objective is to generate synergies among the organizations involved and the civil society for the purpose of developing, promoting and implementing in practice multi-sectorial and integral public policies and actions for prevention so as to improve the awareness on road safety and therefore reducing injuries, disabilities and deaths caused by traffic accidents.

2.1.6 Institutional Framework

The development of strategies is in full compliance with the provisions contained in the Political Constitution of the Mexican United States in its Article 4 and in the General Health Act in its Article 27. The 2007-2012 National Development Plan (PND) establishes in its 4th Objective: "To improve health conditions of the population through a timely and adequate prevention" and in its 5th Objective: "To provide efficient health services, with quality, warmness and safety for patients". As a result, the PND teams up with the PROSEV through Strategy 4.1 related to the strengthening of actions including promotion and community service as well as the development of actions of verification and of authorization, in coordination with responsible agencies, aimed at protecting people against health risks. On the other hand, the PROSEV is compatible with Objective 12, in matters of promoting the integral education of persons within the educational system as a whole, participating, as required by Strategy 12.9, in the systematic organization of workshops for the prevention of risk behaviors among students of secondary education and of education between elementary school and college so as to strengthen early education to prevent and diminish risk behavior through a close inter-sectorial relationship.

Sustainment of PROSEV is based on the 2007-2012 Sectorial Health Program (PROSESA) that contemplated five objectives, among which Objective 1 outlines: "Improving health conditions among people". The PROSEV will specifically contribute to the fulfillment of Goal 1.7: "Reduce by 15% the number of deaths caused by traffic accidents involving motor vehicles among the population aged 15 to 29 years". To reach this goal, the PROSEV will follow the strategies established by the PROSESA, particularly in what refers to Strategy 2: "Strengthen and integrate the actions for promoting health and prevention and control of diseases" by means of Line of Action 2.14 "Foster promotion measures of a safe roadway so as to prevent non intentional injuries and disabilities".

2.2. Ministry of Communications and Transport

2.2.1 Background

It has been estimated that the population with driving possibilities (15 to 64 years old) will increase on the average about 29% between 2000 and 2015, until approaching approximately 68% of the entire population by the end of the period. The fleet of operating motor vehicles registered in 2009 exceeded 30 million, practically duplicating the figure recorded in 1998. The vehicular distribution is as follows: 66.1% of automobiles, 29.5% of freight trucks, 3.3% de motorcycles, and 1.1% of passenger buses. In the last ten years, the number of automobiles and of freight trucks has increased by 93%, with an annual increase rate of 7.5%, whereas motorcycles have increased close to 300% with an annual increase rate of 17%. The average age of the vehicular fleet is of 14.3 years.

The National Highway System is divided into the Rural Network (including improved earth roads and rural roads) with 237,726 km, the Feeder Network (constituted by 31 State networks) with 73,874 km, and the Federal Network (Basic and Regional) with 48,475 km.

The annual growth rate of the highway infrastructure in Mexico amounted to 1%, the Rural Network showing the largest annual growth rate (2.3%), passing from 236 thousand to 238 thousand kilometers. In the period 2002-2007 the Federal Toll Road Network increased by 2% (from 7 thousand to 7.8 thousand kilometers), whereas the Federal Free Road Network evidenced a reduction due to the change of jurisdiction created by the growth of urban zones in the country.

The Mexican Transport Institute (IMT) reported in its 2008 Yearbook on Accidents Statistics that during that year and along the network patrolled by the Federal Police (PF), with an approximate length of 55,687 km that basically comprises the Federal Network, there was an occurrence of 30,551 accidents; 33,580 injured people; and 5398 deaths; the cost of property damages reached 1,495.7 million pesos, whereas the total cost of those accidents was equal to 27 thousand million pesos (considering an exchange rate of 11 pesos per US dollar, and average unit prices per injured person and per death of 12 thousand and 400 thousand US dollars, respectively). In addition, 45,502 vehicles became involved (1.53 participants per accident) and 849 pedestrians.

The largest percentages of accidents occurred at the road network patrolled by the PF are imputable to speeding drivers (39%); for invading a traffic lane (9.4%); for carelessness or intention (5.9%) and for driving in a state of drunkenness (1.4%). Mention should be made that the percentage attributed to driving after alcohol consumption is not representative of the real figure because it is common that in most cases such condition is not registered in the accident report. The most common cause related to the road itself is wet and slippery pavement, with 8.6 and 6.5%, respectively, whereas for natural weather conditions, rainfall represents 7.1% and for vehicles, tire failures represent 2.1%. In general, the most common types of accidents correspond to “driving off the road” with 34.8%, followed by “lateral collisions”, “rear collisions”, “head-on collisions”, and “crashing against a fixed object”, with 16.4%, 13.9%, 7.6% and 7.4%, respectively.

The Road Safety Program of SCT is structured according to the following five aspects: 1) The user of the roadway; 2) The vehicular fleet; 3) The road infrastructure; 4) The legal and institutional framework and the compliance with the rules and regulations; and 5) The institutional cooperation. Mention should be made that the strategies and lines of action applicable to the “Users of the Roadways”, the “Vehicular Fleet” and the “The Legal and Institutional Framework and Compliance with the Rules and Regulations” have been conceptually developed to be implemented in the whole country, whereas those related to the “Road Infrastructure” only correspond to Federal applications and it is expected that the actions to be taken by the Federal branch become reflected in both State and municipal jurisdiction. A description of the fundamental elements of this program is presented as follows.

2.2.2 Mission

To develop actions aimed at preventing and decreasing the number of road accidents as well as their consequences along domestic roadways and particularly along Federal Highways, with the involvement of public and private sectors and the community.

2.2.3 Vision

By year 2020, to count on the legal framework, the institutional structure and the coordination and management mechanisms that guarantee the safety of the users of the road and street networks.

2.2.4 General Objective and Strategic Objectives

The general objective of the Road Safety Program of the SCT is “By year 2020 achieve that the number of deaths related to traffic accidents does not exceed 15 thousand a year and that the number of injured people is not higher than 300 thousand a year through the establishment of actions based on the best international practices and standards, using an approach focused on results to be able to evaluate on a permanent basis the specific actions implemented”.

Strategic objectives:

- Objective 1. Improve the adequate use of the road and street network by users.
- Objective 2. Foster a Road Infrastructure that maintains a service level to expedite a safe traffic and pedestrian mobility.
- Objective 3. Improve the safety of the vehicular fleet.
- Objective 4. Promote a legal and institutional framework to propitiate a safer road operation and achieve its effective implementation.
- Objective 5. Promote the institutional cooperation among the various government branches and the community as a whole.

2.2.5 Strategies and Lines of Action

Table 2 summarizes the structure of the Road Safety Program of SCT in terms of its strategies, lines of action and activities. The responsible party for the implementation of the program is the SCT itself, securing the collaboration of Federal, State and Municipal governments as well as the support of private corporations and of non government organizations.

2.2.6 Institutional Framework

The 2007-2012 Sectorial Program of Communications and Transport constitutes for the SCT the governing instrument of its actions in the medium term. This is why after taking into account as starting point the *Visión México 2030* program, the PND and the results of a wide-scope survey among leading performers of the sector that have contributed elements of diagnosis and of action, the 2007-2012 Sectorial Program of Communications and Transport is structured in terms of four main sectorial objectives: 1) Expand the geographic and social coverage of the infrastructure; 2) Improve its quality and efficiency; 3) Increase the safety levels associated to the infrastructure and to the services of the sector by means of actions aimed at improving the qualification of the human factor, the infrastructure, the systems and equipping, as well as the supervision and safety culture for the purpose of preventing the occurrence of illegal acts, accidents, the loss of human lives and property losses within the system of communications and transport; and 4) Transform the country in one the principal competitive logistic platforms on a world-wide basis.

Finally, the 2007-2012 National Infrastructure Program (PNI) establishes as Strategy IV: “Improve the physical condition of the road infrastructure and decrease the number of accidents”. It also established for such purpose to take specific actions: on the one hand to reduce the accident index from 0.47 to 0.25 for every million of vehicle-kilometers; and on the other hand, increase from 72% to 90% the length of the federal highways that operates in good condition pursuant to international standards. These actions should have been complied with by year 2012, since they belong to the long-term vision contemplated by the PNI.

Table 2. Strategies, Lines of Action and Actions of the Road Safety Program of the SCT

	STRATEGIES	LINES OF ACTION	ACTIONS
1	Road Users	1.1 Educate, convince and promote habits among teachers and the scholastic population (preschool, primary, secondary, etc.) in topics related to accident prevention, through the use of official textbooks published by the Ministry of Public Education (SEP) and of results of studies already completed by the Ministry of Health (SS) in the area of Road Safety	1.1.1 Include the topic of Road Safety on a permanent basis in official textbooks. 1.1.2 Train teaching staff in Road Safety issues. 1.1.3 Include activities of road safety in the different educational levels.
		1.2 Incorporate the community, private enterprises and State institutions in the execution of integral actions oriented to the prevention of traffic accidents.	1.2.1 Promote advertising campaigns among massive communication media such as radio and television, aimed at promoting Road Safety Education and to create awareness among users of the roadways with respect to obey and respect alcohol consumption limits, traffic signs, pedestrians and bicyclists, as well as compliance with speed limits, with particular attention on weekends and vacation terms. 1.2.2 Promote advertising campaigns among massive communication media such as radio and television, aimed at promoting the use of safety devices among users (safety belts, child restraining systems and safety helmets).
		1.3 Improve procedures for training and upgrading private and professional drivers (including motorcyclists) according to the type of license	1.3.1 Enable the requirement of approving a theoretical-practical course prior to training depending on the type of license at a certified school to obtain (private and professional drivers) and renew (private drivers) or authenticate (professional drivers) the driver's license. 1.3.2 Review and update the contents of courses required to issue and renew or authenticate the driver's license. 1.3.3 Implementation of a certification system for schools offering the training course prior to obtaining and renewing or authenticating the driver's license.
		1.4 Improve the requirements for the issuance of driver's permits and licenses	1.4.1 Implementing at national level the theoretical test via computer to obtain driver's permits and licenses. 1.4.2 Implementing at national level rules and regulations for applying psycho-physical examinations for the issuance of driver's licenses and permits. 1.4.3 Establish and implement criteria to issue permits for first-time drivers (e.g. minimum age of 18 years, restriction of night driving during the first year, drive accompanied by an adult driver during the first year, and requirements for first-time motorcyclists). 1.4.4 Establish and implement criteria for retaining the driver's license among adults older than 70 years by means of examinations of physical conditions and capabilities every two years.
		1.5 Implement a point-based system for drivers with national coverage	1.5.1 Develop a point-based system for granting driver's permits and licenses. 1.5.2 Develop a campaign for the implementation on a nation-wide point-based system.

Table 2. Continuation

	STRATEGIES	LINES OF ACTION	ACTIONS
1	Users of the Roadways	1.6 Carry out actions aimed at creating moral awareness among professionals of the Transport Sector and their training in matters of Road Safety	1.6.1 Activities of awareness, training and upgrading of professionals of the Transport Sector in matters of Road Safety. 1.6.2 Promotion of the compulsory use of safety belt among professional drivers. 1.6.3 Promotion of the psycho-physical aptitude of professional drivers. 1.6.4 Control of driving and resting times of professional drivers. 1.6.5 Implementation of a program for road accident prevention among companies. 1.6.6 Promote early retirement from the activity among drivers older than 70 years, by means of a requirement from SCT to freight companies. 1.6.7 Strengthen by about 20% the inspection and supervision of truck transport companies in matters of Road Safety through the DGAF.
		1.7 Improving attention and assistance of victims of road accidents and their families	1.7.1 Establish an Integral System with national coverage for Attention to Emergencies with effectiveness to shorten the time of response for arriving at the site of the accident and to assist the victim of the traffic mishap. 1.7.2 Fostering and promotion of the use of the emergency hot line standardized at national level (066). 1.7.3 Implementation of a program for legal and psychological assistance to victims and their families involved in traffic accidents.
		1.8 Extend the coverage of programs for prevention and treatment of alcoholism and drug consumption of the Health Sector to highway drivers, as well as the programs to monitor fatigue and psycho-physical medical examinations of the SCT to municipal and state coverage.	1.8.1 Carry out actions of alcohol and drug consumption measurements on a random basis at highways taking into account the experience gained by the Ministry of Health. 1.8.2 Carry out searches of fatigue and of psycho-physical medical examinations on a random basis at urban and sub-urban areas, profiting from the experience gained by the DGPMPT of SCT.

Table 2. Continuation

	STRATEGIES	LINES OF ACTION	ACTIONS
2	Road Infrastructure	2.1 Development and updating of rules and regulations for improving Road Safety.	2.1.1 Review and update the Manual of Geometric Design of Roads. 2.1.2 Review and update the Manual of devices for signing and traffic control. 2.1.3 Develop the Manual on Road Safety of SCT. 2.1.4 Include among the rules and regulations of SCT for transport the procedure for auditing Road Safety.
		2.2 Train the personnel of the Transport Sector (SCT, CAPUFE, concessionaires of toll roads, etc.) in the area of Road Safety Audits.	2.2.1 Review and update the academic contents of the courses addressed to training of auditors on Road Safety. 2.2.2 Offer courses for training of auditors on Road Safety.
		2.3 Perform Audits of Road Safety at the stages of design and pre-opening of roadway works, to reduce the risk to users of the roadway and therefore prevent or mitigate potential accidents	2.3.1 Perform Road Safety Audits on the construction project of major highways intended to be built. 2.3.2 Perform Road Safety Audits on already built projects, prior to their opening to traffic. 2.3.3 Perform Road Safety Audits to highways in operation (or inspection).
		2.4 Implement procedures of Road Safety Audits on highways in operation following the traditional method for auditing and/or the IRAP methodology (International Road Assessment Programme) [IRAP, 2010]	2.4.1 Implement during 2010 the IRAP methodology to the Mexican part of the Pacific Corridor of the Central American Project (Puebla – Coatzacoalcos – Ocozocoautla – Arriaga – Cd. Hidalgo). 2.4.2 Implement between 2010 and 2012 the IRAP methodology to the Federal Basic Network.
		2.5 Upgrade the maximum speed limits in the road network	2.5.1 Upgrade the speed limits in freeways, highways and urban/suburban zones to 110 km/h, 90 km/h and 50 km/h, respectively. 2.5.2 Upgrade the maximum speed limit for freight and passenger vehicles to 90 km/h in freeways, leaving the same limit applied to light vehicles in highways and urban/suburban zones, with the exception of freight vehicles transporting hazardous materials and residues. 2.5.3 Upgrade the maximum speed limits in freeways, highways and urban/suburban zones for long-run freight vehicles transporting hazardous materials and residues to 65 km/h, 50 km/h and 40 km/h, respectively.
		2.6 Continue with the initiatives of the SCT for the implementation of ITS technologies in the Federal Road Network	2.6.1 Execute the National Plan for Implementing ITS technologies (SCT, 2010b), that contemplates technologies such as systems of variable messages, kiosks, emergency telephones, monitoring cameras, local management centers, etc. 2.6.2 Implementing the Management System of Incidences occurring at the Federal Road Network.
		2.7 Provide information to users of the road about incidents occurring along the Federal Road Network	2.7.1 Increase coverage of updated information on the operating conditions (traffic accidents, speeds, weather conditions, zones of vehicular congestion, work zones, poor driving conditions, etc.) of the Federal Road Network via Internet. 2.7.2 Implement radio stations to broadcast incidents occurring before and during the trip at the Federal Road Network.
		2.8 Promote compliance with the rules and regulations in the area of signing and information on road works	2.8.1 Carry out actions to guarantee compliance with the rules and regulations applicable to warning signs in work zones. 2.8.2 Include in the work contracts the obligation of the contractors to pay an insurance covering sufficiently the accident potential at the work zone.

Table 2. Continuation

	STRATEGIES	LINES OF ACTION	ACTIONS
2	Road Infrastructure	2.9 Strengthen the system of stations for controlling weight and dimensions of heavy vehicles moving along the Federal Road Network	2.9.1 Increase the number of verifications of weight and dimensions at highways. 2.9.2 Implement the verification of excess weight by means of mobile stations along the Federal Road Network.
		2.10 Preserve pavements and structures of the Federal Road Network	2.10.1 Provide maintenance to pavements of the Federal Road Network having a deficient wearing course caused by traffic, natural agents and ground conditions, for the purpose of achieving improved uniform conditions and surface friction, according to the pavement management system HDM-4 [World Bank's Transportation Department, 2008]. 2.10.2 Provide maintenance to bridges and structures of the Federal Road Network according to the Integral Safety Program for Bridges [SCT, 2010c].
		2.11 Reduce, at the Federal Road Network, potential conflicting zones and obstacles or elements of the infrastructure prone to generate accidents	2.11.1 Eliminate potentially dangerous elements of the infrastructure, mainly located at intersections, links and lateral zones. 2.11.2 Level lateral slopes at highways and protect culverts.
		2.12 Guarantee proper maintenance of horizontal and vertical signing, retaining systems, etc.	2.12.1 Continue with the Sub-Program of Signs Maintenance assigned to the DGCC
		2.13 Implement measures to improve sites of conflict (points or stretches with high accident rate) by means of methodologies of Road Safety applied in Mexico and abroad	2.13.1 Continue with the execution of the program for attention of sites of conflict
		2.14 Modernization of the Federal Road Network	2.14.1 Carry out the Program of Implementation of Arterial Roads and Bypass Roads. 2.14.2 Develop and implement a program for integral car stops for resting and services.
		2.15 Adapting the Federal Road Network for the use of pedestrians, bicyclists and motorcyclists	2.15.1 Develop and implement a program for improving the Federal Road Network for the safe passage of pedestrians (e.g. pedestrian crossings, sidewalks, islands and medians to protect pedestrians, bus stops for passengers of the public service, etc.). 2.15.2 Develop and implement a program for improving the Federal Road Network for the safe passage of bicyclists in urban and suburban zones (e.g. separate lanes for bicyclists with respect to the rest of the traffic flow, etc.).

Table 2. Continuation

	STRATEGIES	LINES OF ACTION	ACTIONS
3	Vehicular Fleet	3.1 Implement programs of physical/mechanical inspections of the vehicular fleet	3.1.1 Enforce the standard for inspecting the physical/mechanical conditions of vehicles (NOM 031). 3.1.2 Development of the network of certified centers for the verification of the physical/mechanical vehicle conditions in the country 3.1.3 Implement the annual physical/mechanical inspection for all sorts of vehicles.
		3.2 Improve the operating schemes for the renewal of the vehicular fleet of the freight and passenger federal public transportation system (equipment with a service life exceeding 10 years)	3.2.1 Strengthen the Program of Vehicular Renovation (junk disposal) by means of improved mechanisms of financing and tax incentives. 3.2.2 Promote the Program of Vehicular Renovation (junk disposal) among transportation chambers and associations.
		3.3 Implementation of safety devices in vehicles	3.3.1 Promote the installation of speed governing devices and of digital and analog tachometers for freight and passenger public service transportation vehicles. 3.3.2 Implementation of signing on the freight vehicles' contour with a reflecting material to improve visibility and safety of third parties. 3.3.3 Implementation of signing devices with catadioptric properties for bicycles as well as lights, mirror and signing devices for motorcycles.

Table 2. Continuation

	STRATEGIES	LINES OF ACTION	ACTIONS
4	Legal and Institutional Framework and Compliance with Rules and Regulations	4.1 Amendments to strengthen the institutional structure for road safety improvement as well as promotion of additional legal reforms required	4.1.1 Promulgate the Act of Mobility and Road Safety for purposes of creating a General Council of Road Safety and to a new decentralized sectorial government agency of SCT to coordinate actions and programs on Road Safety, as well as the coordination protocols to foster and instrument the national policies on Road Safety. 4.1.2 Promote the necessary regulatory reforms (e.g. driving permits and licenses on a point basis, new speed limits, rules and regulations for infrastructure improvement, NOM 031 standard, fatigue while driving, computer-aided theoretical test for obtaining driving permits and licenses, short-range dedicated communication for ITS technologies, introduction of tax incentives, sanctions to companies with low performance records on road safety). 4.1.3 Promotion of reforms to the Criminal Code (e.g. tougher sanctions for specific levels of alcohol, speeding, detection of drug consumption, violations of permits). 4.1.4 Count on a Regulatory Framework to record speeding situations and excess on weight and dimensions through the use of ITS technologies. 4.1.5 Promote among state and federal traffic legislatures the compulsory nature of liability car insurance.
		4.2 Strengthen supervision and control for the effective implementation of the rules and regulations	4.2.1 Attention to emergency calls by the Federal Police. 4.2.2 Increasing the effective surveillance time periods. 4.2.3 Strengthen actions of the Federal Police ("*Caballero del Camino", "Antialcohólico", "Lince", "Carrusel", "Cinturón", "Radar", "Semana Santa, Navidad, Año Nuevo* and *Verano*"). 4.2.4 Strengthen specific actions of the Professional Transport Sector ("*Cumplimiento del requisito de portar la licencia de conducción en orden", "30 Delta", "Control de Pesos y Dimensiones*", etc.). 4.2.5 Implementation of a radar network for automated speed surveillance and control at the Federal Road Network. 4.2.6 Promote the scrutiny of vehicles illegally introduced into the country.

Table 2. Continuation

	STRATEGIES	LINES OF ACTION	ACTIONS
5	Institutional Cooperation	5.1 Creation of the General Council on Road Safety and of the public organization responsible for Road Safety in the country	5.1.1 Create the General Council on Road Safety counting on the participation of the three government branches, the police and users of the roadways. 5.1.2 Creation of a new Public Organization accountable for Road Safety in the country.
		5.2 Incorporation of the interests of Road Safety in the development of traffic legislation, technical standards, regulations and bylaws for application for SCT, SS and PF, through the management of the new Organization	5.2.1 Negotiate the incorporation of the interests of the Road Safety in the development of traffic laws, technical standards, etc. 5.2.2 Promote among states and municipalities the homologation of traffic laws, technical standards and so forth.
		5.3 Establish a Road Safety Monitoring Station for freight and passenger transportation	5.3.1 Creation of the Road Safety Monitoring Station for freight and passenger transportation. 5.3.2 Establish joint actions among the Road Safety Monitoring Station and the agencies and organizations of the public and private Transport Sector.
		5.4 Improve the systems to compile, treat, analyze and disseminate information on road accidents occurred at the highway and street network	5.4.1 Implementation of a computer-assisted program for in-line retrieval of accident reports issued by the highway patrol and delivery of the corresponding data bases to authorized users within a time period not exceeding two months. 5.4.2 Follow up with duration of 30 days of injured people in road-induced accident reports. 5.4.3 Development of the coordination/inter-relationship among different data bases (related to hospitals, police, forensic, insurance companies, highways, etc.) for the purpose of securing better quality information on issues of Road Safety

3. TRANSFER OF TECHNOLOGY INTO PRACTICE

3.1. Ministry of Health

From the lessons learned three years after commissioning of the PROSEV, the results retrieved by IMESEVI are summarized as follows. This part of the report deals with the general and particular observations derived from both the qualitative and quantitative information related to the following topics: (a) the use of restraining devices in occupants of motor vehicles; (b) the control of alcohol consumption among drivers of motor vehicles; (c) the use of helmets among motorcyclists; and (d) compilation of data on injured people and mortal victims of road accidents from reports issued by ambulances, clinics and Forensic Medical Services (SEMEFOs).

3.1.1 Use of Restraining Devices among Vehicle Drivers and Passengers

To determine the use of restraining devices a direct observation was made in the roadways during day time and at avenues carrying heavy vehicular traffic. The study showed variations as a function of a series of variables that can be related to the site where data was collected as well as to characteristics of the persons, vehicular aspects and conditions of traffic movement.

Approximately, 13% of persons injured in traffic accidents was wearing safety belts, 22% were not and 65% are unknown; on the other hand, 6% of mortal victims wore the safety belt at the time of the accident whereas 21% did not and 73% are unknown. Although few persons admitted that they routinely drive without wearing the safety belt, the results from

this survey show that about 50% of the vehicle occupants fail to wear safety belts and only 2% of the vehicles that carry infants do use children´s restraining devices.

The probability of wearing the safety belt ranges from 70% at the Federal District to 28% in Monterrey. The probability of wearing the safety belt is of 68% for drivers, of 33% for copilots and of 5% for passengers riding in the back seat of the vehicles; furthermore, participants claimed that if the driver fails to wear it, in general the other passengers follow suit. Data evidenced that passengers of automobiles and of family vans have a 15% higher probability of wearing safety belts than passengers of taxis and of light freight vehicles.

With respect to infant´s restraining devices, the results indicate that their use in higher for babies but as children grow their use almost vanishes.

3.1.2 Alcohol Concentration in Drivers of Motor Vehicles

In Mexico, close to 50% of traffic accidents are related to alcohol consumption, whereas 60% of accident-related deaths take place under the influence of alcohol or of other drugs. In addition, 23% of the deaths of drivers that had drunk alcohol occur among youngsters aged 15 to 24. In response to the seriousness represented by the behavior of drivers under the influence of alcohol, in several major cities of the country limits of alcohol consumption have been established and passed for drivers: in the Federal District of 0.04 g/dL; in Monterrey and Guanajuato, 0.08 g/dL; and in Guadalajara, 0.10 g/dL.

Large differences exist between cities in what refers to driving under the influence of alcohol; for example, in the Federal District this behavior shows a more critical pattern; a large majority of persons (90%) drives with zero alcohol consumption, but about 4% of them exceeds the legal limit of 0.40 mg/L. In the city of León, the percentage increases to 32% of the drivers that prove positive in the test, but very few (0.3%) exceed the legal limit.

The number of persons riding in a vehicle is definitively related to the probability that the driver has drunk alcohol. The key figure seems to be three persons (i.e. the driver plus two passengers).

The findings indicate that the population group with the highest risk corresponds to unmarried males.

3.1.3 Use of Helmets for Motorcyclists

There are neither official updated data in Mexico nor investigations to assess the risk factors associated to the accident rate of motorcycle users and consequently a study on the use of helmets for motorcyclists was performed.

For various reasons, the use of motorcycles as transportation vehicle and as a recreation means has gained popularity in Mexico. Records available indicate that the fleet of motorcycles increased by 84.6% from 2001 to 2006.

According to data from the CENAPRA, there exists in Mexico 50% more probability of suffering a traffic accident when riding a motorcycle as compared to car driving. The main risk factors associated to the accident rate in users of motorcycles are the age of the

drivers, the time of day and the day of the week. Most traffic accidents where motorcyclists are involved occur in persons aged 17 to 37, between 12:00 noon and 9:00 p.m. (reaching their peak at 15:00 hours) and in Fridays or Saturdays.

Even though wearing of helmet is compulsory for motorcycle drivers and companions, data indicate that the probability of a motorcyclist to wear a helmet reaches 99% in the Federal District as opposed to 68% in Guadalajara.

There is an 87% chance that a person riding alone in a motorcycle wears the protective helmet, whereas this probability decreases by 25% in motorcycles carrying an additional passenger (62%). When the motorcyclist transports passengers, it is possible that the driver hands over his helmet to the passenger who is a casual user of the motorcycle and does not carry his own protection; this is why wearing of helmets is considerably reduced in the case of motorcycles riding with passengers.

3.1.4 Injured Persons and Mortal Victims of Road Accidents

The results of retrieval of data on injured people and mortal victims of road accidents based on reports issued by ambulances, clinics and SEMEFOs indicate that injured persons who enter emergency rooms in Mexico have four times the possibility of evidencing high alcohol levels in blood and 2.5 times more probabilities of declaring alcohol consumption within six hours prior to the accident. Data shows that one of every five admissions to emergency rooms as a result of traumatic events, evidences alcohol in the blood: 25% of males and 6% of females admitted into emergency rooms have had previous consumption of alcohol.

3.2. Ministry of Communications and Transport

Actions representative of the principal transfers of knowledge into practice are described below.

With respect to Action 1.1.3 of the Road Safety Program of SCT (Table 2), the IMT has participated in the course of years in an Exhibit of Science and Technology organized by the Science and Technology Council of the State of Querétaro, with attention focused on road education training for children and adolescents, through the dissemination of printed material, playing of games (such as crossword puzzles on road safety), etc.

In what refers to Actions 1.2.1 and 1.2.2, in general no advertising campaigns have been carried out through massive dissemination media because of their high cost; however, leaflets have been prepared on accident prevention through the *Dirección General de Comunicación Social* of the SCT, by means of which promotion has been made of highways, freeways, bus terminals, etc. In addition, an advertising campaign was launched during 2010 in different media, through an alliance among SCT, CAPUFE and *Fundación Internacional del Automóvil* (FIA), to be known as *"Carreteras Seguras"* (Safe Highways). This campaign will be implemented in three stages:

- A first stage, scheduled from the end of August 2010 to the beginning of September, to launch the campaign through a press conference at the Mexico City - Querétaro Toll Road (Route 57), with the participation of important guests from the press and collaborators, with a performance of a drill with special effects and a lunch served at Tepoztlán for the press and guests. Promotional products are distributed, such as carrying belts, key holders and other gifts, all of them printed with the logo "Safe Roads".

- A second stage, during the month of October 2010, during which promotion is made of a series of points that drivers should take into account before traveling along highways, all of them brought together in a campaign to be known as “Ten for the Road”, including the following 10 recommendations: (I) Wearing of safety belts by all occupants; (II) Compliance with speed limits; (III) Compliance with road signing; (IV) Avoid driving if tired; (V) Avoid driving under stress conditions (drugs, alcohol, annoyance); (VI) Check mechanical conditions and tires of vehicle; (VII) Adequate use of the vehicle in terms of capacity of passengers and of freight; (VIII) Take precautions and inquire about weather conditions prior to start traveling (probability of snow, ice, fog, etc.); (IX) Avoid using cellular telephones while driving in any of the modes available; and (X) Be familiar with first aid treatment and with hot lines for assistance and rescue (074). This stage is carried out with the participation of sponsors by means of posters in billboards and along highways, flashes in television at official times, flashes for drill transmission, spots in open television and radio, as well as at “*Hora Nacional*” radio program with national coverage.
- A third stage, from November 2010 on, to include a “Campaign to Collect Funds for Aerial Rescue” by commissioning the first helicopter for the rescue of injured people in road accidents that was purchased with contributions from the community and operated by the Government.

In what refers to Action 1.6.1, the IMT offers on an annual basis an “International Course on Road Safety” alternating the topics between “Means and Technologies for Infrastructure Improvement” and “Dealing with the Human Factor”. In addition, the IMT delivers on an annual basis an “On-Line Virtual Certificate on Road Safety” covering both the treatment of the infrastructure and the human factor, being this effort the only one available through remote education on this topic in Mexico. There is also a scholarship program to graduate students in programs of specialization and Master’s Degree in topics related to road safety available at various universities in the country.

In relation to Action 1.8.1, the SCT performs annually about 4 million medical check-ups on an ongoing basis to drivers of the federal public service, 150 thousand integral psycho-physical examinations and 200 thousand toxicology analyses. There are also on-site medical examinations under the campaign “30 Delta” during vocational periods, particularly during the Easter holidays, in the summer and at the end of the year. There are also permanent modules at the terminals of the main transportation modes for performing the examinations. Regulations also exist for controlling the duration of driving in the professional service.

With respect to Action 2.1.1, progress has been made in the updating of the Manual for Geometric Design of Roads published by the SCT because the existing version dates back to the sixties of the 20th century and it is necessary to update it since conditions of vehicles and of the country have changed radically in the last 50 years.

In relation to Actions 2.1.2 to 2.1.4, work is being made to update the Manual for Signs and Traffic Control Devices of the SCT since the Road Safety Manual of SCT has been practically completed and it has been contemplated to include as part of the rules and regulations for transport infrastructure of SCT the process of road safety audits to the different stages of the highway projects.

In what refers to Action 2.3.3, an audit has been performed in close to one thousand kilometers of freeways in operation.

Reference is made to Actions 2.4.1 y 2.4.2, for which audits on Road Safety have been started at highways in operation, using the IRAP (International Road Assessment Programme) methodology, starting with a pilot phase during 2010 to the Mexican section of the Pacific Corridor of the Central American Project (Puebla – Coatzacoalcos – Ocozocoautla – Arriaga – Ciudad Hidalgo) to cover 1878 kilometers of the road system with a subsequent stage during 2010 and 2012 along 31 thousand kilometers of the Basic Federal Network.

When dealing with Actions 2.5.1 to 2.5.3, mention can be made that work has progressed in the incorporation of maximum speed limits into the Federal Roads Traffic Regulations in terms of type of vehicle, of road and of service rendered.

With respect to Action 2.8.1, as part of the rules and procedures of the transport infrastructure of SCT, there is a new regulation available on signing and protective devices for work zones.

In relation to Actions 2.9.1 and 2.9.2, construction of new stations for automated control of weights and dimensions has been completed to achieve a broader coverage of the Federal Road Network.

In terms of Action 2.12.1, there exists as part of the rules and regulations for the transport infrastructure of SCT an updated regulation related to horizontal and vertical signing, containment systems, etc. Another regulation is also being developed in the topic of rumble strips so that new highways are fitted with this device since their construction.

In what refers to Action 2.13.1, a total number of 1730 conflictive sites were attended in free Federal Roads from 1997 to 2006, as well as more than 200 toll roads operated by CAPUFE. At those sites a reduction of 50% in the number of annual accidents and injured persons was achieved, and of 70% in the total number of deaths per year [Rivera and Mendoza, 2009]. Also, the study and improvement executive project for 19 emergency escape ramps in the toll roads operated by CAPUFE were carried out.

In what deals with the actions of Strategy 3 (Vehicular Fleet), a clause has been incorporated into the Federal Roads Traffic Regulations with a binding effect for all trucks and hauling units to be fitted with a bumper or counter-bumper placed at a maximum height of 40 cm measured above the wearing surface. Implementation has also been made of a program for reordering and replacement of small vehicles used for public transportation of passengers along roads with federal jurisdiction.

With respect to Action 4.1.1, for the purpose of strengthening the institutional structure to improve safety management of the road and street networks, an initiative has been recently promoted to pass a new National Act on Mobility as a preliminary requirement to create a General Council on Road Safety and a new decentralized Government Agency under the jurisdiction of SCT to coordinate the actions and programs related to Road Safety, as well as the coordination protocols to foster and instrument national policies on Road Safety.

Finally, when dealing with actions of the Line of Action 5.4, the IMT generates on an annual basis the electronic database of accidents occurred along the Federal Road Network, as well as a yearbook containing statistics on accidents recorded every year in such Network by the federal highway police.

4. CONCLUSIONS

In Mexico, endeavors made to improve safety along the road and street networks are headed by the Ministries of Health, and of Communications and Transport. In the case of actions pursued by the SS mention should be made of the use of restraining devices among occupants of motor vehicles, the control of alcohol consumption in drivers of motor vehicles, wearing of safety helmets by motorcyclists, and retrieval of data on injured persons and mortal victims of road-related accidents reported by ambulances, clinics and Forensic Medical Services (SEMEFOs). In what refers to SCT, actions related to motor transport include: psycho-physical and medical examinations; toxicology testing; issuance and renewal of driving licenses for operators of federal public motor transport; theme-related and/or seasonal safety actions; renewal of the vehicular fleet of freight and passenger transportation; and verification of physical and mechanical conditions of vehicles. In addition, actions related to the infrastructure include: modernization and maintenance of the Federal Road Network; installation of signaling and safety devices; freeing of the right of way; and attention to conflicting points, 1730 of which were attended from 1997 to 2006. Special mention should be made of actions related to the modernization of the Federal Road Network that involves the development and implementation of a series of tools to strengthen planning of the Federal Network and to optimize the allocation of resources, the improving of management of the existing infrastructure; the optimization of the supervision of road-related projects, the delivery of a homogeneous and consistent quality of service at the Federal Network; and the improvement of information processing and of the decision making process. The implementation of the strategic plans and approaches referred to before, as well as the successful cases histories of technology transfer into practice arise from ambitious objectives outlined for the medium term by the Federal Government through the two Ministries mentioned above.

5. REFERENCES

[INEGI, 2009]. *Estadísticas, Sociodemografía y Género, Mortalidad 2009* (Statistics, Social Demography and Gender, Mortality 2009), Instituto Nacional de Estadística y Geografía (INEGI). www.inegi.org.mx.

[IRAP, 2010]. Internet Web site of IRAP. www.irap.net

[Rivera and Mendoza, 2009]. *Análisis Costo-Beneficio y Costo-Efectividad de las Medidas de Seguridad Implementadas en Carreteras Mexicanas* (Cost-Benefit and Cost-Effectiveness Analyses of Safety Actions Implemented in Mexican Roads), Publicación Técnica No. 319, Instituto Mexicano del Transporte (IMT) www.imt.mx

[SCT, 2010a]. *Programa de Seguridad Vial de la SCT* (Program on Road Safety of the SCT). Secretaría de Comunicaciones y Transportes, México.

[SCT, 2010b]. *Programa Nacional ITS de la SCT* (ITS National Program of the SCT), Secretaría de Comunicaciones y Transportes, México.

[SCT, 2010c]. *Programa Integral de Modernización de la Red Federal de Carreteras* (Integral Modernization Program of the Federal Road Network), Secretaría de Comunicaciones y Transportes, México.

[SS, 2008]. *Programa de Acción Específico 2007-2012 de Seguridad Vial* (Specific 2007-2012 Action Program on Road Safety) (PROSEV), Secretaría de Salud, México.

[World Bank's Transportation Department, 2008]. The Highway Design and Maintenance Standards Model (HDM-4).